ADHD and Gender Wage Disparities

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Abstract

Existing literature on ADHD disparities in earnings has not considered potential gender differentials in how ADHD functions and presents challenges to individual outcomes. Existing evidence suggests that women with ADHD are more likely to be diagnosed with inattentive type ADHD, while men are more likely to be diagnosed with hyperactive and combined type ADHD. I examine the potential impact caused by gender disparities in ADHD symptoms by comparing estimates of gender wage disparities between ADHD men and women and neurotypical men and women. I use a longitudinal dataset that has been used in a previous study on ADHD wage outcomes (Fletcher, 2013) in my analysis, however I construct controls for human capital in the wage model that were not used prior. I find a smaller gender-based earning disparity between individuals with ADHD against those without. I replicate existing findings that ADHD has a negative impact on wage outcomes.

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1. Introduction

As the field of psychology has developed in the past few decades, there has been a proliferation of knowledge regarding neurodiversity and the difficulties faced by individuals who are neurodivergent. A neurotype that has gained considerable attention in academia this past decade is ADHD, a cognitive disorder concerning an inhibited capacity for executive function. The proliferation of knowledge about the functionality of ADHD has led to evidence concerning gender disparities in the symptoms and presentation of ADHD. Men are more likely to be diagnosed with combined and impulsive type ADHD while women are more likely to be diagnosed with inattentive type ADHD. Men and women with ADHD also have a propensity towards different comorbidities, with men exhibiting more 'external' disorders and women exhibiting more 'internal' disorders (Andreas Jangmo et al, 2021).

The impact of ADHD on labour market outcomes is a subject that has grown in relevancy since Fletcher's seminal 2013 study, '*The Effects of Childhood ADHD on Adult Labor Market Outcomes*'. Fletcher found that having ADHD reduces expected earnings by up to 33% on average, as well as limiting employment retention. More recent studies have expanded on the subject and corroborated Fletcher's findings, in that ADHD has a significant effect on wage outcomes.

However, no one has yet attempted to research the impact of ADHD on existing gender disparities in earnings. Given that current research indicates that ADHD presents differently in men and women, there is a possibility that the gender wage disparity for ADHD individuals is different from that of neurotypical individuals. A difference in wage disparities could thus give insight into the impact on economic outcomes that arise from the difference in the presentation of ADHD symptoms between genders.

I use an American longitudinal study of adolescents followed into adulthood to estimate the gender wage differentials for neurotypical individuals and ADHD individuals separately. I then compare the differentials from each respective group to help determine if the gender differences in ADHD symptoms impact economic outcomes.

I find a smaller, statistically significant gender wage differential for ADHD individuals when compared to neurotypical individuals. I also find evidence supporting previous findings of the negative impact of ADHD on wage outcomes. Furthermore, I find that the interaction between being a women and having ADHD has a statistically significant negative impact on wage outcomes.

1.2 Background and Theory

1.2.1 ADHD and Economic Outcomes

Attention-deficit/hyperactivity disorder (ADHD) is a cognitive disorder characterised by an ongoing pattern of inattention and/or hyperactivity-impulsivity. Inattention is defined as the difficulty to sustain focus and remain organised that is not caused by defiance or lack of comprehension. Hyperactivity is described as an extreme restlessness that often presents as fidgeting, moving when not socially appropriate, or talking excessively. Impulsivity refers to the inability to regulate self-control, often presenting as making rash decisions without considering all the consequences or talking out of turn. Diagnoses of ADHD are characterised into one of 3 categories: primarily inattentive type, primarily hyperactive type and combined.

With the proliferation of psychology research and an increased number of diagnoses, ADHD is becoming more understood by the general populace. Individuals with ADHD are considered to be neurodivergent, a categorical term shared with people on the autism spectrum that describes a neurotype that is distinct from the neurotypical population.

The exact causes of ADHD are difficult to discern, but modern theories hypothesise that it involves genetic factors that cause the brain structure to develop differently when compared to neurotypical individuals. Specifically, studies have found that the prefrontal cortex is often smaller in individuals with ADHD than those without and takes longer to fully mature. The prefrontal cortex is a key area of the brain responsible for executive functions, the set of cognitive processes used to coordinate other cognitive behaviours, such as self-organisation and the prioritisation of responsibilities. ADHD is thus often characterised as an executive function disorder.

