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Alyssa Schneebaum
Miriam Rehm
Katharina Mader
Patricia Klopf
Katarina Hollan

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The Gender Wealth Gap in Europe

Alyssa Schneebaum[*]   Miriam Rehm[†]

Katharina Mader[‡]   Patricia Klopf[§]

Katarina Hollan[¶]

Abstract

This paper studies the gender wealth gap using 2010 Household Finance and Consumption Survey data for 15 European countries, and finds that households with only one male adult have more net wealth than households with one female adult, and that households with an adult couple have the highest net wealth. Using OLS regressions to predict net wealth and the inverse hyperbolic sine transformation of net wealth, as well as the nonparametric DiNardo-Fortin-Lemieux re-weighting technique, to study the relationship between household and personal characteristics with net wealth, the paper finds that differences in labor market characteristics between male and female households, most notably lifetime labor force participation and wages, explain much of the gender wealth gap.

JEL Classifications: D31; J16; E21

Key Words: Gender; Wealth; Wealth Gap; Distribution

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[*]Department of Economics, Vienna University of Economics and Business (WU). Address: Welthandelsplatz 1, 1020 Vienna (Austria). Email: alyssa.schneebaum@wu.ac.at

[†]Department of Economics and Statistics, The Vienna Chamber of Labour (AK Wien). Address: Prinz Eugenstraße 20-22, 1040 Vienna (Austria). Email: miriam.rehm@akwien.at

[‡]Department of Economics, Vienna University of Economics and Business (WU). Address: Welthandelsplatz 1, 1020 Vienna (Austria). Email: katharina.mader@wu.ac.at

[§]Department of Global Business and Trade, Vienna University of Economics and Business (WU). Address: Welthandelsplatz 1, 1020 Vienna (Austria). Email: patricia.klopf@wu.ac.at

[¶]Austrian Institute of Economic Research (WIFO). Address: Arsenal, Objekt 20, 1030 Vienna (Austria). Email: katarina.hollan@wifo.ac.at

1 Introduction

Questions surrounding the distribution of wealth have recently witnessed a surge in interest, which has been closely related to the availability of high quality micro data. Much of the existing literature on wealth distributions focuses on the United States and the United Kingdom (e.g. Wolff, 1998), with more limited research on European countries (e.g. Frick et al., 2010; Bover, 2010; Piketty, 2014). Deepening the investigation into wealth differences between socioeconomic groups, for instance by race (Oliver and Shapiro, 1997), has also been focused on regions for which data are available. Thus far, gender has not been a prominent topic in this research, despite some notable exceptions (e.g. Deere and Doss, 2006a; Yamokoski and Keister, 2006; Sierminska et al., 2010). Especially in contrast to the gender pay gap, a favorite topic among labor economists and sociologists, the gender wealth gap has received far less attention in the literature. Reasons have been the relative shortage of wealth data compared to income data, and the difficulty in untangling ownership information (Sierminska, 2014).

This paper presents an analysis of the gender differences in wealth for the euro area based on a survey harmonized by the European Central Bank, the Household Finance and Consumption Survey (HFCS). The HFCS contains household-level information on net wealth, defined as real plus financial assets minus debt. Detailed socioeconomic data on the household and its members allow researchers to compare households with similar characteristics to test the role of gender in determining a household's wealth.

The HFCS enables researchers to take large strides in studying the distribution of wealth by gender by providing harmonized data for most euro area countries, but the HFCS data are aggregated on the household level. Having data on the wealth of households, not individuals, complicates the analysis of the intra-household distribution of wealth, particularly because household members may not have equal access to wealth (Grabka et al., 2013; Sierminska et al., 2010) or decision-making power (Mader and Schneebaum, 2013). This paper goes around this problem by restricting the analysis to three groups: households headed by male reference persons with no partner living in the household (male single households, or just "male households"), households headed by female reference persons with no partner living in the household (female single households, or just "female households"), and households whose reference person is a member of a different-sex couple, where the spouse or partner is living in the same household.

The paper investigates the difference in wealth between couple households, male households, and female households by using three multivariate econometric methods. First, for compatibility with the existing literature, OLS regressions predicting the level of household net wealth are performed using a vector of standard and novel explanatory variables. Second, to account for the highly right-skewed distribution of net wealth, the regression is also done using an inverse hyperbolic sine (IHS) transformation of the net wealth data. Third, since the gender wealth gap varies over the unconditional net wealth distribution, a nonparametric decomposition developed in Fortin et al. (2010) (DFL) is used to study

the correlation of various characteristics with the gender wealth gap across the entire distribution of net wealth.

The results are in line with the existing literature on gender differences in the wealth distribution in the US, UK, and Germany, and also with the much more established literature on the gender wage gap (e.g. Blau and Kahn, 1997; 2000; Weichselbaumer and Winter-Ebmer, 2005; Plantenga and Remery, 2006). Labor market characteristics go a long way towards explaining the differences in wealth between male and female households, even though a gap in wealth based on households type remains even after all measurable characteristics are controlled for. Male households have higher wealth than female households, which is largely due to differences at high levels of net wealth – the equivalent of a "wealth glass ceiling." The contributions of this paper are the estimation of the gender wealth gap for the entire euro area, and the application of DFL decomposition to study the gender wealth gap across the entire distribution of net wealth.

The paper is structured as follows: Section 2 gives an overview of the theoretical and empirical background of gender differences in the accumulation and distribution of wealth, Section 3 presents the data and methods, and Section 4 contains the empirical results. Section 5 concludes.

2   Gender Differences in Wealth Accumulation

As discussed in Wolff (1998), there are various reasons why people own different levels of wealth: they are at different stages in the life-cycle; levels of entrepreneurial spirit as well as success differ; they have distinct tastes for income, human capital accumulation, and savings; and luck is unevenly distributed across the population. Despite the fact that we already know quite a bit about how wealth is accumulated, studies on inequality in wealth distribution have often neglected the issue of gender (e.g. Wolff, 1998). There are, however, good reasons to expect that wealth is unevenly distributed by gender. Consider the following simple model of wealth accumulation, taken from Schmidt and Sevak (2006, p.142):

$$A_{t+1} = (1 + r_t)(A_t + Y_t - C_t). \tag{1}$$

The model in equation 1 says that a household's stock of wealth or assets A in time period $t + 1$ is a function of the stock of assets (A_t), the income earned (Y_t), along with the consumption level (C_t) in a previous time period t, and the rate of return on those previously accumulated assets, r_t. Inheritances and other wealth transfers can increase or decrease the stock of assets given by A_t. The rate of return r_t depends on risk preferences and portfolio selection. Assume that the rate of return on investments is constant across periods. What determines these components of wealth, and how might they differ by gender?

Consider first the role of a person's age and education in determining their wealth.

Higher levels of schooling are consistently shown to be positively related to greater income (see e.g. Card, 1999). Greater income allows for more saving ($Y_t - C_t$ in equation 1), increasing wealth, meaning that more educated people should have more wealth. There are other channels beyond income through which education influences wealth, as well. A higher level of education can lead to more knowledge of investment opportunities (affecting r_t in equation 1). Also, given intergenerational persistence in educational outcomes, more highly educated people are likely to have highly educated parents (Hertz et al., 2007; Schneebaum et al., 2014). Those parents will likely have higher income and wealth themselves, leaving them with valuable assets to pass to their children in inheritances later. These inheritances affect a person's wealth by increasing A_t. Since educational outcomes differ by gender, women are at an educational wealth disadvantage. Women had lower levels of educational attainment on average until only recently (and still do in some countries) (see e.g. Schneebaum et al., 2014), we can therefore expect women to accumulate lower levels of wealth than men.

