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Underpopulation, an impending economic crisis.

Is home office correlated to realized fertility?
A case study of Australia's demographic

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Abstract

This study aims to investigate the correlation between working from home and realized fertility and whether there are any differences between women and men. Existing literature highlights the fact that home office is an effective tool for parents to balance their work and family life, especially for working mothers, as they are more negatively affected by having a child compared to men. Using HILDA, an Australian household-panel study, data sets for the years 2019, 2015 and 2011 were constructed, and a probit model was used to run a regression. The results show that for an Australian woman, aged 18-45, home office is statistically significantly correlated to realized fertility for the 2019 data set and is robust over the 2015 and 2011 data sets, and the probability of having had a child increases when worked from home. However, for a man, only the 2019 data set shows a statistically significant correlation and a decrease in having had a child when worked from home. These results were found while controlling for internet access, education level, marital status, employment, household income and age. Although this study can only claim correlation and not causality, it hopes to provide evidence to the fact that home office is possibly an effective mechanism to elevate the low fertility rates observed in many countries today, at least for women.

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1. Introduction

Contrary to popular belief, *underpopulation*, poses a much greater challenge to our world currently compared to its more known antonym: *overpopulation* (Coleman & Rowthorn, 2011). Underpopulation, also called population decline, is largely due to the ever-decreasing total fertility rates (TFR). In the past 50 years, due to an increase in accessible contraception, women's education and participation in the workforce and a decrease in child mortality, the global fertility rate has halved, with it currently being at 2.4 children per woman (Roser, 2017; Central Intelligence Agency [CIA], 2022). This is still over the needed replacement rate of 2.1, which is the rate which sustains the population size of a society; however, lesser developed and low-income countries are the main reason for the global TFR being as high as it is (Population Reference Bureau, 2021). For example, according to the Population Reference Bureau (2021) the fertility rate for adolescent girls (aged 15-19) is particularly high in low-income countries with 94 births per 1000 adolescent girls, compared to middle- and high-income countries which have a rate of 36 and 14 births per 1000 adolescent girls, respectively. Thus, there is a disproportional distribution within the countries and continents in terms of total fertility rates (*Fig. 1*). Only 93 out of 227 countries have a TFR over 2.1 with 134 being below said rate (CIA, 2022). Low birth rates are of concern as they inevitably lead to negative long-term effects on the economy, due to failing societal safety nets and a deterioration in tax and industrial based competitiveness (Sleebos, 2003). For instance, in many East Asian countries, the fast-dropping fertility rates are leading to a net population decline that has begun 10 year earlier than expected, restraining long-term growth prospects in these countries (Murayama, 2021). Thus, the hope for these East Asian countries in addition to many European countries, the US, Canada and Australia to achieve a 'demographic dividend' will not be possible as an economic stagnation

or decline will occur as the population starts to age. A demographic dividend is when the working-age population grows larger than the dependent population (Hopkins, 2022).

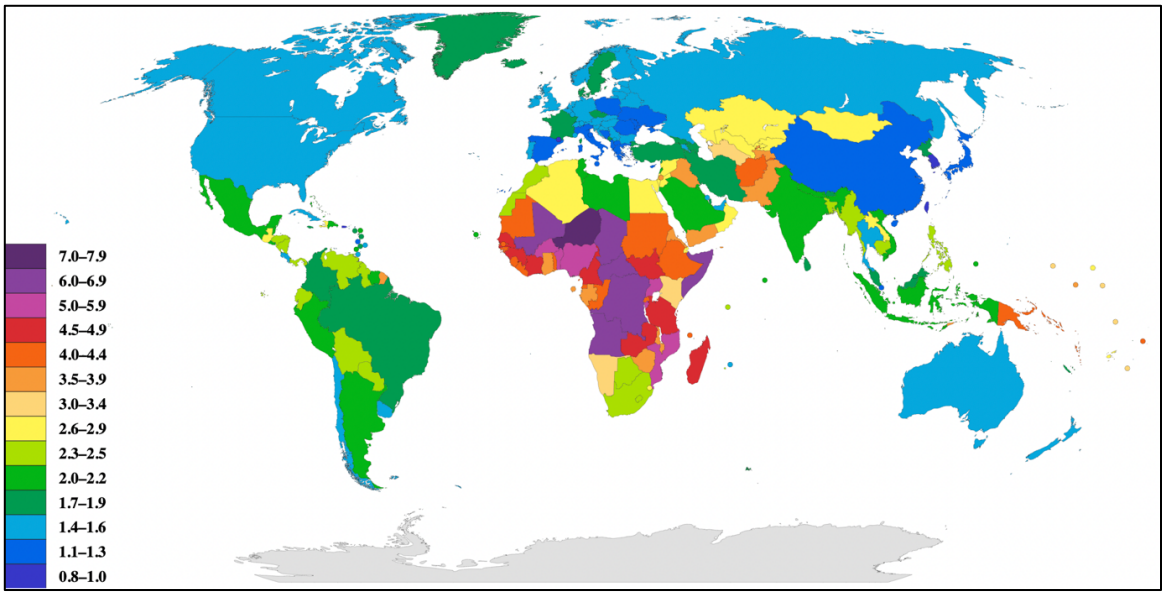

Figure 1 Global Total Fertility Rate Map. Data retrieved from: Population Reference Bureau's 2020 World Population Data Sheet

The research into how technology will mend this crisis has just begun. Greenwood et al. (2005) coined the term 'engines of liberation', which describes advances in household technology (e.g., internet access) that allows both parents to participate in the labor market while decreasing the constraint of fertility choices and the burden of housework. This nowadays can be summarized as having the option of working from home, i.e., home office, which in most circumstances requires internet access. As low fertility rates are an effect of female empowerment, the opportunities for women and also men to combine their family responsibilities and work are central to preventing the continuous decline of total fertility rates (Roser, 2017; Goldscheider et al., 2015; Balbo et al., 2012). Accordingly, the research question of this study is as follows:

How does the use of home office correlate to realized fertility? In particular, are there differences between women and men?

The exploration of the proposed research question was done through a probit regression with data provided by the *Household, Income and Labour Dynamics in Australia* (HILDA) survey. HILDA, established in 2001, is an Australian nationally representative household-based panel study that collects information on labor market and family dynamics and economic and subjective well-being (Melbourne Institute, 2021). The contribution that this study will provide to the existing literature is twofold. On the one hand, it will provide a template on how to conduct a study concerning home office and its correlation to realized fertility, which can be used in future studies to examine how the mandatory home office regulation during the Coronavirus pandemic is correlated to fertility. On the other hand, due to data availability, most of the studies that have been produced on this or similar subjects focus on the US, Germany or Britain. In contrast, this paper will analyze Australia, which has a fertility rate of 1.7, well below the replacement rate (CIA, 2022). As Wright (2021) states, in terms of Australia, the pandemic will forever weigh on the nation's population profile, and it is to be expected that this is the same for other countries as well. Using data sets for the years 2019, 2015 and 2011, a probit model was created to analyze if the probability of having had a child increases or decreases with an Australian individual, aged 18-45, using home office or not. The results indicate that the probability of an Australian woman having had a child increases significantly in 2019 and these findings are robust over the years 2015 and 2011. Whereas for Australian men, it was found that there is a decreased probability of having had a child when working from home, and the correlation between their realized fertility and the use of home office is only statistically significant in 2019. Note that this study is merely looking at the correlation between the assessed variables and not claiming causality.

