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The Effects of Prenatal Testosterone on Adult Wages: Evidence from Russian RLMS Data and Measured 2D:4D Digit Ratios*

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Abstract

There is now a large literature on the correlates of prenatal androgen exposure and various individual measures of performance in sports, business, or schooling. However, there is still relatively limited evidence of the impact of prenatal androgens on life achievement. Using data from the Russian longitudinal survey and measured digit ratios, we found that age-corrected market wages are nonlinearly correlated with low measured 2D:4D ratios signifying higher prenatal testosterone. Unlike earlier work on noncognitive correlates of labor market wages, our findings indicate a clear-cut optimum 2D:4D ratio for women's wages with higher and lower 2D:4D being associated with lowered wages. However, the size of these effects is small, especially compared to the influence of education on income.

Keywords: Adult wages, Prenatal Testosterone, Female earnings
JEL: J24, J31

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1 Introduction

Until recently the economics literature has mostly focused on the positive effects of cognitive ability on achievement in school and in the workplace. But research has long suggested the importance of behavioral or psychological variables for occupational success. Traits such as locus of control, the Big Five personality dimensions, self-direction, impulsivity, machiavellianism, self-esteem, and emotional intelligence, are recognized for their ability to explain differences in educational attainment and occupational success. Behavioral or psychological traits have only recently made their way into mainstream economic literature for their relationship with economic success (Semykina and Linz, 2007). Thus, the more recent work on noncognitive determinants of achievement established that traits such as persistence, confidence, or motivation play a clear role in market success (cf. Heckman, J., Stixrud J. and Urzua S. 2006 for the most recent evidence). However, the various estimates of noncognitive effects are rather inconsistent and suffer from unreliable measures of personality traits. For the most part, these are based on answers to self-reported surveys, which are known to be less reliable than IQ tests (Lindqvist and Vestman, 2011; Borghans et al., 2008). Furthermore, few of the existing studies have systematically investigated non-linear effects of noncognitive characteristics and have produced only limited findings on sex-differentiated effects.

There is also a large parallel literature in biology and the social sciences showing that prenatal testosterone exposure is correlated with large number of attributes (including cognitive ability, personality traits, susceptibility to disease, sexual orientation, and competitive behavior). In the last few years it has been shown that exposure of prenatal androgens affects both future behavior and life choices (Brosnan et al., 2011; Hell and Päßler, 2011). Prenatal hormonal exposure affects development of the male sex organ, secondary sex characteristics as well as brain development and cognition functions. This exposure is said to have "profound, permanently masculinizing effects on human neural circuitry and peripheral tissues, which in turn partly account for a multitude of behavioral, cognitive, and health-related human sex differences see in later postnatal life (Voracek et al., 2010)". One marker for the level of prenatal testosterone (T) which is experienced by an embryo during pregnancy is the inverse correlation of T exposure to the relative length of the second to the fourth finger (2D:4D, cf. Malas M.2006). The 2D:4D ratio is calculated by dividing the length of the index finger of one hand by the length of the ring finger of the same hand. 2D:4D ratios for right and left hands are correlated but not identical. The finger lengths form up during the first trimester in the womb and relative lengths are fully established by the second year of ones life.

The 2D:4D digit ratio is sexually dimorphic: while the second digit is typically shorter for both females and males, the difference between the lengths of the two digits is greater in males than females (Putz et al., 2004). Thus males tend to have lower ratios than females, and relatively more men have shorter second than fourth fingers. We can then observe claimed links between prenatal testosterone exposure and future behavior and also investigate the possibility that these effects might differ for men and women. For example, people with higher levels of testosterone are likely to be more risk-loving and more aggressive. There is also limited evidence on links between 2D:4D and performance in areas such as sports or school (Butovskaya et al., 2010).

Though there are ongoing issues in our understanding of this measure and the precise biological mechanisms that link prenatal testosterone to observed digit ratios, the digit ratio still serves as one of the best and most common proxies for prenatal androgen exposure (Honekopp et al., 2007). Unlike most direct measures of cognitive ability or personality, 2D:4D is almost entirely determined by both genetic endowment (since it is partially heritable) and prenatal androgen exposure and is unaffected by environmental considerations after early infancy (leaving aside accidents or postnatal finger injuries which are not systematic). Because the digit measures are so exogenous to life experience, it may be the best current proxy for hormonal personality effects that one could use. 2D:4D ratios are linked to both standard measures of cognitive ability as well as noncognitive personality traits but there have only been a few studies of 2D:4D on adult performance in sports, business, or schooling. Many of these studies have been inconsistent and done on small and rather truncated samples (Groves, 2005; Millet, 2011). To date, there has been no large scale study linking digit ratios to general labor market outcomes although Coates, et al. 2009 have established a clear link between prenatal T and success in the specific area of bond market trading.

Our study uses data from the Russian longitudinal survey from Moscow to obtain information from a sample of over 2500 individuals who have also consented to have their finger measured (which in turn is a subset of the much larger sample of people in the full Russian social survey). This is therefore the first such study that takes a large and representative sample and allows us to link digit ratios to success in the job market. By using information participants' reported incomes from the year prior to the survey, we can look at the links between 2D:4D and wages while controlling for other factors such as age and gender. Moreover, characteristics associated with high testosterone could plausibly have non-linear effects on performance – some risk-taking or aggressiveness, for instance, might be beneficial, but too much might lead to destructive behavior. The importance of non-linearity becomes a problem for existing measures of the reward to cognitive ability and life outcomes where biological and noncognitive characteristics correlated with increased cognitive ability. If the effects of noncognitive characteristics were either monotonically positive or negative (for example if risk-taking were always good for success or impatience always lowered wages) then we would at least know the direction of the bias in estimates that use cognitive indicators as proxies for human capital given unobservables. But if the effects of any of these characteristics are non-linear and non-monotonic and exhibit tradeoffs between positive and negative traits, then we would be concerned because we would now have no idea whether our estimates of the effects of our measures of human capital are biased upwards or downwards depending on the unobserved noncognitive characteristics of the sample employed.