Wealth can also vary over the life-cycle, an observation described by the life-cycle hypothesis (Modigliani, 1966). This hypothesis states that individuals seek to smooth their consumption over time to maintain a constant lifestyle, and will make their consumption and saving decisions accordingly. Individuals will thus save part of their income during their working years in order to afford comparable consumption in retirement. However, a high rate of dis-saving in retirement implied by the life-cycle hypothesis is not unambiguously observed in the empirical literature (e.g. Piketty et al. (2011)). Nevertheless, wealth over age broadly tends to have an inverted u-shape form. Since women typically live longer than men, we may therefore expect higher levels of wealth for women based on age. Further, women are more likely to outlive their husbands than the other way around, so women will be more likely to inherit from their husbands, contributing to their wealth in old age.

Labor market characteristics are also important determinants of wealth, and income and wealth are highly positively correlated (Piketty and Zucman, 2014). In equation 1 income affects wealth through savings, $Y_t - C_t$. Women on average receive lower wages than men for the same work (Blau and Duncan, 1967; Council of the European Union, 2010), and women are more likely to work in part-time jobs as a result of care and housework responsibilities, which are still primarily assigned to women (Jepsen et al., 2005; Manning and Petrongolo, 2007; Bardasi and Gornick, 2008; Fernández-Kranz and Rodríguez-Planas, 2009; Matteazzi et al., 2012). Relatedly, women are more likely to face interruptions in their working histories, further shortening the time spent in the labor market (Budig and England, 2001; Gangl and Ziefle, 2009). The disadvantages women face in the labor market, namely lower income levels and shorter paid working time, result in weaker possibilities for women to accumulate wealth. Women have to work longer to earn the same amount of income as their male counterparts and therefore also need to work more to accumulate comparable levels of wealth, holding the saving rate and other factors constant across gender.

Inheritances are an important part of wealth accumulation and contribute directly to A_t in equation 1. Some empirical papers find that inheritances comprise around half of households' wealth (Gale and Scholz, 1994); the rest is formed by savings and other transfers. Other studies find support for the so-called *law of 20/80*, which states that inheritances constitute up to 80% of household wealth (Kotlikoff and Summers, 1988). Still others find the exact opposite to be true, namely that only around 20% of total wealth are inherited and the rest accumulated through saving (Modigliani, 1988). Some of the variation in findings on the role of inheritances in determining net wealth arise from differences in conceptualizations of inheritances: it is unclear whether inter vivo transfers, such as parents' contributions to the human capital accumulation of their children, for example, should be considered bequests (Deere and Doss, 2006a). There is ongoing debate on the effect of inheritances on the overall level of wealth and wealth inequality (see e.g. Bowles and Gintis, 2002; Piketty et al., 2011; Fessler and Schürz, 2013). Although inheritance regimes differ around the world (see e.g. Deere and Doss, 2006b), there is a clear trend towards equality between genders regarding outcomes of inheritance practices in the countries studied here (Pestieau, 2002). Women may be more likely to inherit because they live longer than men on average, but the value of their inheritances may be lower than men's (Mader et al., 2014).

Finally, differences in asset allocation patterns and risk preferences, which affect the rate of return on assets (captured by r_t in equation 1), form another cause of wealth gaps. Decisions concerning asset allocation may differ by gender because of differences in how men and women are socialized (Chang, 2010). It is a widely held belief that women are more risk averse than men, but Nelson (2012) puts together a convincing study which draws this idea into serious doubt. In any case, Neelakantan and Chang (2010) show that an unexplained gender wealth gap persists even once controlling for differences in risk preferences between men and women. Furthermore, having accumulated less wealth due labor market differences and lower educational attainment, women have fewer financial means at their disposal to invest in some more expensive and potentially more lucrative assets, such as stocks, real estate or business assets. Since women own fewer of these high-return assets, they have fewer possibilities to accumulate the same levels of wealth as men.

Empirically, the literature contains unanimous evidence of a gender wealth gap, in which women accumulate less wealth than men. Chang (2010) wrote a book exploring the gender wealth gap, providing an important introduction to and overview of the topic of wealth differences by gender. Chang focuses her analysis on the United States, and uses empirical data from the 2004 Survey of Consumer Finances (SCF) to show that the gender wealth gap is largely attributable to differences in access to the *wealth escalator*.[1] Chang concludes that "a woman's wealth gap would continue to exist even if men and women had the same incomes because women are more likely to have custody of children

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[1]The wealth escalator is defined as a set of "legal, institutional and societal mechanisms that help some convert income into wealth at a much faster pace than is possible by savings alone" (Chang, 2010, p. 38).

and of the expenses that children accrue" (Chang, 2010, p.74). Chang (2010) argues that, based on the theory and empirical findings in the book, a gender wealth gap will continue to exist until social policies, employers, and society erase the economic disadvantages of motherhood.

Many of the empirical studies on the gender wealth gap can be found in a special issue of *Feminist Economics* dedicated to differences in wealth by gender (Strassmann, ed, 2006). A paper by Deere and Doss (2006a) gives a broad overview of studies on the gendered distribution of wealth and summarizes the evidence of a gender asset gap based on historical data from probate records going back to the 19th century. Deere and Doss (2006a) further update this information (using mainly US and UK data), finding a large gender wealth gap which has persisted over time. Other studies included in this issue using more recent survey data are Schmidt and Sevak (2006), Yamokoski and Keister (2006), and Warren (2006). These works look at the wealth holdings of women and men in the United States and the United Kingdom. Schmidt and Sevak (2006) use wealth supplement data from the Panel Study of Income Dynamics (PSID) from 2001 to analyze the differences in household wealth by gender and marital status. They find the largest gap in wealth holdings between married couples and female households, but show that the gender wealth gap almost disappears in a subsample of young households. Yamokoski and Keister (2006) look at the gender wealth gap in the young baby boomer cohort in the USA, using data from the National Longitudinal Survey of Youth (NLSY-79) between 1979 and 2000 and find a large gap between never-married or divorced females and males and married couples, where females have the lowest net wealth. Both single mothers and fathers have lower median wealth than adults without children, yet never-married or divorced single mothers suffer the highest wealth disadvantages (Yamokoski and Keister, 2006, p.189). Warren (2006) analyzes the gender wealth gap in the UK with data from the Family Resources Survey (FRS) of 1996, finding that only 66% of women in the sample owned pension savings while all men did (Warren, 2006, p. 213).