If diagnosed, ADHD is able to be treated to an extent. Prescribed stimulants such as methylphenidate can increase the neurotransmitters and improve the dopamine production in the brains of ADHD individuals, allowing for improved executive function. Cognitive behavioural therapy and psychoeducation can also be used as a means of educating individuals about their cognitive limitations and help provide healthy coping mechanisms. However, as treatment is often contingent on a formal diagnosis, many people with ADHD do not get the help they need either because they lack the means to secure a diagnosis or due to a limited understanding of the disorder itself.

Due to the limited ability to employ executive functions, individuals with ADHD often struggle with areas of life that neurotypical individuals do not. There is a growing body of literature studying the relationship between ADHD and economic outcomes. Individuals with ADHD are at increased risk for poor occupational outcomes (Jangmo et al., 2021). They have reduced earnings compared to their neurotypical peers and have a higher rate of unemployment. Individuals with ADHD are also more likely to be fired and are more likely to receive government assistance (Fletcher, 2013).

ADHD is also a significant predictor of academic difficulties. Standardised test outcomes and academic performance is lower in individuals with ADHD than those without, even when controlling for IQ (L. Eugene Arnold et al., 2015). Treatment does improve academic outcomes, but not to the extent to which they are on an equal level with neurotypicals. Individuals with ADHD are also significantly less likely to attain higher level education than the rest of the population, with only 15% of young adults holding a four year degree compared to 48% of the general population and 0.06% holding a graduate degree compared to 5.4% of the general population (Kuriyan et al., 2013).

Individuals with ADHD are more likely to be incarcerated and are significantly overrepresented in prison populations with a 10 fold increase in adult prisons compared to general population prevalence (S. Young et al, 2015.). Adolescents and young adults with ADHD also have a greater risk for developing substance use disorders (Wilens et al, 2014). Lastly, ADHD is frequently associated with negative mental health outcomes and comorbid psychiatric diseases (Katzman et al, 2017).

1.2.2 ADHD and gender

The relationship between ADHD and gender is complicated. ADHD is significantly more prevalent in men than in women, with some estimates finding men to be almost three times more likely to be diagnosed. Some studies have found a gender difference in the presentation of ADHD, with women being more likely to exhibit inattentive symptoms and men being more likely to exhibit hyperactive and combined symptoms (Li, Ting et al, 2018). Furthermore, there exists observed gender disparities in the comorbidities associated with ADHD (B.S. Solberg et al, 2017). Women are more likely to experience more ‘internalised’ disorders such as depression, anxiety and bulimia, while men are more likely to experience more ‘externalised’ disorders such as substance abuse and personality disorders (Maria Strauss et al, 2020).

There also exists limited evidence of a difference in cognitive function between men and women with ADHD. Gender-specific effects regarding working memory and behavioural control have been found in studies of cognitive performance (Strauss et al, 2020). Others, however, contest the significance of ADHD based gender cognitive function disparities, arguing that each gender is far similar rather than different in the way ADHD functions (Rucklidge, 2010).

Regardless of the source of gender disparities in the presentation of ADHD, their existence prompts the question of their impact on economic outcomes. Furthermore, there already exists gender disparities in economic outcomes for the general population, the most infamous being the gender wage gap. Thus, if ADHD has a negative impact on economic outcomes, and ADHD presents differently between men and women, would there subsequently exist a disparity in the gender disparities in economic outcomes between ADHD individuals and non ADHD individuals?

1.3 Literature review

The relationship between ADHD and earnings was pioneered by Fletcher in his 2013 study '*The Effects of Childhood ADHD on Adult Labor Market Outcomes*'. Prior to Fletcher's research, no studies examined the long term relationship between ADHD and adult labour market outcomes. Fletcher used a traditional econometric model of regressing logged earnings on ADHD and control variables for human capital and socioeconomic effects. He used the ADD Health study, an American longitudinal study that followed a cohort of students in grades 7-12 into adulthood. The study had an estimate of between a 34% to 36% reduction in earnings for individuals with ADHD compared to the general population.