In earlier work, Nye, et al. 2012 showed that students' grades in samples drawn from both the Higher School of Economics in Moscow and the University of the Philippines School of Economics in Metro Manila showed clear links with measured 2D:4D, but only for women. Generally women's measured 2D:4D ratios showed pronounced non-linear effects (inverted U) on their grade point averages (GPA) with the optimum occurring just around or slightly below the group averages (slightly higher prenatal T). However, these samples (more than 700 students in Moscow and 120 in Manila) may have suffered from truncation and selection bias as both schools are elite institutions drawing from the best-performing students on national entrance examinations, which would eliminate those with low cognitive ability, poor work habits, or evidence of nutritional deficiency.

There is also work by Coates J., Gurnell A. and A. Rustichini 2009 showing that financial traders in London had yearly profits which were strongly correlated with prenatal T exposure (negatively correlated with 2D:4D) and indicating no non-linearity. Since prenatal T may be correlated with risk-taking, the authors hypothesized that in this industry, the willingness to take large risks had more obvious and direct rewards with no obvious downside in the study. However, they could not take survivor effects into account as it might well have been the case that unsuccessful high T, high risk traders might have also been driven out earlier at a higher rate than those earning less and taking fewer risks. Thus it might the case that high T is valuable for bond-trading if you survive, but that its presence might also make one more susceptible to destructively risky investments.

In a German study, using data from an internet survey, Hell B. and K. Päßler 2011 showed that 2D:4D measures are associated with occupational interests. Occupational interests were measured with a standard interest inventory (occupational interests were measured according to Holland's hexagon-model). Hell and Päßler found significant negative correlations between digit ratios and interest in things (as opposed to social or people-oriented interests) for males, but did not find any relationships for females. However, none of this was linked to market outcomes or actual employment outcomes. Furthermore, 2D:4D measurements were self-reported. Thus our work is the first study linking measured 2D:4D to labor market outcomes using a large, heterogeneous sample of individuals that shows a strong non-linear effect for females.

2 Method

We worked with a sample of Moscow and Moscow district households. We collected more than 2500 observations (female - 55 percents, male - 45 percents) which include people from many different groups and cohorts. We use average market wages from the previous year as our measure of labor market outcomes. The data were taken from the Russian Longitudinal Monitoring Survey (RLMS-HSE)[1], 20th wave of the survey (October 2011- February 2012). Finger measurements were taken from a randomly selected sample of survey households living in the Moscow region. Our data only include survey participants from Moscow and the Moscow district, whose finger measurements were taken.

The basic regression is expressed as:

$$lnW_i = \beta_0 + \beta_1 Dr_i + \beta_2 Dr_i^2 + \epsilon \quad (1)$$

Where lnW_i- natural logarithm of average salary for last 12 months; Dr_i, Dr_i^2 – hand digit ratio and hand squared digit ratio.

To adjust results for age effects and the effects of education we expanded our basic model to include age of respondent, and to account for the impact of non-linearity of years in school we add dummy-variables for schooling that take into consideration the highest level of education attained as well as years in school. So far the additional model is expressed as:

$$lnW_i = \beta_0 + \beta_1 Dr_i + \beta_2 Dr_i^2 + \beta_3 Educ_i + \beta_4 E_i + \beta_5 E_i^2 + \epsilon \quad (2)$$

Where lnW_i- natural logarithm of average salary for last 12 months; $Educ_i$-years of schooling; E_i, E_i^2- age and the age squared as a proxy for work experience; Dr_i, Dr_i^2 – hand digit ratio and hand squared digit ratio.

It is important to note that educational levels may themselves be correlated with measured 2D:4D, in as much as the conditions affecting prenatal testosterone exposure and their manifestation are related to such characteristics as cognitive ability and confidence/aggression that are likely to be important determinants of observed educational attainment. Thus controlling for education will likely lead to an underestimate of 2D:4D's significance if these factors are related to both prenatal T exposure and to education. Of course, measured 2D:4D cannot be endogenous to observed educational levels though random factors (such as injury or exercise). Although these may affect finger length these effects are unlikely to be systematic and would just add noise. Nonetheless, we excluded any observations showing substantial finger injuries that might skew the ratios.

3 Participants

Finger measurements were taken from respondents between the ages of 14 and 98; all persons younger than 25 and older than 60 years were excluded in the sample we chose to analyze in order

[1] "Russian Longitudinal Monitoring survey, RLMS-HSE", conducted by the National Research University Higher School of Economics and ZAO "Demoscope" together with Carolina Population Center, University of North Carolina at Chapel Hill and the Institute of Sociology RAS.

to focus on those who would be in the labor market. We followed previously published work on 2D:4D and eliminated extreme values - in the right and left hand it was within a range 0.80 to 1.20 Manning and Peters (2009) - and also removed those respondents who had damaged ring or index fingers on both hand.

The resulting sample consisted of 1746 observations (44 percents - males). The mean age is 42 years (SD = 11), Basic statistics for male and female subsamples are presented in Table 1 and Table 2 Appendix 5.

Whenever the OLS results show that there is a significant quadratic relationship between 2D:4D and the wages, we also compute the optimal value of 2D:4D that maximizes salary outcome[2]. That is, maxima are computed for significant inverted-U relationships. Note that an inverted-U (U-shaped) relationship is implied by a positive (negative) estimated coefficient β_1 and a negative (positive) estimated coefficient β_2. (The maxima/minima are not computed for the regressions in male sample since there is no significant quadratic relationship between 2D:4D and the wages).