A handful of other studies on the gender wealth gap have emerged in the literature since then. Neelakantan and Chang (2010) analyze the gender wealth gap at retirement using data from the 2006 Health and Retirement Study (HRS) in the United States and find a negative correlation between risk aversion and one's level of wealth. They show that if women had men's risk preferences the gender wage gap would decline, but not disappear. Another study exploring wealth differences by gender at retirement was carried out by Denton and Boos (2007). The authors use a sample of respondents older than 44 from the 1999 Canadian Survey of Financial Security and find that women accumulate a third less wealth on average than men. A recent study by Ruel and Hauser (2013) uses data from the Wisconsin Longitudinal Study on 6,821 high school graduates from 1957 to show that variables on status attainment (such as currently working full-time or part-time, being self-employed or retired) had the most power in explaining gender wealth gaps. However, even controlling for gender differences in status attainment, human-capital, investment strategies, family formation, and family-of-origin influences, a gender wealth gap persists.

The studies discussed so far use survey data on wealth that were collected at the household level. The German Socio-Economic Panel (SOEP) survey, however, collects data and reports on wealth at the individual level. Grabka et al. (2013) analyze the intra-partnership wealth gap using this data from 2007. They find a mean gender wealth gap of €33,000 in their sample of 7,200 cohabiting couples (regardless of marital status). In Sierminska et al. (2010), the same authors find that the gender wealth gap within married couples is about €50,000, which is largely explained by differences in labor market participation of husbands and wives. Comparable studies analyzing the gender wage gap at the person level are missing from other countries, where only household level data are available. Sierminska et al. (2010) and Grabka et al. (2013) present evidence that any gender wealth gap between female and male single households may also exist between men and women within a couple.

In our empirical analysis, in which we can only analyze household level data, we expect to find a greater level of wealth in male households compared to female households, which will diminish as we compare male and female households with a similar number of and ages of children, inheritances, and labor market characteristics, and comparable education, age, and marital status of the respondent. It is unclear how strong the relationship between inheritances and wealth is, and whether men or women will benefit from bequests more. Further, since being older has been associated with higher wealth, we expect female households to benefit from their age structure. However, we expect that some female household characteristics, namely that more female households have children, and that they have lower levels of education and weaker labor market outcomes, will be negatively related to wealth. In the following sections we describe the data and analytical methods we use to test these hypotheses.

3 Data and Methods

3.1 Data

To test for differences in wealth between male and female households data from the 2010 Household Finance and Consumption Survey (HFCS) are employed. The HFCS is a harmonized survey in all euro area countries.[2] Available data of the first wave 2010[3] are used. The net sample size is 62,558. The HFCS data provide multiply imputed values for item non-response, which are taken into account in the estimates reported by using Rubin's Rule.

The HFCS contains detailed information on household net wealth and its components, as well as socioeconomic characteristics of household members, which allow us to include a standard set of controls in tests of the gender wealth gap (Yamokoski and Keister, 2006; Sierminska et al., 2010; Grabka et al., 2013). At the household level, net wealth, earnings,

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[2]Ireland and Estonia did not participate in the first wave of the survey, and Latvia was not yet part of the Eurozone.

[3]For a detailed description of the survey methodology see ECB - European Central Bank (2013).

Table 1: Net wealth by household type (in €)

	Sample size	Mean	1st Decile	Median	9th Decile
Euro area					
Female households	12,582	127,477	176	42,160	328,068
Male households	6,953	150,635	88	38,948	351,793
Couple households	38,474	292,455	4,969	163,795	602,265

Source: own calculations using data from 2010 HFCS.

inheritances, and the sector of businesses owned by the household are of particular interest. At the person level, the reference person's age, gender, education, relationship status, presence of children, and employment status are used.

Like most wealth surveys, the HFCS collects wealth data on the household level. This paper therefore compares three different household types: male households, female households, and couple households, as defined in section 1. In order to keep the population under comparison as uniform as possible, the sample of single households is restricted to households whose reference person is living either alone, with children, or with grandchildren. Similarly, only couple households without other adults present are kept. No households in which other adults are present, such as those with the parent of the reference person in the home, are part of this analysis.

The sample thus contains 54,433 households. Table 1 gives an overview of the distribution of net wealth by household type. On average, couple households own roughly €292,000, male single households hold slightly more than half of that (€151,000), and female single households have less than half of that(€127,000). While the distribution is right-skewed for all household types, this is most pronounced for male single households as evidenced by the mean/median ratio.

Figure 1 shows this information in more detail. While both male and female single households own less net wealth than couple households, the difference between male and female single households only becomes visible to the naked eye in the top percentiles of the respective household types. At the median, there is not much of a gender wealth gap - indeed female households at the middle of the distribution have *more* wealth then male households. On average over the entire distribution, though, male household have 15% more wealth.

Figures 2 and 3 expand the bottom 10 and top 35 percentiles to allow for a closer look at the distribution of net wealth. The richest male households have more wealth than the richest female households, but male household are also more likely to be indebted (have negative wealth - see figure 2).

As we describe in the next section, we compare the wealth of male, female, and couple households with similar characteristics to test for a gender wealth gap. Table 2 shows the average of net wealth for households with each variable, along with the share of households in that household type with that characteristic.
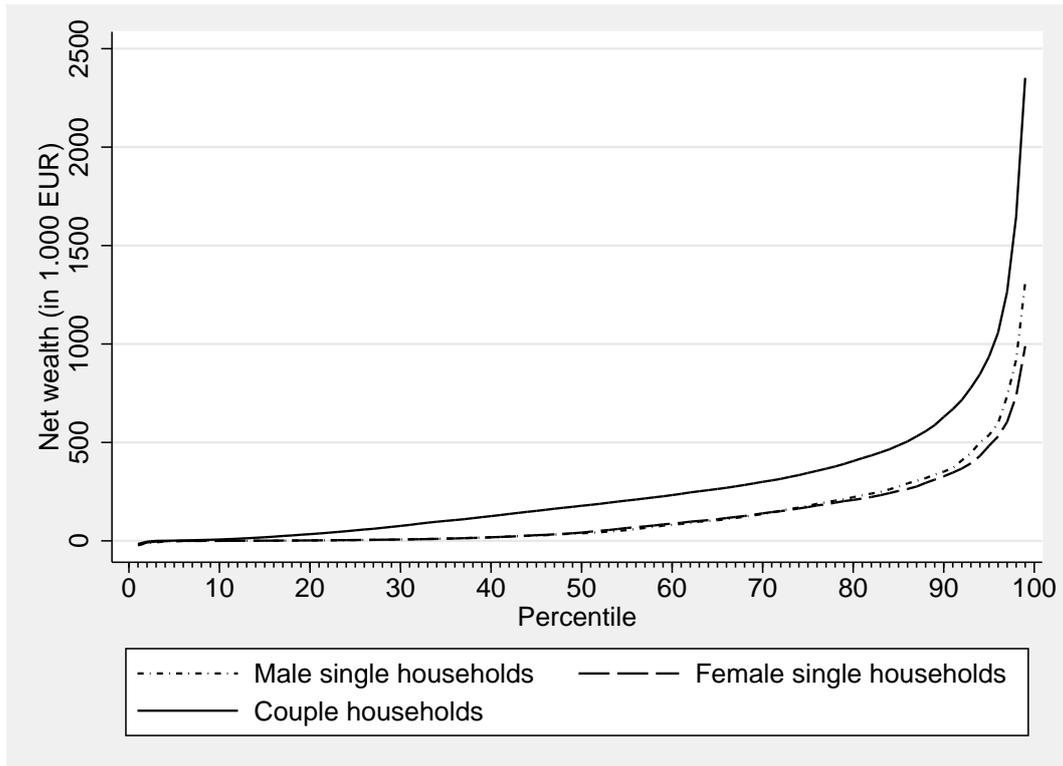
Figure 1: Distribution of net wealth by household type
Source: own calculations using data from 2010 HFCS.