The remainder of this paper will be structured as follows. Firstly, a literature review and corresponding main hypotheses will be presented, summarized by an empirical model which

visualizes the theorized relationship between the variables. Secondly, the data and the construction of the sample sets are detailed. Thirdly, the empirical method of the probit model is explained, followed by the results and robustness checks of the probit regression, split between women and men. Fourthly, the results' interpretations and implications are discussed and linked to the greater context of the researched variables. Lastly, conclusions are drawn among the limitations of this study and subsequent suggestions for future research.

2. Literature Review

From the existing literature, it becomes apparent that the motivation for women and men to have children is different mainly due to the persisting gender roles that one can find within cultures and that women's fertility is restricted by age. Thus, within the study, the genders will mainly be discussed separately. The following sections will review the existing literature on the main influential factors on realized fertility and draw hypotheses on what type of correlations are to be expected.

2.1 Home Office

Over the past few decades, the nature of family and work has changed dramatically due to the world shifting more and more from industrial-based national economies to information-based global economies (Hill et al., 2003). With this, telecommunications, which is the exchange of information by electronic means over distance, has become cheaper while becoming more functional and powerful, creating alternatives to how and where to work. Moreover, the workforce has evolved to include more dual-earner and dual-professional couples, yet this has enhanced the struggle for both men and women to balance their home and workplace demands

(Hill et al., 2003). This has led to the introduction of home office, also called telework, to allow parents, especially mothers, to balance work and family life. Having a higher perception of control over work has been found to significantly influence the intention of becoming a parent, which can be achieved through the use of home office if such is desired (Begall & Mills, 2011). Giovanis (2015) examined the relationship between gender roles and teleworking by accessing data from the British Household Panel Survey. They found that both women and men who are teleworkers spend more time on housework, including childcare, and the probability of the responsibility of said housework being shared equally between the couple is higher than with nonteleworkers. This notion is supported by Ciminelli and Schwellnus (2021) and their pre-pandemic analysis of 25 European countries. They found that the use of home office allows for more flexible work schedules allowing working mothers and fathers to spend more time on childcare, mainly due to the reduced time it takes to commute to and from work. In addition, they state that by being able to work from home, parents do not feel the need to switch to part-time jobs. With this study, there is an indicator that even before the pandemic, a motivator for parents to work from home was correlated to taking care of their children. This leads to this study's two hypotheses:

H1: The use of home office correlates with a woman's realized fertility, while controlling for education level, marital status, employment status, household income, and age.

H2: The use of home office correlates with a man's realized fertility, while controlling for education level, marital status, employment status, household income, and age.

2.2 Internet Access

With the introduction of high-speed internet, the digital revolution has become increasingly disruptive. Once the internet became a retail good, in the late 90s, it became abundantly clear that economic and social interactions would fundamentally change for good. Especially the effect on family dynamics has been captured by various scholars over the years. For instance, studies have found that the way we interact and communicate online with one another has changed the way relationships, platonic or romantic, are formed and maintained (Gennaro and Dutton, 2007; Berger, 2013; Bellou, 2014). Eynon and Helsper (2011) found that having children in the household is related to how adults engage with the internet, and Wajcman (as cited in Huijer, 2018) discovered that the internet fosters new work and family lifestyle patterns. This is supported by Tincher's (2015) findings which state that the internet has 'blurred the boundaries' between home life and work, which has varying effects on the relationships between family members. From their sample, they found that the internet led to both an increase in contact between family members in certain families and a decrease in others, as the family member is obligated to be 'on-call' all of the time, which limits the chance for members to bond. Through technological advancements, access to information and contraception has become more accessible which has had varying effects on female labor force participation and fertility decisions (Adhikari, 2010; Purdy, 2017). As an example, Guldi and Herbst (2015) found that the internet has a negative effect on teenage pregnancy rates in the US, and Billari et al. (2019) found that in Germany, access to DSL internet increases the fertility of highly educated women aged 25-45. However, on the contrary, recent research conducted by Lui et al. (2021) found, through a cross-sectional secondary data analysis of Chinese women of childbearing age, that the more frequented use of the internet, the lower their fertility intentions were. They concluded that through regular exposure to the internet, women became less likely to agree to the Chinese traditional gender roles of the man being the sole financial provider and

the woman being exclusive the housemaker of the family. As the literature makes evident, it is of note that an individual having internet access is most likely not driven by their fertility desire, essentially making it a noisy variable. Further, nowadays, to be able to work from home, an individual would most definitely need access to the internet. Therefore, internet access will be controlled for in this study.

2.3 Education

It has been found that there is a negative correlation between levels of education and fertility rates (Kim, 2016). Using the 2016 Australian Population Census, Gray and Evans (2019) found that although tertiary education is becoming more common in Australia, fertility within these tertiary educational groups remains lower compared to other education groups (i.e., secondary school and below). Gray and Evans' conclusion supports the long-standing findings of higher educated women and them having fewer children on average; this correlation, however, does not apply to men. Miettinen et al. (2015) conducted an overview of the fertility trends in Europe and found that less-educated men are less likely to have a child compared to higher-educated men. They conclude that this mainly has to do with the fact that men can still have children in their later stages of life, meaning that education merely postpones their fertility desires. Nevertheless, higher post-school qualifications for both genders generally lead to higher income levels, consequently leading to higher opportunity costs for each additional child. This reduced the desire to want more children, although the opportunity costs are higher for women compared to men (Bradbury, 2005; Kim, 2016; Kountouris, 2020).

2.4 Income

The negative correlation between fertility and income is supported on a country and on an individual level (Vandenbroucke, 2016). This means that the higher the household income, the

lower the number of children (Price, 2013). It can be assumed that parents with a higher income value 'quality over quantity', which means a higher economical investment into each child, thus constituting to the aforementioned higher opportunity costs per child. (Balbo et al. 2012). Furthermore, women are more economically burdened compared to men when they have a child, and with each additional child, that a woman has, increases the amount that she would have to pay for childcare during the time she works away from home, while her income stays the same (Mishra & Smyth, 2010). This could indicate that a woman's motivation to work from home is potentially stronger than for a man.

