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Working Paper Series

'Rethinking Specialization and the Sexual Division of Labor in the 21st Century'

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No. 04 / 2020 **June 2020**

Rethinking Specialization and the Sexual Division of Labor in the 21st Century

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June 2020

Abstract

We show that comparative advantage plays little or no role in explaining the sexual division of labor. Instead, gender norms are the likely explanation. Using direct measures of within-couple specialization, we find that absolute advantage in market work has little (no) role in the time allocations of heterosexual (same-sex) couples. Sex-based specialization is much greater. We then test the predictions of a formal Beckerian model of comparative advantage. A woman would need to be 109 times more productive in market work than her male partner before reaching expected parity in domestic work, and this is likely biased downwards.

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We are grateful for valuable comments from, and discussions with Victoria Baranov, Deborah Cobb-Clark, Mario Fiorini, Esther Mirjam Girsberger, Dan Hamermesh, Chris Jepsen, David Johnston, Shelly Lundberg, Shiko Maruyama, Jessica Pan, Olena Stavrunova, Steven Stillman, as well as participants at AASLE 2019, the 2019 Australian Gender Economics Workshop, the 2019 VUW Applied Econometrics Workshop, and seminars at UTS and UNSW. All errors are our own. This paper uses unit record data from the Household, Income and Labor Dynamics in Australia (HILDA) Survey. The HILDA Project was initiated and is funded by the Australian Government Department of Social Services (DSS) and is managed by the Melbourne Institute of Applied Economics and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the author are not to be attributed to either DSS or the Melbourne Institute.

1. Introduction

The sexual division of labor, by which men specialize in market work (MW) and women specialize in domestic work (DW) has been studied through various lenses. The canonical economic explanation is biologically-determined comparative advantage within heterosexual couples (Becker 1991). According to this theory, women's innate ability to bear, deliver and feed children with their own milk, leads them to specialize in DW, whilst men focus on MW (Becker, 1991). Becker (1991) argues that even small differences in sex-based biological determinism can lead to large differences in comparative advantage, due to gendered differences in human capital investments from very early in the life course.

The sexual division of labor is also consistent, however, with other explanations. In particular, alternate models emphasise the role of gendered cultural norms. The prescriptive nature of gender norms can affect behaviour if gender stereotypes are internalised, and thus directly shape one's preferences (Bertrand, 2020). The self-reinforcing nature of gender norms has also been demonstrated empirically, particularly around underlying gender differences in maths scores (see for example Carlana, 2019; Dossi et al. 2019).[2] Even if individuals do not fully internalise such stereotypes, gender norms may still change behaviour due to the perceived cost of deviating from gender expectations (Akerlof & Kranton, 2000).

The family economics literature has long dispensed with the unitary framework of household behaviour which underpins Beckerian models. Instead, distinct preferences of family members are emphasised in cooperative and non-cooperative bargaining models (see for example the discussion in Lundberg and Pollak, 1996). But bargaining models do not provide an alternative explanation for the sexual division of labor.[3] Comparative advantage and gender norms remain the two competing

[2] For a detailed summary of the relevant literature, see Bertrand (2020).

[3] The bargaining literature has focused primarily on implications for within-household distribution of consumption, rather than on the allocation of productive time. Many bargaining models maintain an assumption of efficient allocation of resources (Lundberg and Pollak, 1996). Nevertheless, in the words of Lundberg and Pollak (2003), 'one of the casualties of this paradigm shift from unitary to non-unitary models is the presumption that families are efficient.' This is because time-use allocations not only affect current domestic production, but also future bargaining power, for example through human capital implications, and so they may not lead to productive efficiency (Lunderg and Pollak, 2003).

theoretical paradigms for understanding this phenomenon.[4]

A number of stylised facts are consistent with Becker's comparative advantage explanation for the sexual division of labor. First, on average, women do more unpaid work – in terms of childcare and housework – than men. Men, in turn, do more market work, on average. Secondly, women's participation in the labor force has increased dramatically in recent decades, at the same time as their comparative advantage in domestic work has decreased. This decline in comparative advantage has a number of drivers. Declining female fertility and the growing availability of birth control have meant that children are decreasingly central to family life (Goldin & Katz, 2002; Stevenson & Wolfers, 2007).[5] Female education – a key determinant of productivity in market work – has increased dramatically relative to men (Blau & Kahn, 2016). Further, explicit policies of gender-based pay discrimination are no longer legal, further increasing returns to female market work. Next, as argued by Stevenson & Wolfers (2007), the emergence of labor-saving domestic technologies not only decreased the time needed for domestic labor, they have also made domestic work less skilled, reducing absolute advantage in domestic work (see also Greenwood & Guner, 2008). This is coupled with the emergence of service industries which have allowed housework to be outsourced. Finally, the shift towards cognitive over physical skills in the workplace has increased labor-market opportunities for women (Welch, 2000; Beaudry & Lewis, 2014). All of these factors have reduced female comparative advantage in domestic work over the last 60 years or so.