Table 2: Average wealth and proportion of population of variables

	Female	Male	Couple
No kids	129,767	141,476	302,835
	(5,484)	(7,166)	(10,575)
	73%	90%	49%
Kids ≤ 6	57,383	176,244	181,428
	(9,128)	(72,811)	(6,415)
	5%	1%	16%
Kids > 6 and ≤ 16	86,554	215,807	280,687
	(6,338)	(51,966)	(15,385)
	11%	3%	23%
Kids > 16	157,461	288,070	351,084
	(10,365)	(52,399)	(10,732)
	17%	7%	25%
Never married	90,100	105,721	-
	(6,425)	(8,022)	-
	30%	53%	-
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	Female	Male	Couple
Married	119,338	199,264	313,822
	(28,668)	(24,092)	(6,446)
	4%	6%	87%
Legal partnership	-	-	197,307
	-	-	(24,194)
	-	-	2%
Cohabiting	-	-	122,316
	-	-	(8,684)
	-	-	8%
Divorced	111,498	176,634	204,747
	(6,479)	(18,559)	(17,002)
	24%	22%	2%
Widowed	163,567	231,234	154,985
	(6,300)	(13,649)	(29,804)
	43%	20%	0%
Age 16-24	9,551	12,190	27,813
	(5,031)	(2,381)	(9,021)
	4%	6%	2%
Age 25-64	112,515	138,957	282,086
	(4,461)	(9,420)	(7,942)
	52%	69%	76%
Age 65+	156,728	212,012	346,157
	(7,461)	(10,186)	(12,288)
	44%	26%	23%
Lower sec, education	113,833	124,015	202,717
	(3,229)	(7,572)	(3,807)
	44%	27%	33%
Secondary education	115,083	111,883	277,532
	(8,494)	(5,889)	(16,652)
	37%	47%	42%
Tertiary education	184,821	250,875	432,178
	(10,874)	(27,216)	(10,704)
	19%	26%	26%
No inheritance	109,453	118,953	242,636
	(4,280)	(7,297)	(7,919)
	80%	80%	76%

<div align="center">Table 2: continued</div>

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	Female	Male	Couple
Small inheritance	166,022	209,952	342,371
	(10,891)	(16,596)	(11,025)
	16%	16%	18%
Large inheritance	371,507	531,020	753,235
	(31,531)	(75,770)	(56,521)
	3%	4%	6%
Agriculture	520,688	973,679	868,717
	(364,044)	(484,466)	(84,716)
	0%	2%	2%
Employee	92,806	106,202	210,389
	(4,911)	(11,352)	(3,783)
	31%	43%	47%
Work autonomy	204,251	368,274	606,279
	(19,033)	(39,463)	(30,211)
	6%	10%	12%
Unemployed	47,088	60,323	111,367
	(4,999)	(11,452)	(9,448)
	5%	8%	5%
Not in the labor force	146,669	164,207	308,658
	(6.576)	(5.913)	(7.727)
	58%	39%	36%

	Female		Male		Couple	
	Mean	Median	Mean	Median	Mean	Median
Earnings	21,659	17,403	27,848	21,671	47,051	37,313
	(310)	(313)	(682)	(550)	(490)	(388)
Work/age ratio	.42	.45	.49	.54	.5	.53
	(.0037)	(.0075)	(.0044)	(.0049)	(.0024)	(.0023)

Note: Average wealth for household type with given characteristic, with standard errors in brackets and percentage of household type with given characteristic.

Source: own calculations using data from 2010 HFCS.

3.2   Analytical Methods

Three multivariate econometric analyses are performed to identify the gender wealth gap in Europe. First, for comparison with much of the existing literature on the gender wealth gap, Ordinary Least Squares (OLS) regressions predicting the level of household net wealth, controlling for household type and a vector of explanatory variables, are employed. Net wealth W_i for each household i is regressed on a constant, household type dummy variables, and controls X as follows:
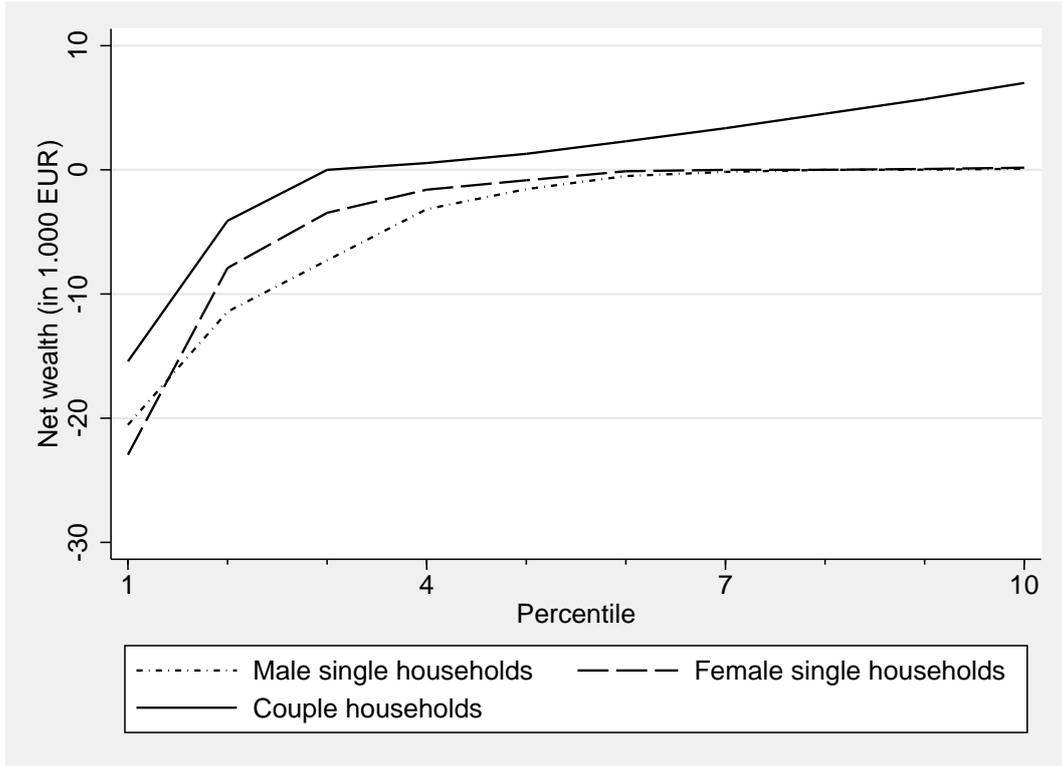
Figure 2: Bottom decile of the distribution of net wealth by household type
Source: own calculations using data from 2010 HFCS.

$$W_i = \beta_0 + \beta_1 Female_i + \beta_2 Male_i + \gamma_{ik} X_{ik} + \delta_{ij} Z_{ij} + \varepsilon_i \tag{2}$$

The main control group of interest is couple households, whose wealth is compared to male and female single households' (abbreviated "male" and "female" in equation 2 above) wealth. Fixed effects δ_{ij} for a household being in country j are included in all models. The k household characteristics in X are put into four main groups: household structure; age and education of the respondent; inheritances; and labor market characteristics of the respondent and household. We add these controls sequentially to test their relationship to the gender wealth gap.