Drawing back to the correlation of home office on fertility, it is of note to include income and education in the literature review as, according to a McKinsey Study (Lund et al., 2020) the main users of home office are those individuals that are highly educated and well paid. This is based on a model that analyzed more than 2,000 activities in over 800 occupations in 9 countries worldwide. Thus, it is of essence to control for these factors in this study. To the author's best understanding, there are no other studies yet available that look at this specific correlation between the proposed factors with a model that can be easily transferable to other countries' demographic data, if this type of correlation is wished to be examined in other low-fertility rate countries.

2.5 Empirical Model

To summarize the literature, a visualization of the relationships of the factors on realized fertility has been created. This model is not claiming causation, only correlation. Realized fertility is the term used to describe actualized fertility desire, which means a child has been

had. The '+' in the figure signifies that the hypothesis hypothesizes that there will be a correlation between the two variables of interest (*Fig. 2).*

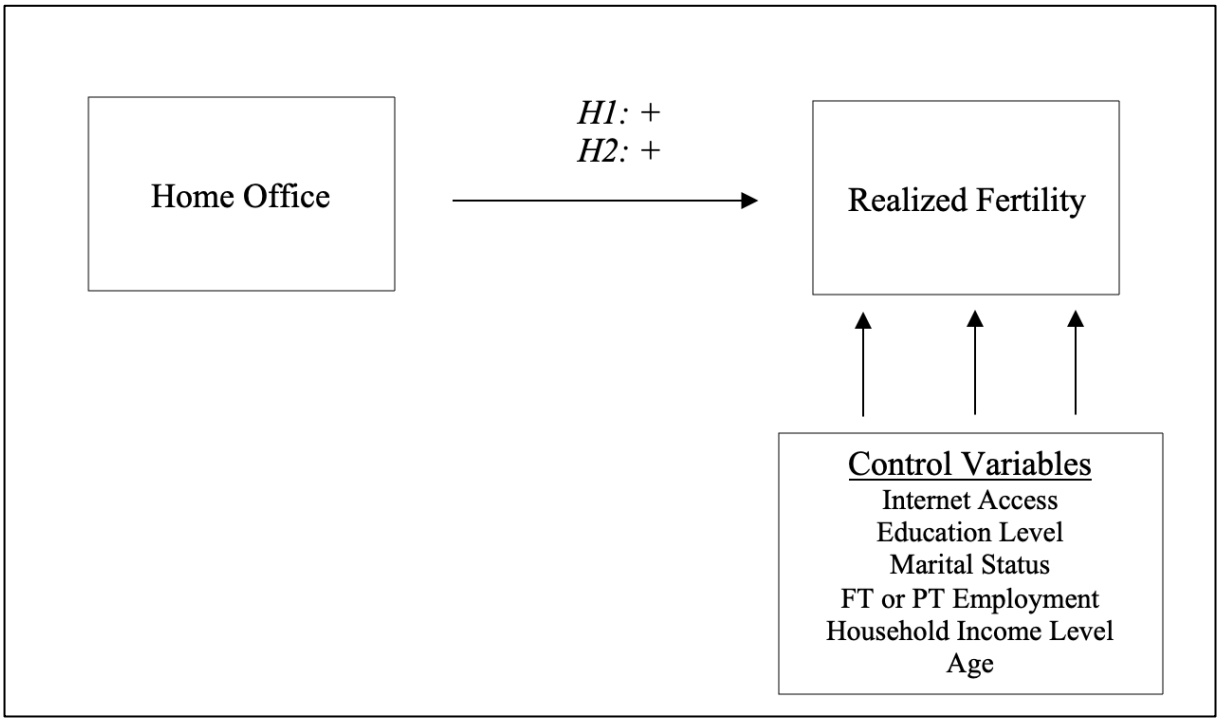

Figure 2 Empirical Model. Author's own creation.

3. Data

The data that this study uses comes from HILDA, the *Household, Income and Labour Dynamics in Australia* Survey, which is a household-based panel study that started in 2001 and follows the lives of over 17,000 Australians each year. The data for the survey is collected annually through interviews. HILDA is unique as it is the only study in Australia that collects extensive information about the labor market dynamics, family life and economic and personal well-being. Funded by the Australian Government and maintained by the Melbourne Institute, this survey provides an insight into the Australian population and has helped policymakers obtain information about areas including social services, education and health (Melbourne Institute,

2021). The following will describe how the HILDA data was used to construct the variables used within the study. By running a variance inflation factor, no multicollinearity was found between the chosen variables. Nonetheless, there is an endogeneity issue between the variables; however, this study is not claiming causality and is only interested in the statistical correlation between the dependent variable and the other variables selected.

3.1 Dependent Variable

The dependent variable in this study is 'realized fertility'. As explained in Section 2.4, realized fertility is the expression used to describe an individual's actualized fertility desire. The indicator variable takes on the value '1' when an individual has indicated in the survey that they have ever had a child. If the individual has never had a child, the variable's value is '0'. For example, if an individual has had their first child in 2012, their realized fertility will be 0 in 2011 and 1 in 2015 and 2019.

3.2 Independent Variable

The independent variable in this study is 'home office'. The indicator variable takes on the value '1' when the individual indicates in the survey that their usual working hours are worked at home, and the value '0' if the individual does not work at home. For this variable, the value can change regardless of if the value was 0 or 1 in the previous years.

3.3 Control Variables

The control variables are as follows: internet access, education level, marital status, employment status, household income level and age. These factors are controlled for as they are deemed to influence realized fertility the most.

Internet Access

Internet access is classified as a control variable as it is not the main variable of interest, yet it is suspected that the access to the internet effects the proposed independent variable (home office). The dummy variable will take the value of '1' if the individual has indicated that they have internet at home, if not, the value is '0'.

Education Level

In this study, an individual's education level is the highest education level that they have achieved in that survey year. Education level was constructed by using seven binary variables that indicate whether the individual has completed one of the following academic distinctions, taking on the value '1' only in the variable column that corresponds to the individual's highest attained education levels and '0' otherwise. It should be noted that some academic distinctions are grouped, which are as follows: (i) Postgrad (either a master's or a doctorate degree), (ii) Grad Diploma or Grad Certificate, (iii) Bachelor or Honors Degree, (iv) Advanced Diploma or Diploma, (v) Certificate III or IV, (vi) Year 12 or (vii) Year 11 and below. These are listed in the order from the longest to the shortest time needed to complete, and in *Appendix A.1,* an overview of the Australian educational system can be found. The education level 'Year 11 and below' is kept as the reference category to estimate the relative effects of the other dummy variables.