Since Fletcher's seminal research, many more studies have investigated the relationship between ADHD and wage outcomes. A more recent study published by PLoS One (Jangmo et al, 2021) found further evidence of an earning disparity by linking the Swedish population graduating from compulsory school in 1998-2008 to clinical psychiatric diagnoses and medications. They found that individuals with ADHD had a 17% lower average annual income.

2. Data

I use data from the ADD Health study, an American longitudinal study of health-related behaviours of adolescents and their outcomes into adulthood. The ADD Health study began with an in-school questionnaire administered to a nationally representative sample of students in grades 7-12 during the 1994-5 school year and has been followed for five waves to date. The original questionnaire is dubbed 'wave I', with the following waves being recorded with a series of in-home interviews in 1996 (wave II), 2001-2002 (wave III), 2008 (wave IV), and 2016-18 (wave V). Wave IV was used exclusively in this analysis as it is the only wave containing both earnings data and data concerning ADHD.

Fletcher also used wave IV of the ADD Health study in his article on ADHD and wage outcomes, however, the scope of his research differs considerably from what the goal of this paper is. Unlike Fletcher, I was only able to gain access to the public access version of this data set, which has a considerably reduced sample size from more than 20,000 respondents to 5,114. While the reduced sample size is unideal, I was unable to find a better alternative source of data containing information on ADHD and earnings.

To determine the presence of ADHD, respondents were asked the following question during the wave IV in-home interview 'Has a doctor, or nurse, or other health care provider ever told you that you have or had attention problems or ADD or ADHD?'[1]. 275 respondents, or 5% of the cohort answered yes to the prompt and 4838 respondents or 95% answered no, with 1 refusal. The question is an unideal way of identifying which subjects have ADHD, as it does not ask for a formal diagnosis. However, it is likely that those told they have attention problems by a healthcare professional may have undiagnosed ADHD.

[1] Recorded in the survey with code H4ID5L

The data for the respondents' earnings comes from the following question in the interview: 'Now think about your personal earnings. How much income did you receive from personal earnings before taxes—that is, wages?'[2]. The responses are interval coded, with the average yearly earnings being approximately $38,000. The cohort has an average age of approximately 29 years old.

I defined control variables for experience, tenure, black, rural, high school diploma, college diploma and female in order to determine the effect of each of these variables on earnings. The variables are defined as follows:

Table 1.

Name	Definition
adhd	=1 if has ADHD, =0 otherwise
female	=1 if female, =0 if male
exper	Years in labour force working full time
tenure	Years working at latest full time job
highschool	=1 if has a high school diploma, =0 otherwise
college	=1 if has a college degree, =0 otherwise
rural	=1 if respondent lives in a rural area, =0 otherwise
black	=1 if black, =0 otherwise

In most cases the control variables had to be manually computed using information from the questionnaire. I calculated the work experience of the respondents by subtracting the value given from the survey prompt 'How old were you when you first began working full time (at least 35 hours a week) at a paying job while you were not primarily a student?'[3] by their age. The resulting value comprises the variable *exper*.

In addition to experience, I computed a control for tenure as a means of controlling for the earnings impact caused by working at the same full-time job continuously. Tenure was calculated by subtracting the value given from the question 'In what year did you begin your (current/most recent) primary job?'[4] by the value give from the question 'In what year did you last work at this job?'[5]. The second question was asked immediately following the first and is referencing the same job. Jobs were only counted if respondents were working at least 10 hours/week, and if respondents had multiple jobs the job that they worked the most at was used.

For both experience and tenure I opted to create quadratic variables, denoted as *expersq* and *tenuresq* respectively. The quadratic variables were included to measure potential diminishing returns from work experience and tenure. The impact of the quadratic variables is not expected

[2] Survey code H4EC2
[3] Survey code H4LM5
[4] Survey code HRLM15Y
[5] Survey code HRLM16Y

to be large given that the cohort is only approximately less than 30 years old on average, but there is still an expected impact.