Control set 1, composed of the household structure variables, contains information on the presence of any child(ren) less than or exactly six years old, between the ages of seven and 16, inclusive, or above 16, and whether the respondent is divorced, widowed, never married, in a legal partnership (but not married), or cohabiting without legal recognition of the relationship, via dummy variables. The control groups are having no children in the household and being married. Note that the female and male "single" households used in this study can be in any of the marital status groupings, because the "single" households are identified only by the lack of presence of a partner living in the household, independent of the respondent's marital status.

The second group of controls contains information on the age and education level of the
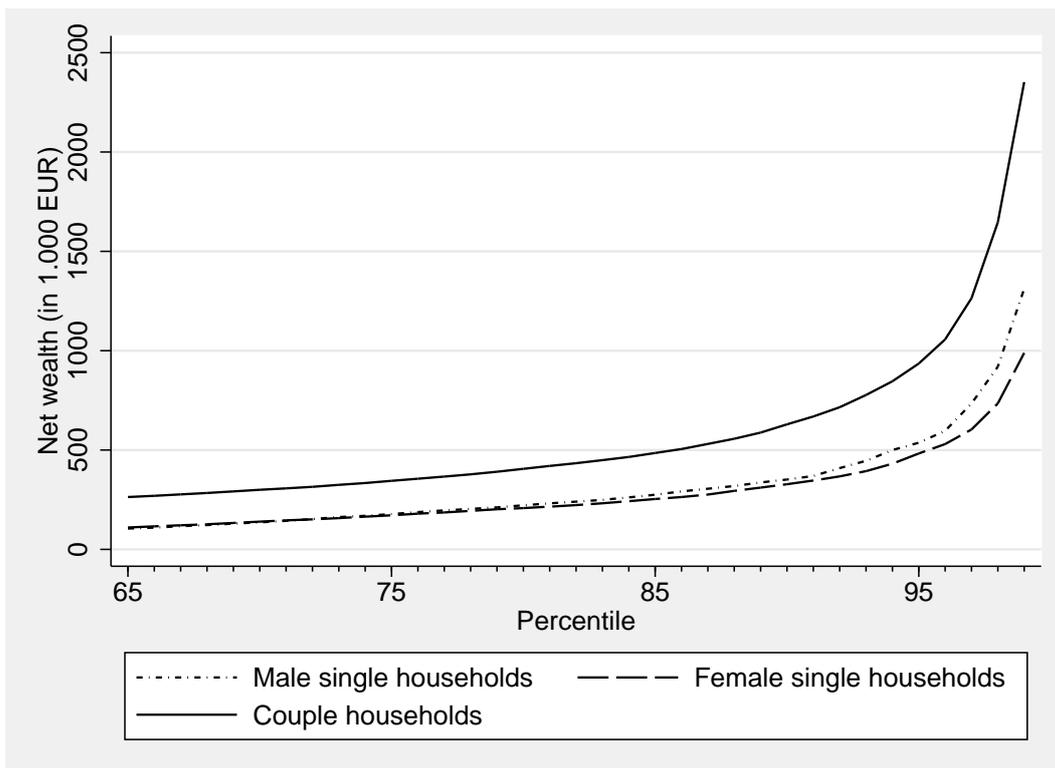
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Figure 3: Top percentiles of the distribution of net wealth by household type
Source: own calculations using data from 2010 HFCS.

respondent. Age is captured in three dummy variables: ages 16-24; 25-64; and 65+, where the middle group is the control. Education is coded by ISCED-97 and is also represented in three categories, where the lowest (only primary or lower secondary schooling completed) is excluded.

A household's inheritances are controlled for in set 3. Inheritances are notoriously under-reported in wealth surveys (Fessler et al., 2012); nonetheless, we use three dummy variables to represent the information we have on inheritances. The first dummy variable indicates if the household received a "large" inheritance, meaning above the median level of wealth for their country, while the second dummy variable signals a household which received some positive inheritance, which was either less than the median level of wealth or whose value was not calculable because of data collection issues.[4] The third dummy variable captures whether the respondent owns an agricultural business, which is considered an inheritance variable because personal farms are generally passed down across generations (Shenk et al., 2010).

Finally, the labor market grouping of control set 4 comprises variables on the working

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[4]The value of all monetary inheritances is transformed into 2010 values using the CPI of the country that the household is in, while the value of all other bequests, most notably main residences, remains at the value that the respondent had reported them having at the time of the gift, regardless of when that was. Inheritances with both money and something else were transformed to 2010 values. The assumption that the nominal value of the non-cash inheritances is fairly accurate is based on the observation that housing prices, shares, and the value of businesses roughly rise with the CPI over the long run (Piketty, 2014). Results are robust to alternative specifications of the value of an inheritance.

life of the respondent. There are dummy variables for the respondent being out of the labor force, unemployed, or having "work autonomy," which, following Sierminska et al. (2010), are those people who report being self-employed and name their job as manager. These groups are compared to employees, who are the excluded control group. Further, the work history of the respondent is captured in a variable measuring the ratio of her/his years of full time work to her/his age, and finally, the total earnings for the household are included. Note that in female and male single households, the earnings will be those of the respondent and anything their children may earn, and in couple households, this variable captures the earnings of both people in the couple and that of their children.

For all individual level characteristics, the value of the reference person applies to the entire household. While less problematic in the case of single households, for couple households this assumption is somewhat arbitrary. Given that our central analysis compares the wealth of male and female households, though, we see this as a reasonable set-up.

The OLS regressor fits a straight line to represent the relationship between wealth and our independent variables. However, wealth data are highly skewed (as shown in Figure 1), and a straight line to fit them would give a bad fit. Thus, the data are often transformed in the literature so that the errors of a function best fitting their values has a normal distribution, mainly via the natural logarithm of wealth (see e.g. Grabka et al., 2013). The natural log, however, is undefined for values less than or equal to zero, and net wealth can be zero or negative when households are indebted. In order to avoid throwing out households with zero or negative values for wealth, we use an inverse hyperbolic sine (IHS) transformation of the wealth data as the dependent variable, represented as

$$arsinh(W_i) = ln(W_i + \sqrt{W_i^2 + 1}). \qquad (3)$$

This transformation allows for the identification of a relationship between wealth and our independent variables, even for negative wealth, which gives a better fit than the OLS model (Burbidge et al., 1988; MacKinnon and Magee, 1990; Pence, 2006). Therefore the following regression equation is estimated to test for gender differences in wealth as a supplement to the OLS model:

$$arsinh(W_i) = \beta_0 + \beta_1 Female_i + \beta_2 Male_i + \gamma_{ik} X_{ik} + \delta_{ij} Z_{ij} + \varepsilon_i. \qquad (4)$$

In the OLS and IHS models, we use the same vector of control variables X.

The OLS and IHS models study differences in wealth at the conditional mean of the wealth distribution. However, studying differences at the mean alone conceals variation which can exist at other points across the wealth distribution. For example, as shown in Table 1, the gender wealth gap is relatively small at the mean of the distribution, but is markedly larger at the bottom and especially the top decile. Thus, the nonparametric DFL decomposition is used to study the effects of various characteristics on the gender wealth gap across the entire distribution of wealth.