Marital Status

An individual's marital status is similarly constructed to the educational level. Four binary variables are used to indicate whether an individual is: (i) Separated, (ii) Married, (iii) De facto, or (iv) Single. The dummy variable only takes on the value '1' in the variable column that corresponds to the individual's marital status in that survey year, '0' otherwise. The marital

status ‘Single’ is kept as the reference category to estimate the relative effects of the other dummy variables. A priori, marital status is controlled for as separated or married couples are more likely to have had realized their fertility desires compared to de facto couples or singles. In terms of the HILDA survey, an individual has to have been married to be classified as separated, and the term ‘de facto’ describes an unmarried couple that lives together.

Employment Status

The main variable is home office therefore an individual is only able to work from home if they are employed in either part-time work (works less than 35 hours per week) or full-time (works over 35 hours per week). Thus, only individuals are included in the data set that have either indicated that they work part- or full-time, with the dummy variable taking the value of ‘1’ when the individual works full-time and ‘0’ if the individual works part-time.

Household Income Level

The household income level indicates an individual’s household financial year’s disposable regular income in AUD. The household income was transformed by using the natural log as to descale the large numbers, normalize them and make the data easier to handle. As income is a continuous data set, it was kept as such.

Age

The last control variable is age, which is also a continuous variable. For each of the three sample years, only those individuals were included in the respective data sets that are aged 18 to 45 years old on June 30th of the respective survey years. This is because this is considered the age range in which most of the population has children, in addition to women’s fertility exponentially declining after the age of 30. (Holland, 2018; Australian Bureau of Statistics,

2020). It should be noted that as the same age range of 18-45 is used within all three sample years, there is a slight variation in total observations between the years. As there are different numbers of individuals in each cohort, those that enter the age range and those that leave the age range will cause the total number to fluctuate.

3.4 Sample

To test the two hypotheses, the following samples were constructed. HILDA only provided the data used for the dependent variable every four years; thus, the three most recent years in which the data was available were considered for this study: 2019, 2015 and 2011. The survey, which as mentioned, is in the form of an interview, is held between August until February of the following year. To illustrate, for the 2011 data, the information was collected from August 2011 until February 2012. As already stated, the data set has been restricted to only include those individuals between the ages of 18-45 and those that have indicated that they are working either part-time or full-time. In addition, the sample was further restricted to exclude those individuals who indicated their marital status as either widowed or divorced as there weren't enough observations to assess. Finally, the data was further constrained to observations with non-missing data on realized fertility, home office and the other control variables. Following the literature, the data is split between the genders; thus, after these restrictions the sample size for 2011 is 2305 female and 2430 male observations. For 2015 there are 3090 female and 3129 male observations, and lastly, for 2019, there are 3214 female and 3139 male observations (*Table 1*). *Tables 2 - 5* provide the descriptive statistics on the main variables used in the analysis for each of the years and genders.

Table 1 Number of Observations, 2019, 2015 and 2011

Year	**2019**		**2015**		**2011**	
Gender	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*
N	3214	3139	3090	3129	2305	2430

Women's Descriptive Statistics

Table 2 Women's Categorical Data, 2019, 2015 and 2011

	N			Percent		
Year	**'19**	**'15**	**'11**	**'19**	**'15**	**'11**
Dependent Variables						
Realized Fertility						
No	1641	1632	1273	51.1%	52.8%	55.2%
Yes	1573	1458	1032	48.9%	47.2%	44.8%
Independent Variables						
Home Office						
No	2468	2442	1858	76.8%	79.0%	80.6%
Yes	746	648	447	23.2%	21.0%	19.4%
Control Variables						
Internet Access						
No	34	71	101	1.1%	2.3%	4.4%
Yes	3180	3019	2204	98.9%	97.7%	95.6%
Education Status						
Postgrad	308	233	100	9.6%	7.5%	4.3%
Grad Diploma or Certificate	213	213	240	6.6%	6.9%	6.1%
Bachelor or Honors	834	771	535	25.9%	25.0%	23.2%
Adv. Diploma or Diploma	354	328	212	11.0%	10.6%	9.2%
Certificate III or IV	623	615	419	19.4%	19.9%	18.2%
Year 12	682	669	610	21.2%	21.7%	26.5%
Reference: Year 11 and below	200	261	289	6.2%	8.4%	12.5%
Marital Status						
Separated	67	59	47	2.1%	1.9%	2.0%
Married	1288	1246	891	40.1%	40.3%	38.7%
De facto	866	785	588	26.9%	25.4%	25.5%
Reference: Single	993	1000	779	30.9%	32.4%	33.8%
Employment						
Part Time	1460	1490	1077	45.5%	48.2%	46.7%
Full Time	1754	1600	1228	54.6%	51.8%	53.3%

Table 3 Women's Continuous Data, 2019, 2015 and 2011

	Mean			Standard Deviation			Min.			Max.		
Year	**'19**	**'15**	**'11**	**'19**	**'15**	**'11**	**'19**	**'15**	**'11**	**'19**	**'15**	**'11**
Control Variables												
Household Income (ln)	11.55	11.46	11.38	0.588	0.603	0.578	6.55	5.60	8.34	13.64	13.64	13.39
Age	31.25	30.79	30.20	7.677	7.935	7.939	18	18	18	45	45	45

Men's Descriptive Statistics

Table 4 Men's Categorical Data, 2019, 2015 and 2011

	N			Percent		
Year	**'19**	**'15**	**'11**	**'19**	**'15**	**'11**
Dependent Variables						
Realized Fertility						
No	1686	1715	1388	53.7%	54.8%	57.1%
Yes	1453	1414	1042	46.3%	45.2%	42.9%
Independent Variables						
Home Office						
No	2462	2495	1958	78.4%	79.7%	80.6%
Yes	677	634	472	21.6%	20.3%	19.4%
Control Variables						
Internet Access						
No	33	91	138	1.1%	2.9%	5.7%
Yes	3106	3038	2292	98.9%	97.1%	94.3%
Education Status						
Postgrad	205	169	79	6.5%	5.4%	3.3%
Grad Diploma or Certificate	131	154	100	4.2%	4.9%	4.1%
Bachelor or Honors	566	546	364	18.0%	17.4%	15.0%
Adv. Diploma or Diploma	246	264	169	7.8%	8.4%	7.0%
Certificate III or IV	894	885	677	28.5%	28.3%	27.9%
Year 12	725	711	628	23.1%	22.7%	25.8%
Reference: Year 11 and below	372	400	413	11.9%	12.8%	17.0%
Marital Status						
Separated	41	50	46	1.3%	1.6%	1.9%
Married	1245	1238	862	39.7%	39.6%	35.5%
De facto	839	817	610	26.7%	26.1%	25.1%
Reference: Single	1014	1024	912	32.3%	32.7%	37.5%
Employment						
Part Time	534	511	367	17.0%	16.3%	15.1%
Full Time	2605	2618	2063	83.0%	83.7%	84.9%