4 Results

4.1 2D:4D on wages

We run OLS regression models using the natural logarithm of salary and the average wage for the last 12 months as the dependent variables, and 2D:4D, squared 2D:4D, age, age squared and years of schooling as independent variables (see Table 3 Appendix 5).

We find that left hand 2D:4D and its squared term are correlated with the logarithm of individuals' salaries in female sample. The relationship between right hand 2D:4D and its squared term with the logarithm of individuals salaries are only borderline significant in female sample. Whereas in the male sample we find no significant correlation between 2D:4D and wages. After adjusting for age and education we observe borderline significant links between left hand 2D:4D and the logarithm of individuals wages (see Table 3).

Digit ratio is the only independent variable it is significant in female sample for both hands, but borderline significant in the male sample. Than we control for education and we observe a decrease in the effect of 2D:4D for the female sample – the left hand ratios is significant at 10 percent level and right hand become insignificant. Note that if education is itself endogenous to 2D:4D – e.g. those who have higher prenatal testosterone are more likely to obtain more education due to greater cognitive ability, greater nutrition, or personality characteristics conducive to more education – we should expect that using 2D:4D and education in the same equation will lower the significance of 2D:4D thus biasing its effects downwards. The fact that 2D:4D is still significant in many of the regressions with education included suggests that a good part of prenatal testosterone's effects do not simply work through the channel of more learning or higher cognitive ability.

Nonetheless, we cannot assume that both the direct effects of 2D:4D on schooling and wages, and the indirect effects of 2D:4D on wages through schooling are identical for males and females. Given sexual dimorphism as well as different cultural attitudes towards male vs. female work and schooling could lead to 2D:4D having very different effects on wages once schooling is taken into consideration.

Even when we add age and age squared (proxy for working experience) as independent variables, the link between 2D:4D and wages still persists in the female sample. Note that as long as we do not analyze 2D:4D conjointly with education the coefficients are highly significant. But as soon as we add education into the estimation the effect of 2D:4D decreases but persists.

[2] $Lmax$ is the value of left digit ratio that maximizes the dependent variable, equal to $\frac{-\beta_1}{2*\beta_2}$, computed only for significant values in OLS. $Rmax$ is the value of right digit ratio that maximizes the dependent variable, equal to $\frac{-\beta_1}{2*\beta_2}$, computed only for significant values in OLS

In Table 4 Appendix 5 we show that using nominal wages instead of their logarithms does not noticeably change the findings. The results follow the same pattern of 2D:4D's relationship with the logarithm of wages.

We also have looked at whether 2D:4D is related to any other important outcome variables. We consider presence of children, number of children, marital status, and employment. In Table 5 and Table 6 Appendix 5 we find that 2D:4D is significantly linked to the possibility of having children (in a probit regression), the relationship occurs to be statistically significant in the female sample and has a U-shape curve.

In addition to OLS estimation of wages and 2D:4D ratios we ran probit analysis of employment status. Exact number of employed people in our sample is 2007 (male - 897; female - 1110), reported unemployed number is 564 (male - 180; female - 384). We find that 2D:4D on right hand significantly predicts ($p<0.1$) the probability of being employed (see Table 7).

The final results describe regressions of 2D:4D on marital status (see Table8). Once again we estimate probit regressions where marital status is the dependent variable where 0 equals single/live alone, and 1 means married/live together/divorced. We did not find any significant link between 2D:4D and marriage (see Table 8).

Figures 1 - 8 (see Appendix 4) reflect the joint distribution of 2D:4D and the log of average salary (and average salary) in the male and female samples. For females the shape of the distribution is sharper and negatively skewed.

4.2 2D:4D's effect on having children, marital status

When considering the effects of prenatal T on wages versus marriage we see contrasting effects for women. First we run probit regressions where the dependent variable is a binary variable whether one has children (1 – in sample 2040 observations reportedly have children) or does not (0, we have 531 observations of those who reportedly have no children). The other regression is a probit model for the probability of getting married being linked with measured 2D:4D (see Table 8). As we see the 2D:4D ratio is positively significantly linked to the probability of having children, especially for women (lower T, greater likelihood of children). After adjusting for age and years of schooling we still observe a U-shaped relationship between 2D:4D and the dependent variable.

We run linear regression analysis for the number of children as the dependent variable (see Table 6). The result is that 2D:4D ratio show border-significant link with the number of children, but age is the most important predictor. The older one gets the higher chance of having children. Also, the less educated a woman is – the more children she has.

Probit analysis on the likelihood of marriage does not reveal any significant links between 2D:4D and marital status (see Table8).

4.3 Min and Max of 2D:4D function

It seems that the most significant relationships are observed in the female sample and generally exhibit an inverted U shape. The computed $Lmax$ value for females is equal to 0.9545, or roughly one standard deviation to the left of the average 2D:4D value in the female sample. The computed $Rmax$ value is equal to 0.9672, and it is about one standard deviation away to the left of the average 2D:4D value in female sample. Thus, the optimum measured 2D:4D for women's wages in Moscow, is seen for those who have somewhat but not too much more prenatal T exposure than the average. The one standard deviation change in salary before 2D:4D optimum and one standard deviation after give 583 rubles on left hand and 556 rubles on right hand in women subsample. At two standard deviations the drop in salary for women was about 2332 rubles for left hand measures and 2225 using the right. In the male sample, as noted, regression coefficients were insignificant.