The DFL method works by creating a counterfactual distribution of wealth for female

households by replicating the distribution of observable characteristics of male households. In other words, it allows to model the distribution of wealth that would prevail for female households if they had the same (observable) characteristics as male households. This counterfactual distribution is constructed by reweighting the female household observations by

$$\Psi(X) = \frac{dF_{X_M}(X)}{dF_{X_F}(X)} \tag{5}$$

or equivalently,

$$\Psi(X) = \frac{Pr(D_M = 1|X)/Pr(D_M = 1)}{Pr(D_M = 0|X)/Pr(D_M = 0)} \tag{6}$$

which can be computed by estimating a probability model to predict $Pr(D_M = 1 \mid X)$ (the probability of being a male household given the characteristics in X) and using the predicted probabilities to compute a value for $\hat{\Psi}(x)$ for each of the female household observations (Fortin et al., 2010). Once the female observations are weighted using the covariates, any difference left between the wealth of female and male households is unexplained by the observable characteristics included in constructing the counterfactual distribution of women's wealth, and any remaining difference between the actual and the counterfactual female wealth distribution can be understood as the effect of being in a female versus male household on wealth accumulation.

In the DFL techique, the order in which covariates are introduced into the weighting scheme makes a difference to the results produced. First introduced in Fortin et al. (2010) and confirmed in several applications of the technique, this issue arises when creating the reweighting measure $\Psi(X)$ by sequentially adding covariates, e.g. starting with $Pr(D_M = 1|X_1)$, computing $\Psi_1(X_1)$ and the counterfactual wealth distribution for female households based only on X_1, then doing the same with $Pr(D_M = 1 \mid X_1, X_2)$, and so on. This process ignores any relationship between covariates introduced earlier with those which come later, despite the fact that there maybe an economic interpretation for their relationship. For example, estimating the effect of presence of children without controlling for other covariates, such as years of full-time work, might be overstated if people with children have fewer years of full-tme work. The problem of sequentially adding covariates, then, can be understood as an omitted variable problem, because estimates based on the first few covariates leave out the relevance of the covariates which are introduced later (Gelbach, 2009). We find that our results are highly robust to any ordering of the inclusion of the covariates.

In section 2, we discussed our hypotheses on the relationship of these independent variables with wealth. In the next section, we present the results of the OLS, IHS, and DFL models testing these hypotheses.

4   Empirical Results

Table 3 shows the results for the OLS estimation using country fixed effects. On average, both female and male households own less net wealth than couple households across all countries of the euro area if no other variables are controlled for (Model 1). The difference between male and female households is large and statistically significant, as indicated by the p-value of the Wald test at the bottom of the table. Female households hold about €319,000 less wealth than couple households, while male households own about €176,000 less than couple households. That is, given the intercept of around €365,000, female households have on average roughly 75% less net wealth than male households in the descriptive data, once controlling for differences in wealth across countries.

Personal characteristics are added in Model 2 in Table 3, which include the presence of children and the response person's relationship status. Compared to a household with no children whose response person is married, households with any children under 6 years of age own less net wealth, while households with children over 16 years have higher net wealth. Households with a reference person that was never married or that is living in a legal partnership have significantly lower net wealth than married couples. The net wealth of households where the head of household is divorced, however, is only significant at the 10% level. Interestingly, the wealth of households with widowed reference persons on average does not differ from the net wealth of married couples, even though the likely age structure of these households would have suggested so. Adding these characteristics to the model makes the wealth of male households not statistically significantly different from that of couple households. The gender wealth gap between male and female household remains large and highly statistically significant. In other words, even comparing households with the same structure in terms of the presence and age of children and relationship status of the reference person, male households still have more wealth than female households.

In the next step (Model 3 in Table 3) age and education are included. As expected, net wealth rises with increasing age and higher levels of education. Households in which the reference person has at least finished secondary education on average hold roughly €268,000 more than households whose reference person has finished only lower secondary education. In the same comparison, households whose reference person finished tertiary education (college or higher) have about €673,000 more. Throughout our specifications the effect of education remains large and statistically significantly correlated with net wealth. Again, even controlling for differences in education and age, the gender wealth gap remains statistically significant.

Inheritance is statistically significantly correlated with net wealth, as Model 4 in Table 3 shows. Both small and large inheritances, and the ownership of an agricultural business contribute to higher net wealth compared to households who did not receive or own them. The effects for the latter two are large – around €1,363,000 for large inheritances and about €964,000 for agriculture. Small inheritances, unsurprisingly, add less wealth. Again, the

controls introduced in Model 4 cannot explain the wealth difference between female and male households.

Finally, labor market characteristics also show a strong correlation with differences in net wealth (Model 5 in Table 3). In particular, work autonomy (which mostly captures self-employment and higher-ranking employed work), the ratio of full-time work to age, and household earnings, show statistically significant relationships with net wealth. Possessing work autonomy increases wealth by around €372,000. Working full time for a greater share of one's life, as captured by the work-to-age ratio, also has strong explanatory power. This variable might be partially capturing the age effect, and thus might be behind the unexpected higher net wealth of households with young reference persons, as compared to middle-aged ones, in Model 5.

Including labor market characteristics drives the statistical significance of the gender wealth gap comparing male and female households down to the ten percent level (the p-value of the Wald test becomes .09). Once labor market differences are added, male households have *more* net wealth than couple households, and female households do not have any less than coupled households on average. It thus appears that labor market differences between female and male households drive much of the gender wealth gap across household types.

The variables used appear to capture all main aspects of the difference between female and couple households. Male households, however, hold net wealth of roughly €176,000 more than couple households. That is, after taking into account all observable characteristics, female households do not differ in a statistically significantly way from couple households. Male households, on the other hand, do. We thus find an unexplained gender wealth gap, in keeping with much of the literature (Schmidt and Sevak, 2006; Yamokoski and Keister, 2006; Grinstein-Weiss et al., 2008; Sierminska et al., 2010; Grabka et al., 2013; Ruel and Hauser, 2013).

This finding can be interpreted in two ways, which amount to two sides of the same coin: in this analysis, if all covariates are taken into account, the gender wealth gap appears to be a result of either unexplained higher wealth of male households, or of the lower wealth of households including a woman (i.e. female or couple households). The methods employed here, however, do not allow for any causal interpretation of our results. We can only say that, on average and even when comparing male and female household with the same observable characteristics used here, female households have less wealth.