Table 5 Men's Continuous Data, 2019, 2015 and 2011

	Mean			Standard Deviation			Min.			Max.		
Year	**'19**	**'15**	**'11**	**'19**	**'15**	**'11**	**'19**	**'15**	**'11**	**'19**	**'15**	**'11**
Control Variables												
Household Income (ln)	11.54	11.43	11.34	0.604	0.580	0.584	4.65	6.58	5.63	13.63	13.64	13.39
Age	31.37	31.29	30.60	7.517	7.879	7.960	18	18	18	45	45	45

4. Empirical Method

As the dependent variable is a binary variable a probit model was used to run a regression. A probit model is used to determine the probability that an individual will fall into one of the realized fertility categories (yes '1' or no '0') by estimating the likelihood that said individual, with specific characteristics (the independent and control variables), will belong to one of the two mentioned categories (Hanck et al., 2021; Kumar, 2022). The probit model does this by using the cumulative standard normal distribution function (Φ). Thus, the model is as follows:

$$RF_i = \beta_0 + \beta_1 HO_i + \beta_2 IA_i + \beta_3 EL_i + \beta_4 MS_i + \beta_5 EM_i + \beta_6 LN\_HHI_i + \beta_7 AG_i + \varepsilon_i.$$

Where,

RF = Realized Fertility

HO = Home Office

IA = Internet Access

EL = Education Level

MS = Marital Status

EM = Employment

LN_HHI = Household Income (ln)

AG = Age

with

$P\ (RF = 1 \mid HO, IA, EL, MS, EM, LN\_HHI, AG)$

$= \Phi\ (\beta 0 + \beta 1 HO_i + \beta 2 IA_i + \beta 3 EL_i + \beta 4 MS_i + \beta 5 EM_i + \beta 6 LN\_HHI_i + \beta 7 AG_i)$

ε is the statistical error term. The subscript *i* defines each respective observation point for each individual. There is no *t* subscript, for time, in this model as the data is not a time series and each year (2019, 2015 and 2011) is treated as separate data sets. As mentioned, the genders are also examined separately leading to six separate data sets being analyzed using the above-mentioned probit model.

5. Results

The presentation of the results is split into two sections, the results for women and then for the men. As 2019 is the closest year to date, thus of most value, the two other years, 2015 and 2011, are used as robustness checks to examine if the model holds for each of the years. For all three years, for both men and women, the deviance value/df is always below 1 which indicates that the data is not over dispersed, evidence that the models all have a good fit. Furthermore, all of the Omnibus tests are significant at the < 0.1% level, which shows that the models are all significantly different to the null model (*Table 6* and *7*).

Table 6 Goodness of fit statistics and Omnibus test for Year 2019, 2015 and 2011. Women.

	2019			**2015**			**2011**		
	Value	df	Value/df	Value	df	Value/df	Value	df	Value/df
Deviance	2394.56	3194	0.750	2278.49	3068	0.743	1595.93	2287	0.698
	LHR X^2	df	Sig.	LHR X^2	df	Sig.	LHR X^2	df	Sig.
Omnibus Test	2059.55	14	0.000	1995.36	14	0.000	1574.23	14	0.000

Table 7 Goodness of fit statistics and Omnibus test for Year 2019, 2015 and 2011. Men.

	2019			**2015**			**2011**		
	Value	df	Value/df	Value	df	Value/df	Value	df	Value/df
Deviance	2285.61	3115	0.734	2256.94	3111	0.725	1911.24	2409	0.793
	LHR X^2	df	Sig.	LHR X^2	df	Sig.	LHR X^2	df	Sig.
Omnibus Test	2043.108	14	0.000	2051.78	14	0.000	1408.02	14	0.000

For the following two result sections it should be taken into account that due to the nature of probit regressions the resulting coefficients have no natural interpretation, and the scale is arbitrary. Thus, in the result tables the odds ratios (Exp (b)) are presented, yet again these numbers hold no true meaning and can only be used to identify if there is an increase or decrease of probability (Urban Institute, n.d.). The no-impact comparison point is 1 on the odds scale and therefore if the odds ratio is under 1 there is a decrease in the probability of realized fertility and if the odds ratio is over 1 there is an increase in the probability of realized fertility.

5.1 Women

In regard to Hypothesis 1 *Table 8* presents the output for women for each of the three years: 2019, 2015 and 2011. As mentioned, only the data set for 2019 is of interest and 2015 and 2011 are the robustness check as each year is considered as an individual data set and thus no comparison can be drawn between the outputs.

The 2019 results show that home office is statistically significantly, correlated with realized fertility for women, indicating that *H1* cannot be rejected at the 1% level. In other terms, a woman from this sample that worked from home in 2019 has an increases probability of realized fertility, i.e., she has had a child. Additionally, these results hold for the other two years, providing evidence that this model is robust over different data sets. In sum all of the control variables besides internet access and household income are statistically significantly correlated to the dependent variable of realized fertility. The odds ratio for the household income and internet access presented in *Table 8* also indicates that the ratio is very close to the no-impact comparison point of 1. A robustness check was performed by excluding both variables of internet access and household income for the 2019 dataset and the results did not indicate any

noteworthy changes. Thereby indicating that even with the two insignificant variables included this model is robust. The results table of the robustness check can be found in *Appendix A.2*.

Table 8 Probit regression results: how home office is correlated to realized fertility. Women.

Year	**2019**	**2015**	**2011**
Dependent Variable: Realized Fertility			
Home Office	1.215***	1.219***	1.270***
	(0.072)	(0.075)	(0.091)
Internet Access	0.818	0.910	0.780
	(0.282)	(0.192)	(0.169)
Education Level			
Postgrad	0.389***	0.408***	0.445***
	(0.150)	(0.151)	(0.195)
Grad Diploma or Certificate	0.503***	0.442***	0.552***
	(0.162)	(0.155)	(0.178)
Bachelor or Honors	0.462***	0.457***	0.442***
	(0.131)	(0.123)	(0.127)
Adv. Diploma or Diploma	0.592***	0.667***	0.656***
	(0.142)	(0.137)	(0.152)
Certificate III or IV	0.911	0.882	0.811*
	(0.131)	(0.122)	(0.126)
Year 12	0.507***	0.570***	0.533***
	(0.135)	(0.126)	(0.126)
Reference: Year 11 and below			
Marital Status			
Separated	7.323***	5.716***	5.442***
	(0.259)	(0.225)	(0.300)
Married	4.644***	4.833***	4.402***
	(0.082)	(0.083)	(0.098)
De facto	1.937***	1.936***	1.913***
	(0.080)	(0.081)	(0.098)
Reference: Single			
Employment	0.481***	0.447***	0.375***
	(0.062)	(0.063)	(0.076)
Household Income (ln)	1.031	1.029	1.040
	(0.060)	(0.059)	(0.075)
Age	1.105***	1.101***	1.108***
	(0.005)	(0.005)	(0.006)
Observations	3214	3090	2305

Notes: Standard Error are reported in parentheses. The odds ratios (Exp (b)) are listed in the table, therefore if the figure is under 1.0 there is a decrease in probability.
*Significant at 10 per cent; **significant at 5 per cent; ***significant at 1 per cent.
Source: Author' analysis of HILDA data.

