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Double take: The effect of sibling sex composition on women's schooling, earnings, and labor supply

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HIGHLIGHTS

- This study estimates the effect of sibling sex composition on human capital and labor market outcomes using dizygotic twins.
- Women born with male co-twins versus female co-twins have increased rates of high school completion and higher earnings.
- No statistically distinguishable sibling sex composition effects are detected for men.

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ABSTRACT

Understanding the role of the family in the production of human capital is a salient question in economics. Using a twin research design that exploits exogenous gender variation in dizygotic twins, this paper investigates the effect of sibling sex composition on schooling, earnings, and labor supply. Women born with a male co-twin have higher earnings and increased rates of high school completion than women born with a female co-twin. Men born with a female co-twin, on the other hand, have outcomes that are statistically indistinguishable from zero. Family attributes provide a limited explanation of the sex composition effect.

1. Introduction

Every economist knows that the family plays a large role in the production of human capital. Examining the impact of sibling sex composition, one dimension of family structure, on human capital outcomes has posed an empirical challenge. Traditional sibling studies suffer from potential confounders such as differences in birth spacing, birth order, family size, and differences in parental endowments such as age. By exploiting the natural experiment of twin births this study estimates sibling sex composition effects using exogenous variation of gender within dizygotic (fraternal) twins. The use of a dizygotic twin design addresses the confounders of a sibling design. Since the variation in the gender of co-twins is as good as randomly assigned, this paper credibly identifies how sibling sex composition impacts the production of human capital.

2. Conceptual framework

A paucity of research has explored the role of sibling sex composition on human capital outcomes, and the few studies on the topic have failed to reach a consensus. Notable work by Butcher and Case (1994) finds positive impacts for sex composition on women's schooling and earnings. Although they are unable to directly test the mechanisms that influence the production of human capital, they offer two possible explanations. First, sex composition may cause parents to change their level of investments and the type of investments. For example, boys may cause parents to spend more time or money on their children or families with boys may engage in gender specific activities. In both situations it may be hard to exclude the female child and she may benefit from having a male sibling. The second explanation involves sibling spillovers as girls raised with boys may become socialized with masculine traits. Thus, the changes in childhood environments whether from parents or siblings are posited as pathways underlying sex composition effects.

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Table 1
Descriptive statistics by gender and sex composition.
Source: National Study of Midlife Development (1996, 2006).

Variables	Same gender				Mixed gender			
	Men		Women		Men		Women	
	Mean	S.D.	Mean	S.D	Mean	S.D	Mean	S.D
Maternal education								
Completed H.S.	0.42	(0.49)	0.41	(0.49)	0.45	(0.50)	0.37	(0.48)
Attended college	0.12	(0.32)	0.12	(0.32)	0.11	(0.31)	0.12	(0.33)
Completed college	0.14	(0.35)	0.07	(0.26)	0.14	(0.35)	0.12	(0.33)
Family characteristics								
Birth order	1.92	(1.75)	2.01	(2.00)	1.62	(1.77)	1.79	(1.81)
Family size	4.93	(2.32)	5.09	(2.60)	4.36	(2.32)	4.71	(2.33)
Respondent characteristics								
Age	48.59	(12.98)	50.07	(12.94)	49.64	(12.30)	50.44	(12.96)
Completed H.S.	0.92	(0.28)	0.84	(0.37)	0.90	(0.30)	0.92	(0.27)
Attended college	0.59	(0.49)	0.50	(0.50)	0.63	(0.48)	0.59	(0.49)
Completed college	0.36	(0.48)	0.22	(0.41)	0.39	(0.49)	0.36	(0.48)
Schooling (years)	13.86	(2.54)	13.09	(2.37)	13.94	(2.52)	13.85	(2.39)
Full time labor	0.87	(0.34)	0.61	(0.49)	0.87	(0.34)	0.65	(0.48)
Part time labor	0.05	(0.21)	0.18	(0.39)	0.05	(0.21)	0.15	(0.36)
Out of labor force	0.07	(0.26)	0.19	(0.39)	0.08	(0.27)	0.19	(0.39)
Earnings	42,182	(35,253)	21,066	(24,024)	43,541	(32,542)	24,877	(28,164)

Standard deviations are in parenthesis next to the means.