To check the robustness of our OLS analysis in Table 3, we also run a regression on the inverse hyperbolic sine of wealth. The results in Table 4 show that accounting for the non-linearity of the data improves the fit of the model, as expected. The findings of the linear OLS hold qualitatively, and the few unexpected results are reversed. In particular, all unmarried household types have lower wealth compared to married couples, except for widowed reference persons. Young adults have lower net wealth than prime-age reference persons in all models, and households with older reference persons have higher net wealth. Higher education is consistently positively related to effects on net wealth, as is having

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Table 3: OLS Estimates Predicting Household Net Wealth

	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
Female single households	-319,218***	-254,826***	-246,440***	-196,097***	80,542
	(25,413)	(61,660)	(61,327)	(60,766)	(92,355)
Male single households	-176,087***	-86,038	-73,208	-48,896	175,566*
	(32,576)	(64,031)	(63,738)	(63,244)	(95,318)
Kids <= 6		-143,189***	-142,998***	-103,792***	4,885
		(36,011)	(36,368)	(36,109)	(54,495)
Kids > 6 and <= 16		-45,112	-20,636	-14,438	3,205
		(29,156)	(29,991)	(29,626)	(45,079)
Kids > 16		56,040**	117,114***	108,698***	30,786
		(27,136)	(27,487)	(27,226)	(40,409)
Never married		-211,205***	-189,583***	-147,870**	-97,315
		(67,192)	(67,428)	(66,698)	(99,374)
Legal partnership		-321,729***	-318,959***	-240,132**	-206,339
		(109,445)	(109,195)	(109,050)	(130,000)
Cohabiting		-70,753	-54,201	-48,099	26,862
		(81,176)	(80,782)	(79,996)	(122,113)
Divorced		-115,141*	-84,173	-60,835	-62,913
		(61,496)	(61,201)	(60,521)	(92,179)
Widowed		-50,178	-19,283	-15,537	-46,728
		(66,790)	(67,830)	(66,938)	(100,714)
Age 16-24			15,246	39,842	270,906**
			(69,049)	(68,535)	(133,378)
Age 65+			242,683***	231,121***	345,276***
			(28,037)	(27,919)	(58,141)
Secondary education			267,704***	221,236***	174,590***
			(27,157)	(26,921)	(42,176)
Tertiary education			673,238***	554,296***	305,461***
			(31,058)	(30,212)	(49,483)
Large inheritance				1,363,299***	956,295***
				(58,524)	(69,142)
Small inheritance				161,396***	92,475**
				(30,610)	(38,412)
Agriculture				964,205***	872,048***
				(91,900)	(120,259)
Household earnings					9***
					(0)
FT work/age ratio					422,347***
					(102,767)
Work autonomy					371,601***
					(55,345)
Not in the labor force					58,571
					(55,473)
Unemployed					117,807
					(73,182)
Constant	365,140***	422,799***	62,017	-56,343	-786,970***
	(65,484)	(67,382)	(71,751)	(69,604)	(116,742)
Wald	0.00	0.00	0.00	0.00	0.09

Notes: Country fixed effects included in the models not shown.

received an inheritance. The labor market variables show the expected signs: only having an unemployed reference person is associated with lower net wealth relative to employees. Finally, the IHS results suggest that there is no statistically significant difference between male and female households in our data once all covariates, and in particular labor market effects, are accounted for.

The results of the DFL analysis are presented in Figure 4 on page 20. The solid blue line in the first panel shows the raw wealth gap between male and female households, across the entire wealth distribution. Aside from a small bump into negative territory for the least wealthy households, where male households appear to have more debt than female households, there is hardly any or no gender wealth gap for households in the lower half of the distribution. From about percentiles 50 to 70, female households have a bit more wealth than male households. After that point, male households have increasingly more wealth than female households. The wealthiest male households have more than the wealthiest female households, and this gap grows for each wealth percentile in the distribution. Indeed for the top one or two percent of households, male households have more than €3m in net wealth more than female households.

The re-weighting applied in the DFL technique makes it possible to ask what the gender wealth gap would be if female households had the same distribution of observable characteristics as male households. These characteristics are introduced in steps, as in the OLS analysis above. In panel A of Figure 4, the weighting is based on household characteristics, namely the probability of having children in the household and of being divorced or widowed. The new distribution is the dotted red line.

Compared to the raw gap, by controlling for these household characteristics the wealth gap for the richest households is reduced somewhat. That is, if female households had the same household characteristics as male households, there would be less of a wealth gap for the richest households. However, along the distribution around the percentiles 30 to 90 (most of the population), a larger wealth gap emerges, wherein male households have more wealth than female households. Thus even if female households had the same rates of parenthood, divorce, widowhood, etc. as men, they would be less wealthy. This finding may be surprising, since women were expected to be less wealthy in part because of their expenses of having children in the household. A potential explanation is that a very large share (almost 75%) of female households have a widowed reference person, and they may have received their partner's wealth upon their death. Thus if these women had the same (lower) rate of widowhood as men, they would have less wealth.

Panel B shows the distribution of wealth female households would have if they had the same household characteristics, age, and education as male households, compared to the case that they had just the characteristics in control set 1. Here the gender wealth gap declines a bit across the distribution - these characteristics are positively correlated with wealth for male households. In panel C, controls for inheritances are added. Again the gender wealth gap is reduced compared to the case of using control sets 1 and 2, but even adding inheritances cannot explain the gender wealth gap. Indeed controlling for

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Table 4: OLS Estimates Predicting IHS Transformation of Household Net Wealth

	(1)	(2)	(3)	(4)	(5)
	Model 1	Model 2	Model 3	Model 4	Model 5
Female single households	-1.76***	-1.75***	-1.72***	-1.60***	-1.25***
	(0.05)	(0.11)	(0.11)	(0.11)	(0.13)
Male single households	-1.71***	-1.38***	-1.34***	-1.28***	-1.14***
	(0.06)	(0.12)	(0.12)	(0.12)	(0.14)
Kids <= 6		-1.35***	-1.27***	-1.17***	-0.52***
		(0.07)	(0.07)	(0.07)	(0.09)
Kids > 6 and <= 16		-0.26***	-0.18***	-0.15***	-0.07
		(0.05)	(0.05)	(0.05)	(0.06)
Kids > 16		0.09*	0.30***	0.29***	0.19***
		(0.05)	(0.05)	(0.05)	(0.06)
Never married		-1.51***	-1.04***	-0.96***	-0.49***
		(0.12)	(0.12)	(0.12)	(0.14)
Legal partnership		-1.47***	-1.20***	-1.01***	-0.73***
		(0.20)	(0.20)	(0.20)	(0.19)
Cohabiting		-1.27***	-1.22***	-1.19***	-0.91***
		(0.15)	(0.15)	(0.15)	(0.17)
Divorced		-0.85***	-0.76***	-0.71***	-0.50***
		(0.11)	(0.11)	(0.11)	(0.13)
Widowed		0.51***	0.47***	0.47***	0.62***
		(0.12)	(0.12)	(0.12)	(0.14)
Age 16-24			-2.99***	-2.92***	-1.24***
			(0.13)	(0.13)	(0.19)
Age 65+			0.97***	0.93***	0.58***
			(0.05)	(0.05)	(0.07)
Secondary education			0.84***	0.75***	0.81***
			(0.05)	(0.05)	(0.06)
Tertiary education			1.84***	1.62***	1.60***
			(0.05)	(0.05)	(0.07)
Large inheritance				2.17***	1.95***
				(0.09)	(0.08)
Small inheritance				1.08***	1.01***
				(0.05)	(0.05)
Agriculture				1.77***	1.07***
				(0.14)	(0.14)
Household earnings					0.00***
					(0.00)
FT work/age ratio					2.58***
					(0.15)
Work autonomy					1.06***
					(0.07)
Not in the labor force					0.50***
					(0.08)
Unemployed					-1.37***
					(0.11)
Constant	11.42***	11.99***	10.87***	10.54***	8.52***
	(0.18)	(0.18)	(0.19)	(0.19)	(0.22)
Wald	0.54	0.00	0.00	0.00	0.17

Notes: Country fixed effects included in the models not shown.

inheritances does not change much, suggesting that inheritances do not differ very much by gender (especially once controlling for age).