In terms of a women's educational levels in 2019, all but having a Certificate III or IV, is statistically significantly correlated with realized fertility. The results show that, with the reference category of completing Year 11 or below, having any other educational level decreases the probability of having had a child. The group of women that have a master's or a doctorate's degree (Postgrad) are the least likely group to have had a child compared to the other educational statuses that one can attain. The following groups are more probable in having had a child compared to the Postgrad group, in increasing order: Bachelors or Honors, Grad Diploma or Certificate, Year 12 and Advanced Diploma or Diploma.

Regarding the women's marital status there is a statistically significant correlation between each of the statuses and realized fertility. For 2019, with the reference category of being Single, being Separated, Married or De facto increases the probability of having had a child, in that order.

In the matter of employment '0' was the code used to indicate a woman working part-time and '1' coded for full-time work. As the odds ratio is below the comparison point 1, it indicates that the women that are working part time in 2019 have an increased probability of having had a child. Thus, being part-time employed is statistically significantly correlated to realized fertility.

Lastly, age is statistically significantly correlated to having had a child yet due to the nature of the dependent variable it is a given that the older a woman is the higher the probability is that she would have had a child.

5.2 Men

In regard to Hypothesis 2 *Table 9* presents the output for men for each of the three years: 2019, 2015 and 2011. Once again, each year is considered as an individual data set and thus no comparison can be drawn between the outputs. The results for 2015 and 2011 are solely robustness check with the results of the 2019 model is examined in further detail below.

The 2019 results indicate that home office is statistically significantly correlated with realized fertility for men, implying that *H2* cannot be rejected at the 10% level. However, for men the results indicate working from home in decreases the probability of realized fertility. Furthermore, these results do not hold up for the other two years, indicating that this model is not robust over the different data sets for men, alluding that there is a hidden variable for men that is better correlated with realized fertility. Another possible explanation could be that the variances are higher in the data set for men, compared to women, thus making the home office variable insignificant for the data sets of 2015 and 2011. Nonetheless, all of the control variables besides internet access are statistically significantly correlated to the dependent variable of realized fertility. Similarly, to the results of the women, the odds ratio for internet access presented in *Table 9* is very close to the no-impact comparison point of 1 and when running a robustness check for 2019, where the variable internet access is omitted, there are no changes in the results (*Appendix A.3*).

Table 9 Probit regression results: how home office is correlated to realized fertility. Men.

Year	2019	2015	2011
Dependent Variable: Realized Fertility			
Home Office	0.880*	1.097	1.008
	(0.072)	(0.074)	(0.084)
Internet Access	0.726	1.221	0.964
	(0.256)	(0.172)	(0.135)
Education Level			
Postgrad	0.371***	0.413***	0.576***
	(0.146)	(0.153)	(0.189)
Grad Diploma or Certificate	0.405***	0.561***	0.506***
	(0.166)	(0.154)	(0.170)
Bachelor or Honors	0.424***	0.406***	0.533***
	(0.118)	(0.113)	(0.121)
Adv. Diploma or Diploma	0.473***	0.527***	0.620***
	(0.139)	(0.132)	(0.147)
Certificate III or IV	0.721***	0.793**	0.869
	(0.103)	(0.098)	(0.100)
Year 12	0.579***	0.596***	0.709***
	(0.112)	(0.108)	(0.109)
Reference: Year 11 and below			
Marital Status			
Separated	6.497***	6.423***	5.493***
	(0.281)	(0.232)	(0.245)
Married	7.673***	8.016***	6.502***
	(0.092)	(0.091)	(0.095)
De facto	2.781***	2.581***	2.749***
	(0.089)	(0.089)	(0.092)
Reference: Single			
Employment	1.223**	1.198*	1.307**
	(0.095)	(0.098)	(0.115)
Household Income (ln)	0.743***	0.772***	0.742***
	(0.058)	(0.063)	(0.068)
Age	1.110***	1.096***	1.088***
	(0.005)	(0.005)	(0.005)
Observations	3139	3129	2430

Notes: Standard Error are reported in parentheses. The odds ratios (Exp (b)) are listed in the table, therefore if the figure is under 1.0 there is a decrease in probability.
*Significant at 10 per cent; **significant at 5 per cent; ***significant at 1 per cent.
Source: Author' analysis of HILDA data.

Regarding men's educational statuses, all educational levels are statistically significantly correlated to realized fertility. With the reference category of Year 11 or below, having attained any other educational level decreases the probability of having had a child. The following is the order of which educational level decreases the probability the most to the least of having had a

child: Postgrad, Grad Diploma or Certificate, Bachelor or Honors, Advanced Diploma or Diploma, Year 12 and lastly, Certificate III or IV.

In terms of the men's marital status, there is a statistically significant correlation between the statuses and realized fertility. With once again the reference group being Single, each of the three statuses increases the probability of having had a child. Being Married increases the probability the most, followed by being Separated and then being in a De facto relationship, in the 2019 model.

Men's employment is coded the same as for women. The odds ratio is above the comparison point 1, thereby indicating that the men that are working full-time, have an increased probability of having had a child. Accordingly, being full-time employed is statistically significantly correlated to realized fertility.

For men household income is statistically significantly correlated to realized fertility. For 2019, the results indicate that men with a lower household income are more likely to have had a child.

Finally, once again, age is statistically significantly correlated to realized fertility due to the aforementioned nature of the dependent variable. It is inherent that the older a man is the higher the probability is that he would have had a child.

6. Interpretation and Implications

Why is home office correlated to realized fertility? Drawing from the presented literature, home office allows for parents to balance their home and work life better. Especially for working mothers, home office will enable them to earn an income without having to resort to working part-time or pay for childcare, which would lead to a drop in both household and personal income. Thereby, when specifically, regarding the results for women in 2019, which were upheld by the robustness checks, working from home statistically increases the probability that an individual has had a child. With finding that there is already a positive correlation between home office and realized fertility pre-pandemic for women, would suggest that companies should be considerate of those in the workforce that would like to maintain working in a hybrid work model permanently, even once the pandemic subsides. This would grant mothers more liberty to balance family and work and possibly even allow individuals to realize their fertility desires, which would increase overall fertility rates. With the pandemic causing economic stress on the majority of Australians (Australian Bureau of Statistics, 2022), in one way or another, home office is considered cheaper in some regards, as money is saved on gas and other forms of transport and on eating out, for example. Companies should realize that keeping a hybrid working model could also be more economically friendly for them as well as it will reduce turnover in case parents need to switch jobs due to home and family life conflicting. It will also decrease expenses such as transport allowance for their employees or rent due to reduced office space needed.