Subsequent research, however finds limited support (Kaestner, 1997; Conley, 2000) or no support for sibling sex composition effects (Hauser and Kuo, 1998). The different outcomes are also possible because the studies employ different data and some examine intermediate outcomes such as test scores whereas others examine long run outcomes such as completed schooling. Nevertheless, the early studies must be interpreted with caution because they rely on full sibling sets that may suffer from confounders. Although twins address the threat of confounders, a similar caveat applies to interpreting results from this study since twinning increases with maternal age and for certain ethnicities, therefore families with twins are likely to be different than families without twins.

3. Methodology

3.1. The national survey of midlife development (MIDUS)

This study uses data from both waves of MIDUS conducted between 1995–1996 (Brim et al., 2011) and 2005–2006 (Ryff et al., 2009). The dizygotic twin sample contains 1202 observations, with 705 twins that were born with a co-twin of different sex, with 497 twins that were born with a co-twin of the same sex, respectively. Wages are reported on a categorical scale and I assign midpoint values for each wage category. Measures on labor force participation include a contemporaneous response of labor force participation in the current survey year and retrospective answers for the past nine years preceding both waves of the survey. The descriptive statistics are presented in Table 1, and the difference in means by gender and composition is the unadjusted sex composition effect. Fig. 1 shows the unadjusted differences for human capital outcomes, and Fig. 2 shows the unadjusted differences for labor market outcomes, and Fig. 3 shows the earnings distributions.

3.2. Estimation strategy

I estimate the empirical model shown in equation one. The dependent variable Y_i includes schooling, labor supply, and earnings for each twin. On the right hand side, the interaction terms are the key coefficients of interest as they provide the sibling sex composition effect for each respective gender. The vector X_i includes dummies for race and survey year. I also control for age and age squared to improve the precision of the treatment effects and to account for time specific trends in the acquisition of human capital and the life cycle variation in earnings. In order to analyze the mechanisms that may influence sex composition effects, I use maternal education, birth order, and family size as proxies for parental investments and include these variables as additional covariates.

$$Y_i = \alpha_0 + \beta_1 Gender + \beta_2 Mixed * Male + \beta_3 Mixed * Female + \psi_i X_i + e. \quad (1)$$

4. Results

Table 2 presents the results for human capital outcomes. In column 1 beginning with women, a different sex co-twin produces economically and statistically significant increases for high school completion by 5.6 percentage points, attending college by 6.8 percentage points, and college completion by 7.8 percentage points, respectively. The coefficient for high school completion remains robust to inclusion of additional covariates such as family size, birth order, and maternal characteristics in columns 2–4. Other measures of schooling such as college attendance, college completion, and years of schooling fluctuate in magnitude and are statistical insignificant upon the inclusion of household characteristics in columns 2–4. On the other hand, the effect of having a female co-twin as opposed to a male co-twin does not affect men's schooling with effect sizes that are statistically indistinguishable from zero in all specifications. Overall, the p-values from the joint tests of significance confirm that increased high school completion is the key finding on measures of schooling.

In Table 3, I examine the effect of sibling sex composition on labor supply. In column 1, women's full time labor supply participation increases by a sizeable and economically significant effect of 4.8 percentage points, but part time labor supply falls by 3.2 percentage points, along with a reduction in being out of the labor force by 1.5 percentage points. In all specifications the coefficients for higher participation in full time work and lower participation rates in part time work do not reach statistical significance, but the effect sizes remain large and robust to the inclusion of proxy variables for parental investments in columns 2–4. In addition to labor supply and schooling, I also examine the effect of sibling sex