To characterize the geographic location of the respondents, I used data from the post interview survey prompt 'Which of the following best describes the immediate area or street (one block, both sides) where the sample member/respondent lives?'[6]. Respondents would be given a value of 1 if their residence was described as a 'rural farm'. 2 if 'rural town', 3 if 'suburban', 4 if 'urban, residential only', and 5 or 6 if they owned '3 or more commercial properties'. I opted to use a dummy variable indicating if the respondent lived in a rural area. The dummy variable was coded as follows:

rural = 1 if respondent's H4EO6 value is 1 or 2
rural = 0 if respondent's H4EO6 value is neither 1 nor 2

Controlling for racial earning disparities was performed by including a dummy variable for black individuals. Data on race was found in the post interview from the prompt 'Indicate the race of the sample member/respondent from your own observation (not what the respondent said)'[7]. Respondents would be given a value from 1 through 4, 1 if they were perceived as 'white', 2 if they were perceived as 'black or African American', 3 if they were perceived as 'American Indian or Alaskan Native', and 4 if they were perceived as 'Asian or Pacific Islander'. The public access data set had no other information pertaining to the respondent's race. The sample cohort was primarily either white (71.8%) or black (24.2%). Other races comprised less than 4% of the cohort and were grouped together, making it difficult to discern the exact impact for each race listed in the survey. As a result, race was controlled for by comparing black individuals against the rest of the cohort. The dummy variable was coded as follows:

black = 1 if respondent's H4IR4 value is 2
black = 0 if respondent's H4IR4 value is not 2

3. Method and Empirical Model

To investigate the relationship between ADHD and gender based earning disparities, I first created 4 different interaction terms for each gender in correspondence with the presence of ADHD and without the presence of ADHD. The variables are given by the table 2:

[6] Survey code H4EO6
[7] Survey code H4IR4

Table 2.

	Male	Female
ADHD	*adhdmale*	*adhdfemale*
Neurotypical (Not ADHD)	*ntmale*	*ntfemale*

I then constructed an econometric model that allows for wage differences between the four groups. I used the traditional approach in the literature in which log earnings are regressed on indicators for human capital (experience and education), as well as sociodemographic indicators (race, geographic area of the individual's place of residence):

$$log(wage) = \beta_0 + \beta_1 adhdmale + \beta_2 adhdfemale + \beta_3 ntfemale + \beta_4 x_4 + \ldots + \beta_i x_i + u \quad (1)$$

$$log(wage) = \beta_0 + \beta_1 ntmale + \beta_2 adhdfemale + \beta_3 ntfemale + \beta_4 x_4 + \ldots + \beta_i x_i + u \quad (2)$$

In which variables ($\beta_4 x_4 + \ldots + \beta_i x_i$) are the control variables for human capital and sociodemographic factors and u is the error term.

The analysis requires the use of two econometric models with different base groups, model (1) using neurotypical males as the base group and model (2) using ADHD males as the base group. Using just one model would be insufficient as the base group's standard errors would not be calculated, preventing the testing of statistical significance for that base group. The estimations for the controls should not change substantially between the two different models.

Once the two models have been estimated, the gender wage disparities for both the ADHD group and the neurotypical control group can be compared. Given the models, the null and alternative hypothesis is as follows:

- H_0: β_3 (1) = β_2 (2)
- H_1: β_3 (1) ≠ β_2 (2)

In which β_3 (1) is the coefficient for neurotypical females compared against the neurotypical male base group and β_2 (2) is the coefficient for ADHD females compared against the ADHD base group. The null hypothesis is that there is no difference in gender disparities between the two groups and the alternative hypothesis is that the null hypothesis is not true.

4. Results

I conducted OLS regression to determine the gender wage differential between the neurotypical and ADHD sample populations. The full results are shown below in Table 4 below. Before

discussing the results Table 3 shows the relevant data necessary to compare the gender wage differentials between the two cohorts:

Table 3: Gender Wage Disparities

	Model.1 (Neurotypical male base)		Model.2 (ADHD male base)	
Variable	*ntfemale****	*adhdfemale****	*ntfemale*(.)	*adhdfemale**
Coefficient	-0.374	-0.497	-0.160	-0.282
SE	0.030	0.108	0.083	0.132
p-value	< 2e-16	4.18e-06	0.053	0.033
Statistical significance: (.) 10% level; * 5% level; ** 1% level; ***0.1% level				

I find that the gender wage disparity is smaller between ADHD individuals in comparison the neurotypical individuals. The gender wage disparity between neurotypical individuals is estimated by the coefficient on *ntfemale* in model 1, -0.374, which can be interpreted to mean that being a neurotypical women reduces yearly earnings by 37.4% on average when compared to neurotypical men, ceteris paribus. The estimate is statistically significant at the 0.1% level. The sign is negative which is expected. The gender wage disparity between ADHD individuals is estimated by the coefficient on *adhdfemale* in model 2, -0.282, which can be interpreted to mean that being a women with ADHD reduces yearly earnings by 28.2% on average when compared to men with ADHD, ceteris paribus. The estimate for *adhdfemale* is statistically significant at the 5% level. The null can thus be rejected at the 5% level, as the gender wage disparities between each group are not equal.