5 Conclusions

In brief, we find that left hand 2D:4D and its squared term are negatively correlated with the logarithm of individuals' salaries for a large sample of Moscow residents drawn from the full Russian longitudinal monitoring survey when controlling for gender. In the case of female respondents, the results are consistently significant even after controlling for level of education, age and presence of children. In the male subsample it is more complicated: there is a relation between 2D:4D and logarithm of wage controlled for age, but adding level of education makes this relation no longer significant. This possibly implies that 2d:4d affects male wages mostly through education, but in the case of women there is also an effect of 2D:4D by itself. In general, the male effects are weaker and often marginal, and are thus inconclusive.

Our main goal was to understand how exposure to prenatal androgens affects labor market earnings. We use measured 2D:4D ratios as proxies for genetically dimorphic responses to prenatal testosterone, which are frequently linked in the existing literature with risk-taking behavior and a number of other personality traits. Indeed we found that the 2D:4D ratio has a significant nonlinear effect (inverted U-shape) on earnings for females. In the male sample that connection is weak and statistically insignificant. The left 2D:4D ratio is significantly correlated with average salary in the general sample, but holding gender constant shows clearly only for females.

This finding is consistent with recent work showing the importance of noncognitive factors for success in the labor market. But it also amplifies and extends the findings of 2012 that show a similar inverted U nonlinearity linking 2D:4D and only for female performance at university. According to Millet (2011) the majority of 2D:4D studies has focused on linear relationship between 2D:4D and variables of interest. Although works alongside psychology had argued about importance of person–situation interactions on behavior, only a few papers have been published with meaningful 2D:4D–situation interactions.

However the potential endogeneity of education to 2D:4D suggests that measures of education that do not account for this could lead to misattribution of the effects of prenatal T to schooling itself or in other cases might lead to underestimation of the role of genetic and noncognitive factors that themselves drive school attainment.

Although many studies in psychology and economics have demonstrated the importance of noncognitive skills to success they often treat these noncognitive factors as if they were monotonically positive or negative. For instance, Duckworth and Seligman (2005) showed that self-discipline did better than IQ at predicting performance in school of one group of adolescents. Heckman et al. (2006) showed that noncognitive skills positively correlated with success in graduating from high school. But in considering survey measures of noncognitive behavior they aggregated indices of yes/no questions on the presence or absence of risky behavior such as smoking, drinking, involvement in crime, or having sex by age 15. But of course, if willingness to take risks exists on a scale that might be parallel to cognitive measures there is no reason to suppose that greater risk taking is necessarily bad or good. In contrast the 2006 measures aggregate a person's likelihood of having passed the threshold of some clearly observable risky behaviors and use that as an index rather than use a direct measure of a person's willingness to take risk. It is therefore not possible to assess whether those with more or less willingness to take risks among those teens who never engaged in the risky behaviors cited did better or worse than other teens with even lower risk taking propensities. Nonlinearities would confound any analysis of the links between cognitive and noncognitive characteristics.

It is also likely that the link between a worker's noncognitive skills and his or her occupational attainment stems in part from the fact that personality traits appear to have labor market returns that are both occupation- and gender-specific (Groves, 2005). This raises obvious questions regarding the extent to which gender differences in noncognitive skills can account for the disparity in men's and women's relative wages. Recent research investigates this issue and generally concludes that noncognitive skills have a significant, but rather modest, role in explaining the gender wage gap (Linz and Semykina, 2009; Cobb-Clark and Tan, 2011).

It is also important to discuss and understand the mechanism through which biological characteristics influence people behavior. In 2D:4D it may be important to think of gender specific type of behavior. Thus Benderlioglu and Nelson (2004) examine the link between aggression and 2D:4D and come to the conclusion that prenatal testosterone does influence certain types of aggression in women. They found that females with lower 2D:4D were more reactively aggressive toward a confederate than other females. Following their study Coyne et al. (2007) done on college students, they show substantial sexual difference in aggression. According to their work lower values of low right–left 2D:4D (directional asymmetry or DA) predicts an indirect aggression in women. At the same time Voracek et al. (2010) argues that testosterone administration negatively correlated with empathy in female e.g. with lower (masculinized) 2D:4D. However, in similar work it has found that digit ratio is related to physical aggression in men, but not in women (Bailey and Hurd, 2005). However, it appears that testosterone may increase aggression in general but the expression of the aggression may be gender specific, with high prenatal androgens exposure showing a link with physical aggression in men, and only indirect aggression in women.

The importance of noncognitive factors that may be correlated with cognitive abilities, yet which have non-linear effects on adult achievement, potentially complicates estimates of cognitive abilities effects on outcomes that make no correction for either noncognitive factors or the potential error of confounding non-linear effects. Our paper therefore not only gives us new insight into the role of prenatal hormones on outcomes but also provides us with a new avenue for studying influences on outcomes of noncognitive characteristics.

Overall our work tends to show that our measured digit ratios have a small but significant effect on women's wages although education (which is more directly correlated with human capital) explains the greater part of earnings. Further work needs to be done on the precise contribution of prenatal T to educational attainment and other factors relevant to human capital in order to separate the mechanisms that cause prenatal hormone exposure to affect labor market outcomes.