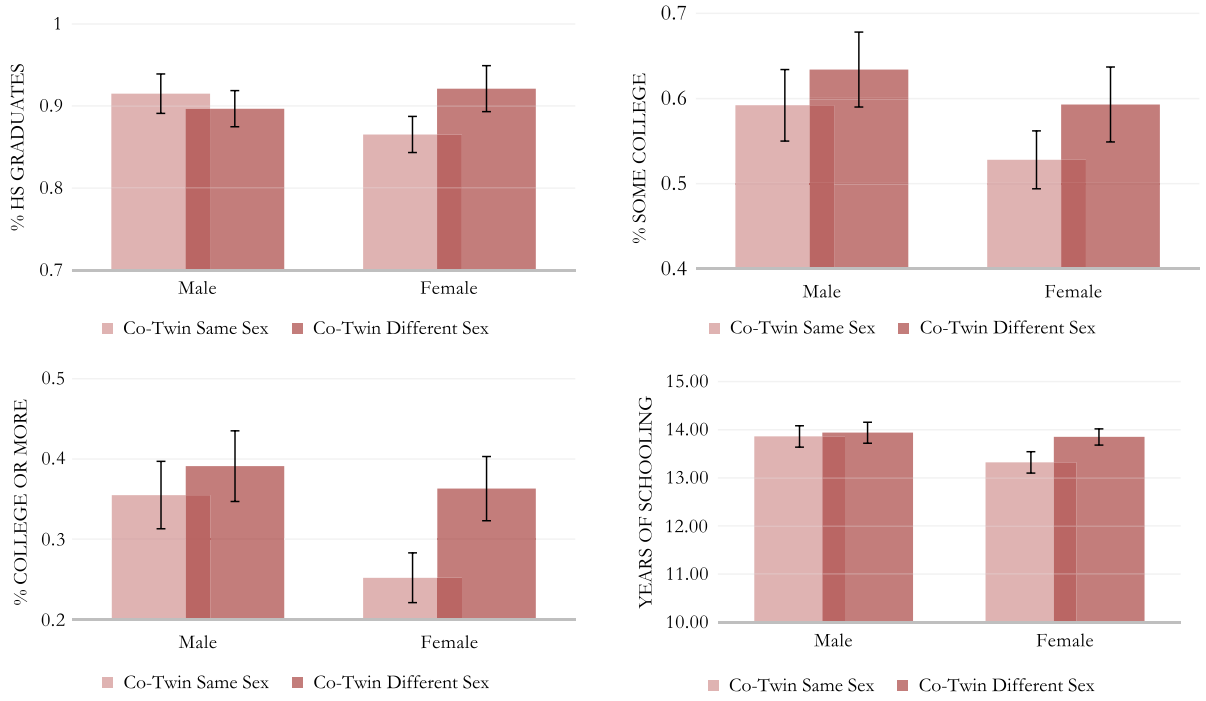

Fig. 1. The effect of sibling sex composition on human capital.
Source: National Study of Midlife Development (1996, 2006).