The results pertaining that there is a decrease in the probability that a man has had a child while working from home in the 2019 sample set is of interest. This, while taking the results of women into consideration, could allude that the persisting gender roles of Australia were the reason for

the difference between these results. To elaborate, in 2018, McSweeny was able to deduce from the HILDA survey that due to the traditional gender divide, Australian women spend 13 hours more on unpaid work (housework, childcare, etc.) compared to men, whereas men spend 11 hours more on paid employment compared to women. Moreover, a women's share of the couple's time spent on paid work drops to 14 percent right after birth, and the share rises to only 30 percent in the ten years after birth. In addition, when regarding, renowned social psychologist, Hofstede's classification of Australia in terms of cultural dimensions, he classifies the Australian society as masculine rather than feminine. Masculine societies are driven by competition and achievement and there are clear gender roles outlined that shall be followed, compared to feminine cultures, which regards quality of life as a sign of success, and gender roles are perceived as fluid (Hofstede, 2021). Therefore, it is plausible that the results of this study are of such as there are less men taking home office to take care of their existing children compared to their female counterpart. Further evidence to the fact of the clear divide in gender roles is that women were more likely to have had a child when they are working part-time jobs whereas for men, it was more likely when they are working full time. This prospectively highlights the fact that women have to resort to part-time work to be able to balance their work and family, whereas for men, this is not the case as it seems not to be the norm.

Nowadays, to be able to work from home, internet access is required, but contrary to the literature, where it has been found that the internet has an effect on fertility, this study found that there was no significant correlation between the control variable internet access and realized fertility, thus making internet access not an empirically valid variable. This is a possible indication that home office is a hidden variable between internet access and realized fertility. Additionally, the variable of internet access is a noisy variable as there are many reasons why

an individual would want to have access besides from working from home or even possibly to realize their fertility. Moreover, when regarding the descriptive statistics (*Table 2* and *4*), the percentage of individuals that had indicated that they do not have internet access is disproportionate to those who do have access. Thus, due to this, the true correlation might not have been detected. Furthermore, the years used to create the sample set are all part of the past decade in which the internet penetration for Australia's population has only climbed from 79% in 2011 to 89% in 2019 (World Bank, 2020). Compared to Billari et al.'s (2019) paper, where they were able to find causality between internet access and fertility rates, they regarded the years before and after the introduction of the internet and therefore, possibly more years would have to be regarded to be able to find a possible correlation between internet access and realized fertility.

In terms of the control variable education levels and the results for both men and women indicating that the higher the education level, the less likely an individual is to have had a child could primarily be because to obtain a higher education level an individual has to commit to their studies for longer which could potentially delay their fertility desires. For the control variable marital status, a priori, that separated couples usually already have children as they have been married, and it has been found that married couples are more likely to have children compared to non-married couples (Stone, 2018). The finding of that being separated increases the probability of realized fertility could potentially indicate that there is a reverse causality, which means that these couples have separated because of their children, and there is various research supporting the notion of children being the cause of separation and divorce (Kluwer & Johnson, 2007; Kabátek & Ribar, 2017). Regarding household income, the results indicate that men with lower household income are more likely to have had children compared to richer men. One of the reasons for why this might be is because men are able to realize their fertility

at a later age, and those who are predominantly in the higher household income bracket and have children might not have been included in this model's age range of 18-45. However, further speculation would be inept as this study only regards the household income and not the personal income.

7. Conclusion

The use of home office is correlated to realized fertility, and there are differences to be found between men and women. Through the use of the data provided by the Australian HILDA survey, a probit model was able to find, for data collected in 2019, that for women there is an increase in the probability of having had a child. Whereas for men, a decrease in the probability of having realized fertility was discovered. These results were found even while controlling for internet access, education level, marital status, employment status, household income level and age. For women, this model is robust across data sets created from data collected in 2019, 2015 and 2011. For men, the model only in the 2019 data set showed a statistically significant correlation, while for women the results were robust over the three years. In respect to women, home office should be considered as a true viable option to help alleviate the economic burden children bring on, as this study supports the existing literature in terms of how women and men are disproportionately affected when having had a child. Lastly, the findings of this study highlight trends, such as distinct gender roles, that were present pre-pandemic in Australia and have presumably only heightened due to the pandemic. Thus, Australian companies and policymakers should note how to make the hybrid working model work for them. For the industry, the hybrid working model not only allows workers to be more flexible with their time, but it also has the potential of reducing expenses. Policymakers should recognize that

mandating healthier work and life balances could potentially aid them in elevating low fertility rates, which would circumvent the negative economic outcomes that low fertility rates cause. The findings of this study have the potential to also provide insight for other higher-income countries with low fertility rates, with the model being easily transferable to other higher-income countries' census data. The adverse effects of low fertility rates are slowly approaching, and now is the time to recognize ways on how to mitigate these effects. If not taken seriously, underpopulation will become our twenty-first-century demographic crisis.

7.1 Limitations and Future Research

The main limitation of this study is the data availability. Although the HILDA is extensive in what information it reports, when it came to the dependent variable of realized fertility, the only data file available was reported on a four-year basis, thereby making it impossible to construct a time series. Due to this, the results for the three years used to construct the data sets were not comparable. Thus, future research should extend this model in a way to compare across different years. A further limitation of this study was that it was only able to control for the household income level and not the personal income level for either of the genders due to data unavailability. In future research, personal income levels should be assessed as the results could shed some light on the 'motherhood penalty' and how home office can possibly be utilized to mitigate this. Another limitation is the variable fertility itself, as many factors contribute to why individuals choose to have or not have children; it is, therefore, difficult to dissect which ones to control for, in addition to finding out which variables can be quantifiably controlled for. As already touched upon in Section 6, internet access was not correlated to realized fertility in this study, although existing literature states otherwise, future research could delve into the idea that internet access needs home office as a mediator to properly effect fertility rates, especially post-pandemic. This would require more than what this study is able to provide, as this study can

only claim correlation and not causality. It would be interesting to investigate how governmental, industry and company policies will change post-pandemic to allow workers to meet both the business objectives and personal/family life matters by allowing them to choose how they would like to work. Lastly, the pandemic can be used as a 'natural experiment', and it would be up to future researchers to study the demographic changes that happened within and after the pandemic. Some surveys and news reports have already indicated that parents are not as willing to return to the office as originally thought. Moreover, a survey conducted by Leng (2021) found that the main reason parents did not want to go back to the office was because they wanted to take care of their children. Thus, it would be of value to take this study a step further to see if home office is the reason fertility desires are actualized or not, which would indicate a possible change in the total fertility rates.