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Appendix 1. Descriptive statistics

Table 1: Summary statistics (male subsample)

Variable	Obs	Mean	Std. Dev.	Min	Max
Digit ratio left hand	1494	1	0.04	0.85	1.18
Digit ratio left hand squared	1494	1	0.09	0.73	1.4
Digit ratio right hand	1494	1	0.05	0.83	1.19
Digit ratio right hand squared	1494	1.01	0.09	0.69	1.43
Age	1494	42	11	25	60
Education	1486	18.37	3.26	3	23
Average wage for last 12 months	981	25111	19012	0	300000
Logarithm of average wage	962	9.97	0.61	6.62	12.61

Table 2: Summary statistics (female subsample)

Variable	Obs	Mean	Std. Dev.	Min	Max
Digit ratio left hand	1077	1	0.04	0.82	1.19
Digit ratio left hand squared	1077	0.99	0.09	.68	1.41
Digit ratio right hand	1077	1	0.04	0.83	1.19
Digit ratio right hand squared	1077	1	0.09	0.69	1.42
Age	1077	40	10	25	60
Education	1071	17.45	3.69	6	23
Average wage for last 12 months	765	36129	25894	0	350000
Logarithm of average wage	761	10.33	0.56	8.01	12.77

Appendix 2. Regression analysis

Table 3: Logarithm of average salary on 2D:4D, age and years of schooling (OLS)

	Males	Males	Females	Females	Males	Males	Females	Females
Digit ratio left hand	8.17		24.7**		8.95		17.3	
	(12.3)		(11.7)		(11.4)		(11.2)	
Digit ratio left hand squared	-4.28		-13.1**		-4.88		-9.27*	
	(6.17)		(5.83)		(5.70)		(5.58)	
Digit ratio right hand		0.48		22.3*		-6.49		16.6
		(12.6)		(11.5)		(11.7)		(11.0)
Digit ratio right hand squared		-0.44		-11.7**		2.91		-8.82
		(6.30)		(5.70)		(5.84)		(5.43)
Age					0.090***	0.090***	0.034**	0.032*
					(0.017)	(0.017)	(0.017)	(0.017)
Age squared					-0.0011***	-0.0011***	-0.00045**	-0.00042**
					(0.00021)	(0.00021)	(0.00020)	(0.00020)
Education					0.051***	0.051***	0.058***	0.059***
					(0.0053)	(0.0053)	(0.0063)	(0.0063)
Constant	6.45	10.3	-1.63	-0.62	3.70	11.3*	0.27	0.57
	(6.18)	(6.29)	(5.87)	(5.81)	(5.74)	(5.83)	(5.62)	(5.52)
Adjusted R-square	-0.001	-0.002	0.006	0.004	0.101	0.099	0.077	
Number of observation	761	761	962	962	755	755	957	957

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

Table 4: Average salary and 2D:4D, age and years of schooling and occupation type (OLS)

	Males	Males	Females	Females	Males	Males	Females	Females
Digit ratio left hand	634860.2		785303.7**		628581.4		586938.4*	
	(562813.4)		(359734.3)		(536127.4)		(348973.7)	
Digit ratio left hand squared	-321661.8		-404099.9**		-326539.4		-301178.9*	
	(281109.6)		(179474.4)		(267754.5)		(174110.3)	
Digit ratio right hand		178730.2		734428.1**		-128863.4		577658.6*
		(568288.7)		(358123.0)		(542187.8)		(346367.1)
Digit ratio right hand squared		-98174.7		-372800.3**		50702.9		-292572.9*
		(284368.3)		(177509.2)		(271281.6)		(171731.5)
Age					3380.2***	3355.3***	1296.1**	1241.3**
					(807.5)	(807.0)	(519.8)	(520.8)
Age squared					-42.0***	-41.6***	-16.3***	-15.7**
					(9.72)	(9.71)	(6.20)	(6.21)
Education					2084.9***	2088.5***	1608.9***	1621.9***
					(248.8)	(249.0)	(201.6)	(201.2)
Constant	-276468.1	-44285.0	-355291.3**	-335777.3*	-365621.8	14191.8	-314075.6*	-312476.1*
	(281547.5)	(283762.7)	(180175.6)	(180551.7)	(269416.6)	(270805.9)	(175009.4)	(174199.9)
Adjusted R-square	-0.001	-0.002	0.006	0.004	0.101	0.099	0.077	0.077
Number of observation	765	765	981	981	759	759	976	976

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

Appendix 3. Regression analysis, additional variables

Table 5: Presence of children and 2D:4D, age and years of schooling (Probit)

	Female	Male	Female	Male	Female	Male	Female	Male
Digit ratio left hand	-79.28**	-29.64	-81.53**	-41.06				
	(-2.78)	(-1.17)	(-2.59)	(-1.53)				
Digit ratio left hand squared	39.06**	14.18	40.11*	19.93				
	(2.76)	(1.12)	(2.55)	(1.48)				
Age			0.0453***	0.0600***			0.0449***	0.0605***
			(9.91)	(10.92)			(9.90)	(10.99)
Education			-0.0321*	0.00771			-0.0335*	0.00765
			(-2.26)	(0.65)			(-2.36)	(0.65)
Digit ratio right hand					-0.752	-47.63	-0.790	-65.39*
					(-0.03)	(-1.69)	(-0.03)	(-2.24)
Digit ratio right hand squared					-0.126	23.05	0.142	31.83*
					(-0.01)	(1.64)	(0.01)	(2.18)
Constant	41.13**	16.05	41.16**	19.31	1.860	25.17	0.496	31.70*
	(2.87)	(1.27)	(2.62)	(1.45)	(0.16)	(1.77)	(0.04)	(2.16)
Observations	1494	1077	1486	1071	1494	1077	1486	1071

T statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Number of children and 2D:4D, age and years of schooling (Probit)