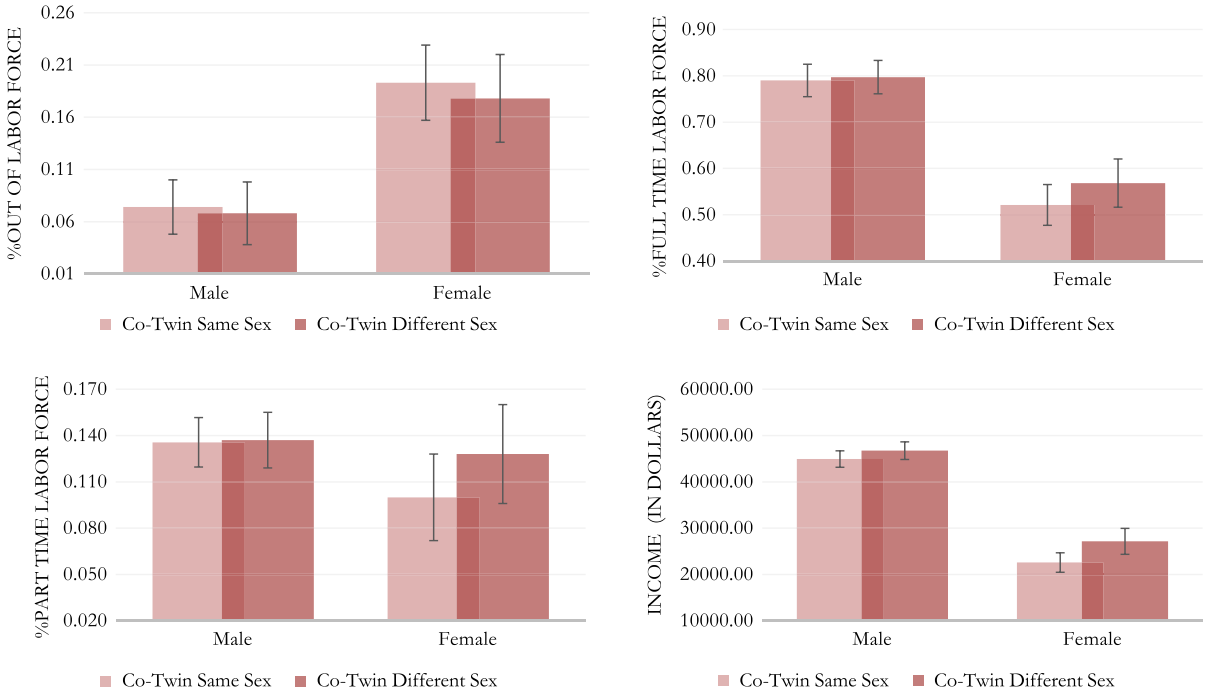

Fig. 2. The effect of sibling sex composition on labor supply and earnings.
Source: National Study of Midlife Development (1996, 2006).

composition on earnings. The statistically significant effect on earnings varies from nearly $4500 to $3350 dollars off of a mean income of nearly thirty thousand dollars indicating an effect of about eleven to fifteen percent in higher earnings. Despite the changes in the magnitude of the earnings coefficient, it remains significant upon inclusion of family background characteristics in columns 2–4. Although the effect size on earnings is fairly large, the analysis on income in this study occurs during late life on the earnings profile when earnings effects are larger and would likely overstate the lifecycle impacts.

For men, however, the effects on labor supply are negligible as labor force participation on both full time and part time work remains the same across specifications in columns 1–4. Estimates for men are very small precise zero effects on both measures of part time and full time work and the coefficients are statistically indistinguishable from zero. The findings are consistent with the

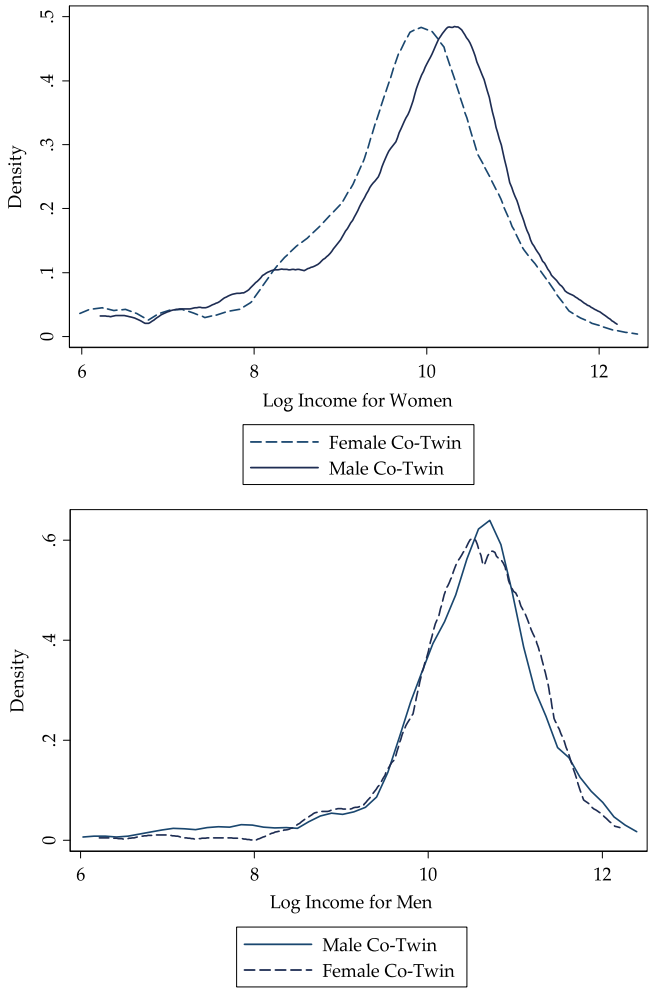

Fig. 3. The effect of sibling sex composition on log earnings.
Source: National Study of Midlife Development (1996 and 2006).

stylized facts of an inelastic men's labor supply. Lastly, given the largely statistically indistinguishable effects of sibling sex composition on labor supply, the *p*-values from the joint tests of significance exceed conventional levels in all columns.