Finally, panel D adds controls for labor market characteristics, and thus shows the counterfactual wealth distribution of female households if they also had the same distribution of all observable characteristics in the study.[5] The results clearly suggest that differences in the labor market drive much of the gender wealth gap. Along much of the distribution, women would have a very large wealth premium if they had the same characteristics as men. These findings are consistent with the literature on the wealth gap (Sierminska et al., 2010), in particular with regard to the large explanatory effect of labor market characteristics.

Figure 4: Wealth in female households, if they had the same distribution of characteristics (sets 2-5) as male households
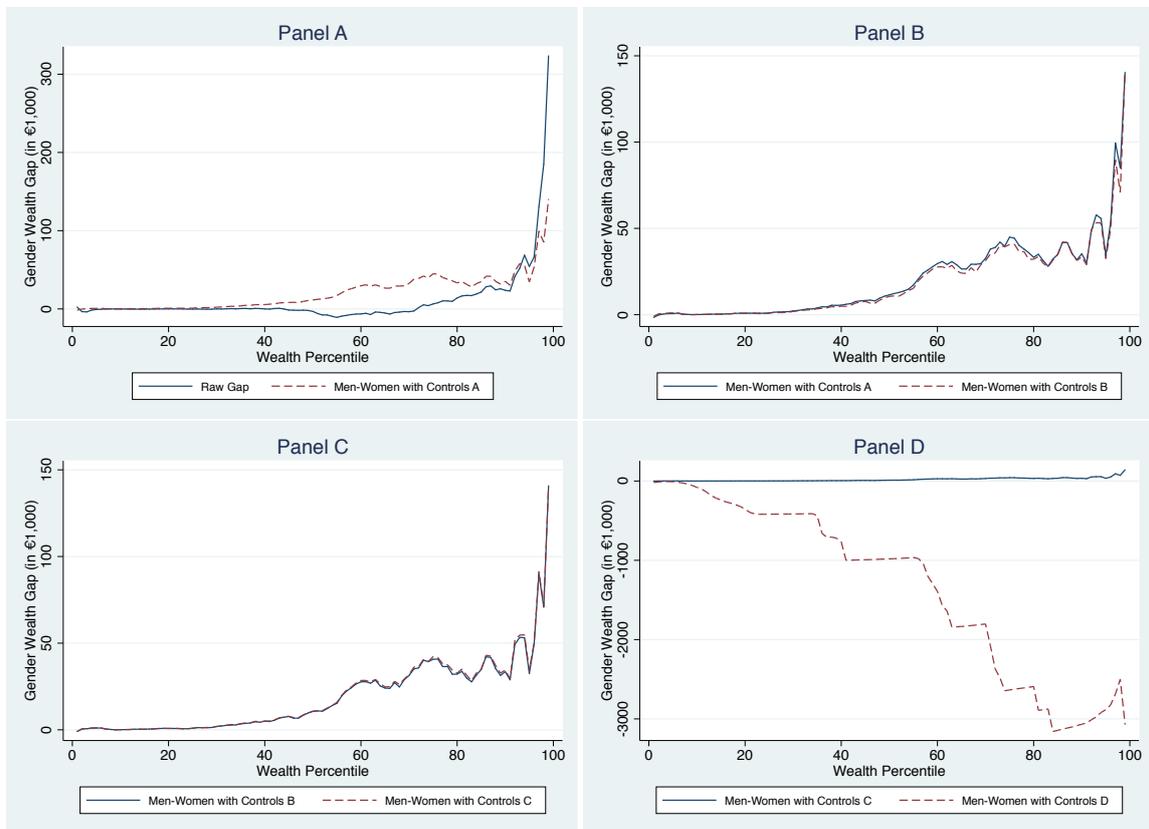
5   Discussion and Conclusions

It is well-documented that wealth is unevenly distributed in society, but there is a large gap in the literature concerning gender differences in wealth. This study used 2010 Household Finance and Consumption Survey data to test for differences in the net wealth

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[5]The dummy variable for owning an agricultural business had to be excluded from the DFL model, because the final logit regression did not converge with it in. This is likely due to the very small percentage of households, and especially female households, owning an agricultural business.

of households headed by female versus male response persons. We find that overall, male households hold 15% more wealth than female households. Using OLS regressions predicting net wealth and the IHS transformation of net wealth, along with a DFL re-weighting procedure, we find that the gender wealth gap cannot be explained by differences in household characteristics, the age and education of the respondent, or in inheritances across household types. Instead, it is labor market characteristics which primarily explain the lower levels of wealth found in female households.

This study is the first to test for the presence and extent of a gender wealth gap in Europe. The finding that such a gap exists, but that it would be eliminated if female households had the same characteristics as male households – particularly in labor force participation and in earnings – is striking and important. It may also offer direction for achieving parity in wealth outcomes by gender: if policy can promote labor market equality for men and women, we can take large steps towards reducing gender-based disparity in wealth outcomes. In particular, universally accessible high-quality child care for children of all ages could help reduce these gender gaps in the labor market. Offering child care would allow mothers, who are still generally considered the ones responsible for being primary care-takers, to stay active in the labor market. As more mothers stay at work and fathers bear more responsibility for caring for dependants, prejudices and expectations about women's lower committment to work would disintegrate, lessening discrimination against them and subsequently raising their pay.

However, some important caveats are in order. There were limitations in the construction and implementation of this study, and we therefore must be careful in the interpretation of our results. To locate a gender wealth gap, we could only compare wealth in male and female *single* households, meaning those who have male and female survey respondents who were living without a partner present. Thus we are missing any information on a gender gap which may exist within couples and households. There may also be a selection bias in which men and women head these single households. The gender wealth gap we observe may be due to the mechanisms which make these households single. If wealthy men and poor women face some selection processes into living without a partner, then we are capturing a story of how households are constructed differently by gender, not one of wealth gaps based on gender differences in wealth accumulation as such. However, we think that it is reasonable to see the story the other way around: people randomly choose how to construct their households and with whom they want to live, and then wealth is accumulated dependent on these choices, not the things which went into household formation processes.

The work presented here has answered some important questions about a gender wealth gap in Europe, but opened the door to ask several others, which future research should address. First, how does the gender wealth gap differ across countries, and how might that be related to policy differences internationally? Second, how has the gender wealth gap developed over time? To the extent that it depends on labor market differences for men and women, as this study suggests, the gender wealth gap is probably at its lowest

point ever. Research to observe the gender wealth gap over time would be able to test the robustness of our finding that the labor market drives the gender wealth gap, but the ability to conduct such research depends on the availability of data to analyze these questions. In this sense, we welcome and encourage the production of more and better data on wealth. In particular, we would benefit from knowing wealth on an individual – not just household – level, as in the German Socio-Economic Panel (see e.g. Wagner et al., 2007). Time series data collecting information on wealth for particular households over a period of time would also be tremendously helpful in understanding the wealth accumulation process. Just as studying pay gaps by gender tells us a great deal about the structure of our society and economy, greater understanding of wealth gaps by gender will illuminate the ways that gender influences economic outcomes.

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