	Females	Males	Females	Males	Females	Males	Females	Males
Digit ratio right hand	-8.89	-18.3	-9.86	-21.1				
	(13.4)	(17.3)	(12.4)	(14.7)				
Digit ratio right hand squared	4.07	8.69	4.70	10.1				
	(6.62)	(8.60)	(6.12)	(7.33)				
Age			0.15***	0.20***			0.15***	0.19***
			(0.019)	(0.024)			(0.019)	(0.024)
Age squared			-0.0015***	-0.0019***			-0.0015***	-0.0019***
			(0.00022)	(0.00029)			(0.00022)	(0.00029)
Education			-0.029***	0.0082			-0.029***	0.0084
			(0.0072)	(0.0074)			(0.0071)	(0.0074)
Digit ratio left hand					-27.8**	-20.1	-23.9*	-22.7
					(13.5)	(19.2)	(13.9)	(17.5)
Digit ratio left hand squared					13.6**	9.56	11.7*	11.0
					(6.75)	(9.57)	(6.96)	(8.73)
Constant	6.15	10.8	3.61	7.52	15.5**	11.7	10.7	8.20
	(6.80)	(8.71)	(6.29)	(7.44)	(6.78)	(9.62)	(6.99)	(8.81)
Observation	1494	1075	1486	1069	1494	1075	1486	1069

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

Table 7: Employment and 2D:4D, age and years of schooling (Probit)

	Females	Males	Females	Males	Females	Males	Females	Males
Digit ratio left hand	40.67*	-14.55	35.11	-14.55				
	(2.07)	(-0.57)	(1.77)	(-0.57)				
Digit ratio left hand squared	-20.27*	6.849	-17.46	6.849				
	(-2.07)	(0.53)	(-1.76)	(0.53)				
Age		-0.0130**	-0.0122***	-0.0130**		-0.0128**	-0.0123***	-0.0128**
		(-2.84)	(-3.59)	(-2.84)		(-2.80)	(-3.61)	(-2.80)
Education		0.0495***	0.0582***	0.0495***		0.0500***	0.0576***	0.0500***
		(4.22)	(5.44)	(4.22)		(4.26)	(5.38)	(4.26)
Digit ratio right hand					46.55*	-64.63*	41.50*	-64.63*
					(2.47)	(-2.36)	(2.22)	(-2.36)
Digit ratio right hand squared					-23.19*	32.44*	-20.72*	32.44*
					(-2.48)	(2.36)	(-2.24)	(2.36)
Constant	-19.71*	8.327	-17.49	8.327	-22.65*	32.76*	-20.60*	32.76*
	(-2.00)	(0.65)	(-1.76)	(0.65)	(-2.38)	(2.40)	(-2.19)	(2.40)
Observations	1494	1071	1486	1071	1494	1071	1486	1071

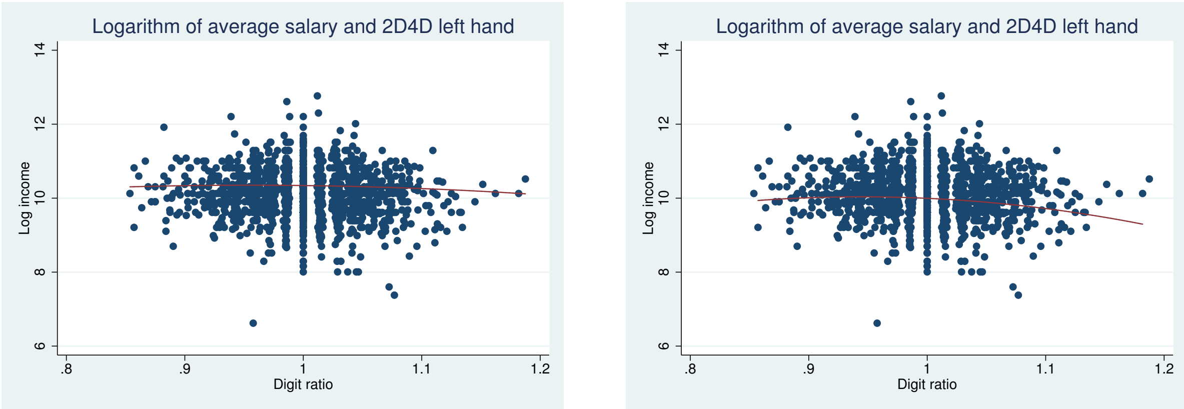
T statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Marriage and 2D:4D, age and years of schooling (Probit)

	Females	Males	Females	Males	Females	Males	Females	Males
Digit ratio left hand	-15.51	4.348	-18.31	4.348				
	(-0.65)	(0.10)	(-0.76)	(0.10)				
Digit ratio left hand squared	7.871	-3.187	9.290	-3.187				
	(0.66)	(-0.15)	(0.78)	(-0.15)				
Age		-0.0250***	-0.0276***	-0.0250***		-0.0247***	-0.0273***	-0.0247***
		(-4.28)	(-7.58)	(-4.28)		(-4.28)	(-7.49)	(-4.28)
Education		0.0376*	-0.00527	0.0376*		0.0379*	-0.00425	0.0379*
		(2.19)	(-0.42)	(2.19)		(2.24)	(-0.34)	(2.24)
Digit ratio right hand					-29.15	-52.33	-30.54	-52.33
					(-1.13)	(-1.15)	(-1.19)	(-1.15)
Digit ratio right hand squared					15.13	25.79	15.72	25.79
					(1.18)	(1.13)	(1.23)	(1.13)
Constant	8.653	0.867	11.33	0.867	15.02	28.50	17.09	28.50
	(0.72)	(0.04)	(0.94)	(0.04)	(1.15)	(1.24)	(1.32)	(1.24)
Observations	1494	1071	1486	1071	1494	1071	1486	1071