The results also indicate that when compared to both the neurotypical male base and the ADHD male base, the gender wage disparity increases for women with ADHD when compared to neurotypical women. Furthermore, neurotypical women still earn less than the ADHD male base, indicating that the negative impact of gender on expected earnings is greater than that of ADHD. However, the estimate of *ntfemale* in model 2 is only statistically significant at the 10% level, meaning the estimate is less reliable.

Table 4: Regression results

Model 1: Neurotypical male base group		**Model 2: ADHD male base group**	
Dependent variable:	***lwage***		***lwage***
Constant	9.249***	Constant	9.033***
adhdmale	-0.232**	*ntmale*	0.213*
adhdfemale	-0.497***	*adhdfemale*	-0.282*
ntfemale	-0.374***	ntfemale	-0.16
black	-0.181***	black	-0.179***
tenure	0.182***	tenure	0.183***
tenuresq	-0.011***	tenuresq	-0.011***
exper	0.069***	exper	0.069***
expersq	-0.003***	expersq	-0.003***
highschooldiploma	0.359***	highschooldiploma	0.359***
collegegrad	0.514***	collegegrad	0.514***
rural	-0.116***	rural	-0.115***
Observations	4497	Observations	4497
R^2	0.1763	R^2	0.1757
Adjusted R^2	0.1742	Adjusted R^2	0.1736
Residual Std. Error	0.976 (df = 4485)	Residual Std. Error	0.976 (df = 4485)
F Statistic	87.24*** (df = 11; 4485)	F Statistic	86.88*** (df = 11; 4485)
Note:	*p<0.05; **p<0.01; ***p<0.001	*Note*:	*p<0.05; **p<0.01; ***p<0.001

4.1 Control Variables

The sign of the coefficients for the control variables in the OLS regressions for both models 1 and 2 are congruent with economic theory. There exists slight discrepancies for the controls between the two models, however they are minimal in effect and do not impact the statistical significance.

Tenure and experience each have a statistically significant positive impact on earnings. The coefficient on *tenure* is 0.182 for the neurotypical male base group and 0.183 for the ADHD male base group, which can be interpreted to mean that each additional year of tenure increases expected earnings by 18.2%-18.3% on average, ceteris paribus. The quadratic variable, *tenuresq*, is also statistically significant with a coefficient of -0.011, interpreted to mean that the positive impact of tenure on wage has diminishing returns. The coefficient on *exper* is 0.069, interpreted to mean that each additional year in the labour force will increase expected earnings by 6.9% on average ceteris paribus. The coefficient on the quadratic variable *expersq*

is negative with a coefficient of -0.003. The coefficient is the expected sign and is statistically significant, but the effect is very small likely due to the young age of the sample.

For education, the coefficient for having a high school diploma is 0.359, interpreted to mean that high school graduates earn 35.9% more than non-graduates on average, ceteris paribus. The coefficient for having a college degree is 0.514, interpreted to mean that college graduates earn 51.4% more than non-graduates on average, ceteris paribus. Both these variables are statistically significant at the 0.01% level for both models. The pronounced positive effect of the estimates for education and work experience indicate that higher human capital increases expected earnings.

The control for race, *black*, has a coefficient of -0.181 in model (1) and a coefficient of -0.179 in model (2), interpreted to mean that being black reduces expected earnings by 17.9%-18.1% on average, ceteris paribus. The coefficient is statistically significant at the 0.01% level. The coefficient is the expected sign, as race based discrimination would likely reduce potential earnings.