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Appendix A

Appendix A.1

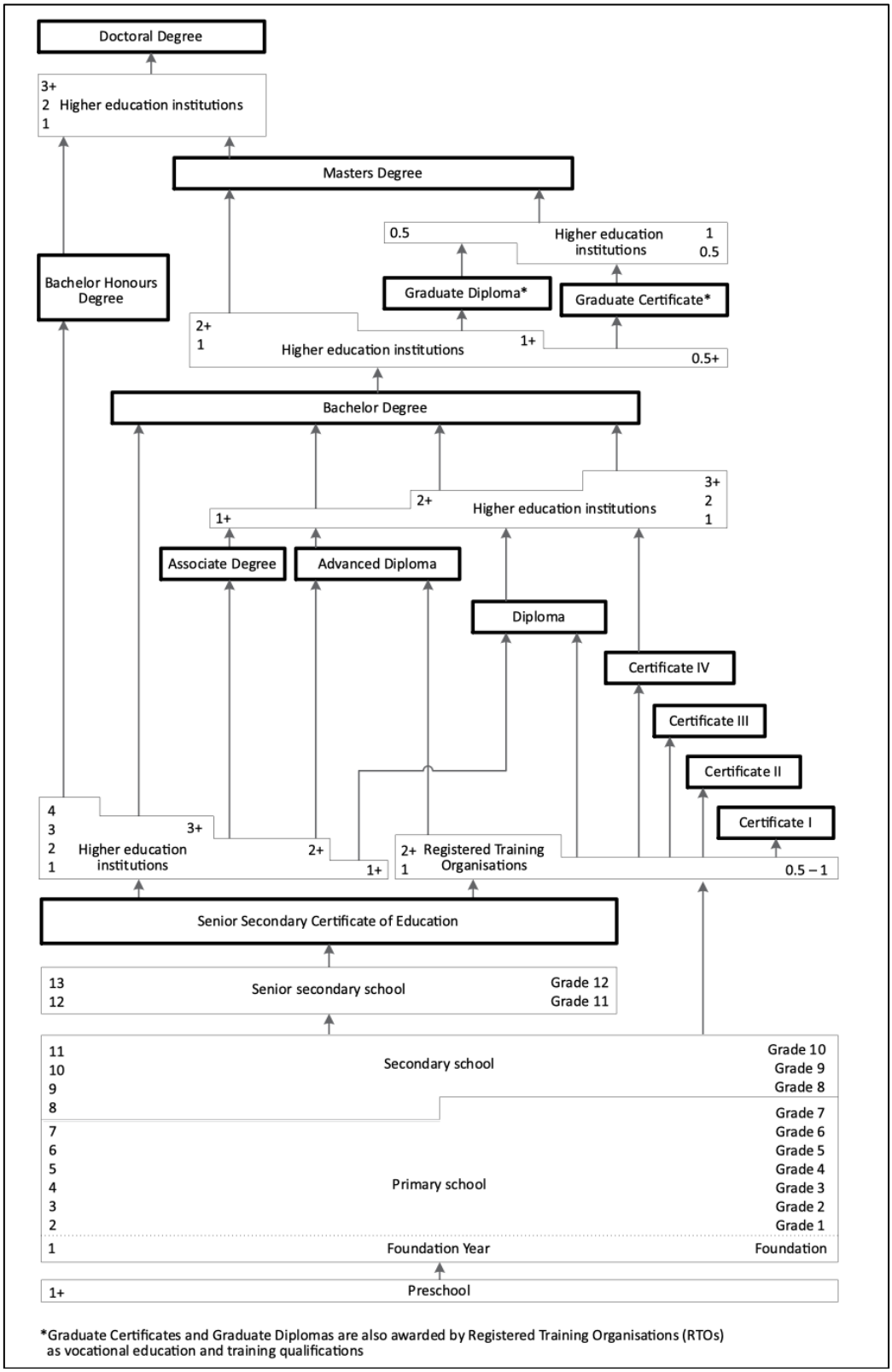

Figure 3 Diagram of the Australian Education System. Retrieved from The Australian Government Department of Education and Training's Country Education Profiles Data Sheet

Appendix A.2

Table 10 Robustness check: Women, excluding variables Internet Access and Household Income (ln), 2019

Year	**2019**
Dependent Variable: Realized Fertility	
Home Office	1.211***
	(0.071)
Education Level	
Postgrad	0.384***
	(0.148)
Grad Diploma or Certificate	0.504***
	(0.161)
Bachelor or Honors	0.462***
	(0.130)
Adv. Diploma or Diploma	0.590***
	(0.141)
Certificate III or IV	0.908
	(0.131)
Year 12	0.506***
	(0.134)
Reference: Year 11 and below	
Marital Status	
Separated	7.290***
	(0.258)
Married	4.693***
	(0.078)
De facto	1.939***
	(0.078)
Reference: Single	
Employment	0.486***
	(0.061)
Age	1.105***
	(0.005)
Observations	3214

Notes: Standard Error are reported in parentheses. The odds ratios (Exp (b)) are listed in the table, therefore if the figure is under 1.0 there is a decrease in probability.
*Significant at 10 per cent; **significant at 5 per cent; ***significant at 1 per cent.
Source: Author' analysis of HILDA data.

Appendix A.3

Table 11 Robustness check: Men, excluding variables Internet Access and Household Income (ln), 2019

Year	**2019**
Dependent Variable: Realized Fertility	
Home Office	0.883*
	(0.072)
Education Level	
Postgrad	0.368***
	(0.146)
Grad Diploma or Certificate	0.403***
	(0.166)
Bachelor or Honors	0.422***
	(0.118)
Adv. Diploma or Diploma	0.469***
	(0.139)
Certificate III or IV	0.716***
	(0.103)
Year 12	0.576***
	(0.112)
Reference: Year 11 and below	
Marital Status	
Separated	6.459***
	(0.281)
Married	7.645***
	(0.091)
De facto	2.774***
	(0.089)
Reference: Single	
Employment	1.222**
	(0.095)
Household Income (ln)	0.744***
	(0.058)
Age	1.109***
	(0.005)
Observations	3139

Notes: Standard Error are reported in parentheses. The odds ratios (Exp (b)) are listed in the table, therefore if the figure is under 1.0 there is a decrease in probability.
*Significant at 10 per cent; **significant at 5 per cent; ***significant at 1 per cent.
Source: Author' analysis of HILDA data.