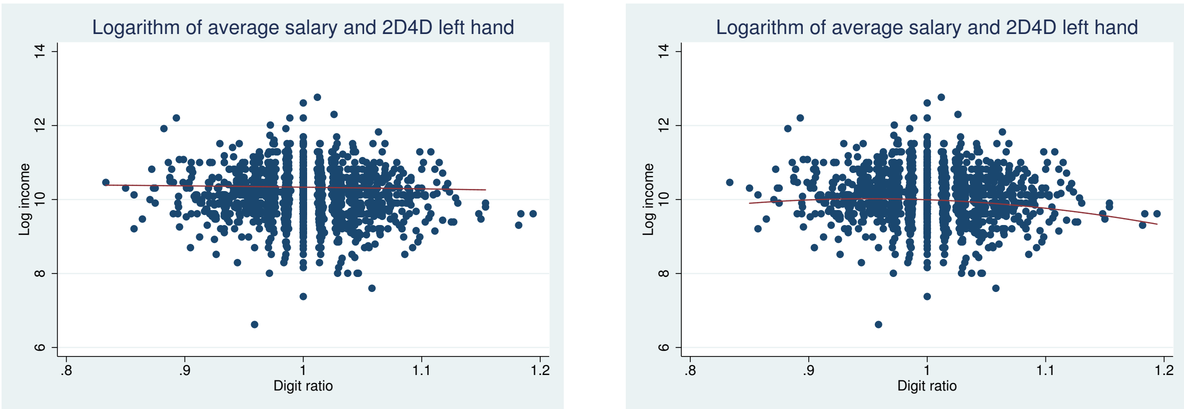
T statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 4. Graphics.