The control for the geographic location of the individual's residence, *rural* has a coefficient of -0.116 in model (1) and -0.115 in model (2), which is interpreted to mean that living in a rural area decreases expected earnings by 11.5%-11.6% on average, ceteris paribus. The coefficient is also significant at the 0.01% level. The negative impact is expected as living in a rural area would mean limited job opportunities and subsequently less earning potential.

4.2 Discussion

The findings suggest that the gender wage differential for ADHD individuals is in fact smaller than the gender wage differential for neurotypical individuals. A possible cause of the disparity would be the differences in how ADHD presents between genders. As men are more likely to be diagnosed with hyperactive and combined type ADHD than women (Li, Ting et al, 2018), it could be that these categorisations of ADHD face harsher penalties in the workforce in comparison to inattentive type ADHD. However, the evaluation of this hypothesis would require a breakdown of ADHD types in the data, which is unfortunately not available.

Another source of the disparity could be the differences in comorbidities between men and women with ADHD (B.S. Solberg et al, 2017). The comorbid disorders that men with ADHD are more likely to experience, such as substance abuse, antisocial personality disorder and conduct disorder may have a stronger negative impact on earning outcomes than the disorders experienced by women, which are more 'internalized'. Once again, the extent of these effects are not possible to estimate given the dataset, though it is a possible explanation.

Comorbidity differentials between men and women with ADHD could also be a source of a misclassification bias. Men are considerably more likely to be diagnosed with ADHD, in part due to the fact that they are more likely to externalise their symptoms and their comorbid

disorders (F.D. Mowlem, et al, 2018). Women with ADHD have historically been underdiagnosed, meaning that the possibility of a misclassification bias is real. Furthermore, lower-income women are less likely to be able to afford private psychiatric evaluation, an effect that is confounded by a less external presentation of symptoms and comorbidities. It would thus be possible that there is a misclassification bias present in the model which would under predict the gender wage differential for ADHD individuals.

One of the largest causes of the gender wage disparity is that there are big differences in the type of occupations and industries in which women and men work. Men on average work in higher-paying occupations than women (E. Gould, et al, 2016). People with ADHD tend to do poorly in traditional work environments than neurotypical individuals, and subsequently are more likely to seek out self-employment (P.C. Patel et al, 2019). The self-selection of ADHD individuals into self-employed occupations would perhaps mitigate the wage disparity caused by industrial differentials between men and women.

5. Limitations and Conclusion

The publicly accessible version of the wave IV ADD health survey has a significantly reduced sample size compared to the private access version, with a sample size of 5114 compared to the original survey that has a sample size of more than 20,000. Sample size issues are a particular limitation in the study of ADHD, as it already comprises a minority of the population. Furthermore, data collection errors in the survey resulted in many omitted responses in the model, which further reduced the available sample. The small sample size will inevitably affect the validity of the OLS estimations. Because ADHD is a cognitive disorder, it is difficult to access large sample datasets on it that pertain to economic outcomes. In order for future research to be done on the interaction of ADHD and gender on wage, better data sources will need to be attained.

To further identify the impact of gender based ADHD symptom differentials on wage outcomes, it would be ideal for datasets to categorise individuals by their specific diagnosed ADHD type. The breakdown of earnings by inattentive, hyperactive and combined type ADHD would give insight into which form of ADHD has the worst wage outcomes. Data on common ADHD comorbidities would also prove useful.

There is likely a misclassification bias causing women to be underdiagnosed in the sample. The bias would under predict the impact of having ADHD on wage outcomes for women, especially considering that lower income women would have the least access to private psychiatric treatment.

Type of employment would be another helpful control variable for the model, as the propensity for ADHD individuals to seek out self-employment is likely to somewhat mitigate the employment demographic disparity between men and women that is a significant cause of the

gender wage gap. The inclusion of such a control would thus likely shrink the gender wage disparity differentials between the two groups.

To conclude, I find a difference between the gender wage disparity between ADHD and neurotypical individuals. The gender wage gap between ADHD men and ADHD women was smaller than that of neurotypical men and neurotypical women. These findings potentially identify the impact of gender based differences in the presentation of ADHD symptoms and comorbidities, in which the male presentation of ADHD has an increased negative effect on wage outcomes compared to the female presentation of ADHD. However, the true causal relationship is not possible to identify given the currently available data.

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