5. Discussion

Attempts to identify the mechanism of sibling sex composition through proxy variables for parental investment such as birth order and family size are unfruitful, as these family characteristics do not affect the magnitude of the sex composition effect. Such a result may occur because the proxy variables that attempt to measure family dynamics may poorly capture their constructs. Another pertinent concern for this study is the limited sample size which results in the lack of statistical power to detect small effects. Therefore, it is possible that sibling sex composition effects may exist for men or for other schooling variables for women, but that these effects are not large enough to be detected with the limited sample size in this study.

6. Conclusion

Using exogenous variation in the gender of fraternal twins, this study finds statistically and economically significant impacts of sibling sex composition on women's earnings and high school completion. More specifically, women born with a male co-twin have an increased rate of high school completion by roughly five

Table 2
The effect of sibling sex composition on human capital outcomes.
Source: National Study of Midlife Development (1996, 2006).

	(1)	(2)	(3)	(4)
High school				
Women	0.057***	0.037*	0.055**	0.047**
	(0.022)	(0.021)	(0.021)	(0.021)
Men	−0.015	−0.028	−0.024	−0.025
	(0.023)	(0.022)	(0.023)	(0.023)
Some college				
Women	0.068*	0.0436	0.059	0.038
	(0.039)	(0.036)	(0.038)	(0.036)
Men	0.045	0.036	0.025	0.023
	(0.043)	(0.040)	(0.043)	(0.041)
College or more				
Women	0.078**	0.051	0.066*	0.045
	(0.037)	(0.033)	(0.037)	(0.034)
Men	0.051	0.045	0.037	0.036
	(0.043)	(0.038)	(0.042)	(0.038)
Years of schooling				
Women	0.530***	0.376**	0.455**	0.328*
	(0.193)	(0.171)	(0.193)	(0.172)
Men	0.104	0.056	0.010	−0.003
	(0.219)	(0.198)	(0.216)	(0.199)
P-value	0.06	0.14	0.12	0.21
Maternal education	No	Yes	No	Yes
Birth order	No	No	Yes	Yes
Family size	No	No	Yes	Yes

Note: All regressions include covariates for race and age. Clustered standard errors are in parenthesis. To address concerns of multiple hypothesis testing, *P*-Values from joint tests of significance are presented for each column.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table 3
The effect of sibling sex composition on labor market outcomes.
Source: National Study of Midlife Development (1996, 2006).

	(1)	(2)	(3)	(4)
Full time				
Women	0.048	0.047	0.048	0.045
	(0.032)	(0.032)	(0.032)	(0.034)
Men	0.008	0.007	0.01	0.007
	(0.022)	(0.022)	(0.022)	(0.023)
Part time				
Women	−0.032	−0.036	−0.037	−0.032
	(0.024)	(0.024)	(0.025)	(0.023)
Men	0.002	0.0004	0.0002	0.008
	(0.014)	(0.013)	(0.014)	(0.014)
Out of labor force				
Women	−0.015	−0.013	−0.010	−0.006
	(0.025)	(0.026)	(0.025)	(0.027)
Men	−0.008	−0.007	−0.008	−0.012
	(0.018)	(0.018)	(0.017)	(0.019)
Earnings				
Women	4476**	3345*	4493**	3659**
	(1991)	(1891)	(1943)	(1862)
Men	1888	1430	1120	1068
	(3062)	(2978)	(2953)	(2902)
P-value	0.37	0.54	0.22	0.37
Maternal education	No	Yes	No	Yes
Birth order	No	No	Yes	Yes
Family size	No	No	Yes	Yes

Note: All regressions include covariates for race and age. Clustered standard errors are in parenthesis. To address concerns of multiple hypothesis testing, *P*-Values from joint tests of significance are presented for each column.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

percentage points, and higher earnings by nearly eleven to fifteen percent. The findings on other measures of schooling such as

college attendance, college completion, and years of schooling, however, are statistically indistinguishable from zero in most specifications. Similarly, the effect of sex composition on labor force participation does not reach statistical significance at the conventional levels, but the large magnitudes imply substitution from part time work to full time.

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