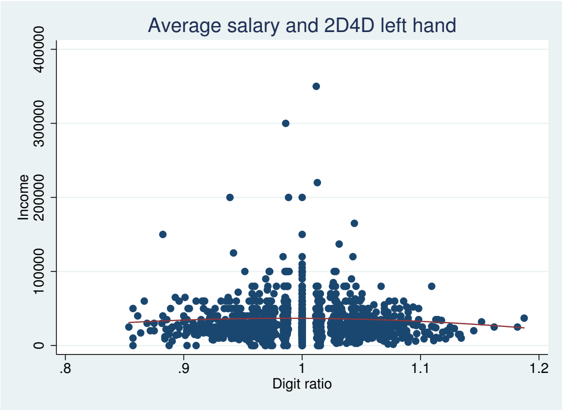
(a) Males (b) Females

Figure 1: Digit ratio (left hand) and logarithm of average salary

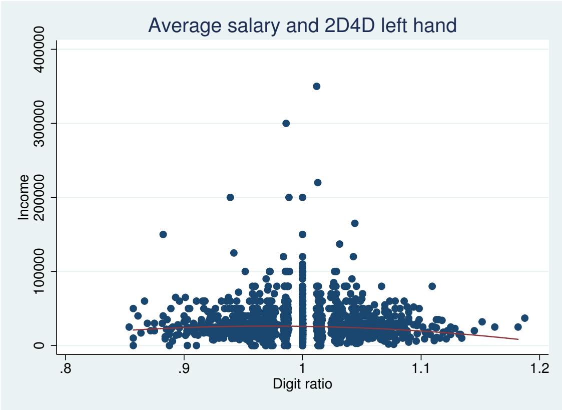


(a) Males (b) Females

Figure 2: Digit ratio (right hand) and logarithm of average salary

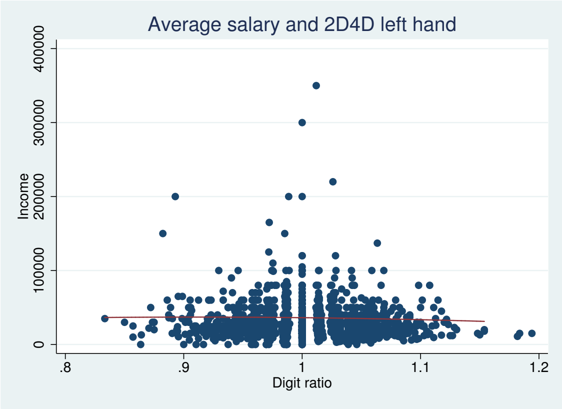


(a) Males

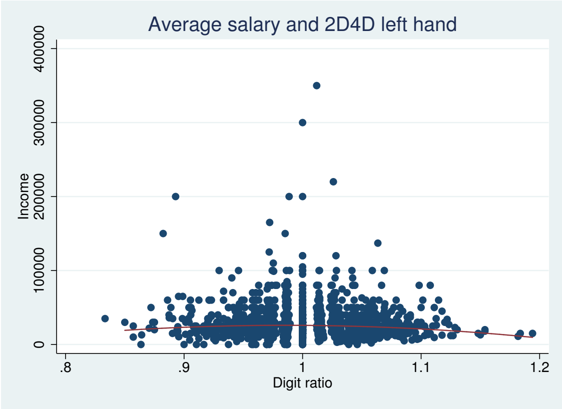


(b) Females

Figure 3: Digit ratio (left hand) and average salary

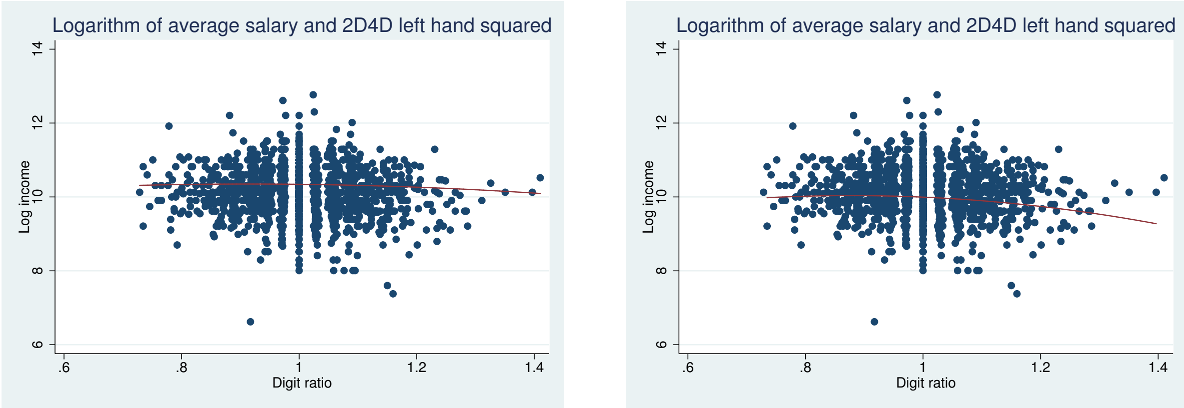


(a) Males



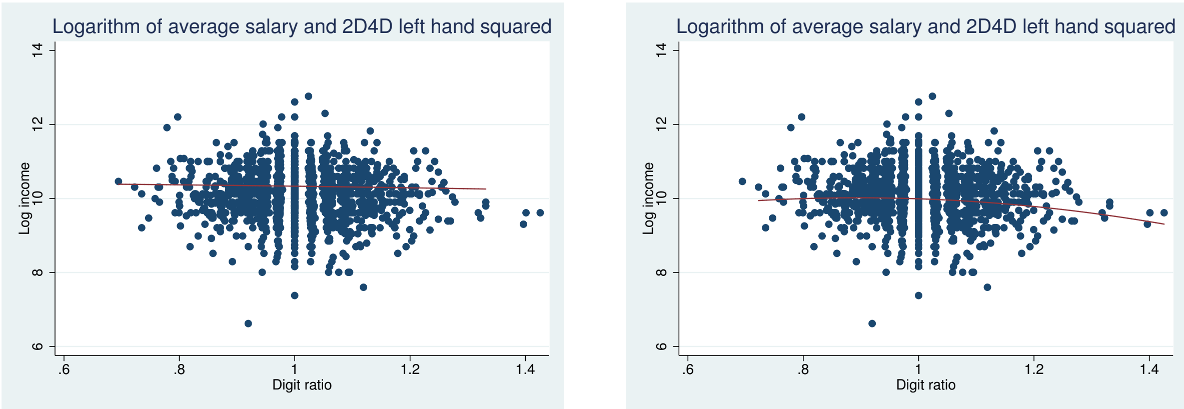
(b) Females

Figure 4: Digit ratio (right hand) and average salary



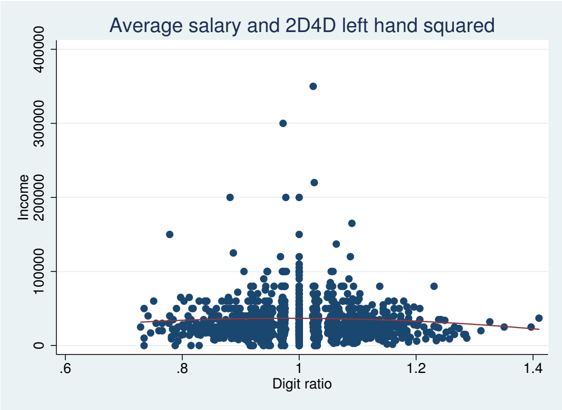
(a) Males (b) Females

Figure 5: Digit ratio squared (left hand) and logarithm of average salary

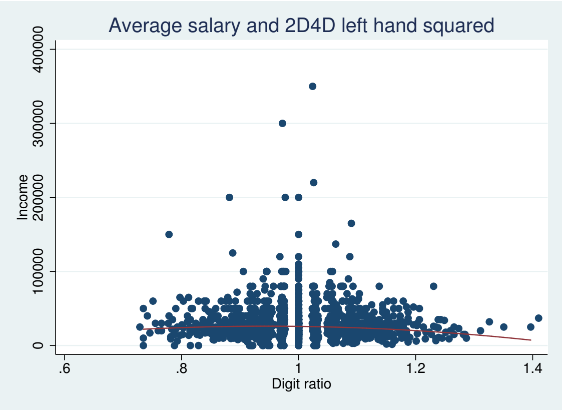


(a) Males (b) Females

Figure 6: Digit ratio squared (right hand) and logarithm of average salary

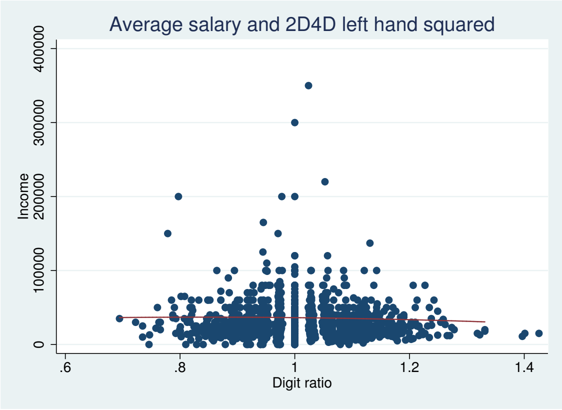


(a) Males

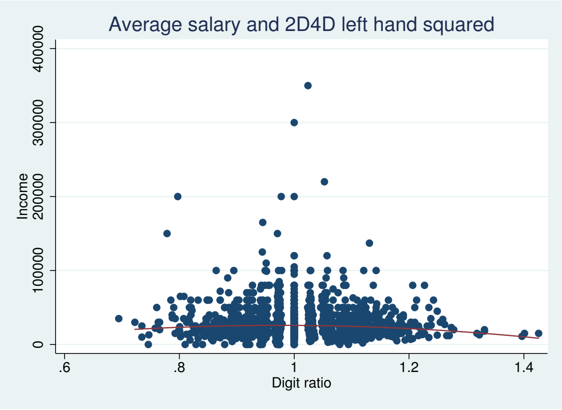


(b) Females

Figure 7: Digit ratio (left hand) and average salary



(a) Males



(b) Females

Figure 8: Digit ratio (right hand) and average salary

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