However, cultural change is an alternative explanation for the aforementioned trends. The sexual revolution of the 1960s, accompanied by the growing availability of birth control, spearheaded the process of dramatically transforming society's expectations for the role of women. The cost of female participation in the labor-market, in terms of deviating from social norms, is in long-term decline. A

[4] The sociological tradition provides an alternative explanation for women's higher housework contributions: 'exchange theory', which emphasises power and dependence. This explanation proposes that women do more housework than men because they have lower economic power, as measured by relative earnings (Bittman et al., 2003). This model, however, does not explain why women do more housework instead of more market work as a consequence of economic power imbalance. Indeed hours of market work are usually treated as exogenous in this literature. Therefore, it does not provide an explanation for specialization or the sexual division of labor, *per se*.

[5] Children are not only at the centre of Becker's explanation for the sexual division of labor, but have also been shown to have an impact on specialization decisions in empirical work (see, for example, Antecol & Steinberger, 2013; Giddings et al. 2014, Martell & Roncolato, 2016).

firm link between specialization and comparative advantage has not been established empirically. And certain findings within the literature are directly contrary to a Beckerian explanation. For example, women whose income exceeds their husbands' tend to compensate for gender deviance by doing a relatively larger share of housework (Akerlof & Kranton, 2000; Bertrand et al., 2015).,Also, within-gender variation in skills or traits tends to be much larger than associated between-gender differences (Bertrand, 2020).

To assess more directly whether comparative advantage is an important driver for the sexual division of labor, we look explicitly at within-household specialization. We examine how such within-household specialization differs between households with different characteristics. Whilst comparative advantage is arguably not measurable, absolute advantage in market work (AAM) is measurable, and there is great variation in AAM between households. There is also much to learn from same-sex and childless households, for whom sex-based comparative advantage is not relevant.

The data we draw on are from Australia's Household, Income and Labor Dynamics survey (HILDA), which is ideally suited for the analysis. It contains the necessary time use variables. Crucially, its panel dimension helps to greatly reduce missing wage data for people who are not employed in a particular wave. Rather than losing those people from the sample, we can instead draw on their wage observations from adjacent waves, or from more distant waves if necessary. This allows us to study the role of AAM for time use decisions at both the internal and external margins. HILDA also identifies same-sex couples, and its sample size is large enough for meaningful analysis. To our knowledge, no other dataset has all these features.[6]

We propose three new Specialization Indices to help facilitate such analysis. The first specialization index (SI_1) measures the extent to which one member of the couple does most of the MW, whilst the other member does most of the DW. This index is hence sex-neutral, and blind also to AAM. It therefore allows us to explore the extent of within-household specialization, without imposing any assumptions on its determinants. Unlike previous attempts to measure specialization, it includes time-use inputs from both the labor-market and household spheres for both members of each couple, which we argue is essential to identify genuine specialization.[7] The second index (SI_2) is a measure of sex-

[6] For example, the American Time Use Survey (ATUS) is a repeated cross-sectional survey, not a panel survey. The hourly wage of people who are not employed at the time of the survey is not observed.

[7] While many studies discuss specialization, few explicitly seek to measure it. Of those that do, most use labor-market proxies "as signals of household specialization" (Jepsen & Jepsen, 2015, p. 110), rather than measuring

based specialization - relevant only for heterosexual couples. It takes its maximum value when the male partner does all of the MW and none of the DW, consistent with sex-based comparative advantage and with gender norms. The third index (SI_3) measures the extent to which couples specialize in a way that conforms with AAM. It takes its maximum value when the spouse with the higher hourly wage does all of the MW, while the other member does all of the DW.

We find that AAM, as measured by relative wages, is only a small factor in specialization for heterosexual couples and plays no role at all for same-sex couples. Further, the small role that AAM seems to have is likely overestimated, since current AAM may simply reflect earlier time use decisions which affect human capital, and are in turn driven by gender norms.[8] In comparison, sex-based specialization, is much larger. These results are inconsistent with a Beckerian comparative advantage explanation for the sexual division of labor.

Secondly, we outline and test the predictions of a formal Beckerian domestic production model. Even though we do not measure absolute advantage in domestic work (AAD), we are able to make strong conclusions. We find that that a woman would need to be more than 100 times more productive in market work than her male partner before reaching expected parity in domestic work. Even amongst couples without children, expected parity in domestic work occurs only when the woman's wage is 12.6 times higher than her husbands'. For the Beckerian model to completely explain the sexual

specialization in its own right.[7] Such proxies are problematic because working more labor-market hours than one's spouse does not necessarily imply doing less hours in domestic labor, or vice versa (Bittman et al., 2003; Bertrand et al., 2015). Conversely, others have attempted to measure household specialization using only measures of time in domestic work, ignoring market work (Stratton, 2005; Bonke et al. 2008). Other papers, such as Black et al. (2007) and Stevenson & Wolfers (2007), seek to circumnavigate these issues altogether by providing a descriptive analysis of specialization. Whilst useful in their discussion of the connection between human capital accumulation and specialization, their capacity to quantify the extent of specialization occurring across households is limited. Thus, we believe our measure of specialization facilitates a richer analysis of within-household specialization relative to previous work.

[8] As we discuss in Section 5, AAM is likely endogenous, but the direction of resulting bias is favourable. AAM is a function of human capital, which in turn reflects choices about time use allocation made in earlier periods of life – through labor supply, and through education. In a similar vein, Becker's theory of sex-based specialization describes a process of gendered human capital accumulation throughout the life course. This implies that AAM may be a consequence of earlier sex-based specialization. Both of these factors suggest that our static analysis should overestimate the importance of AAM as an independent determinant of specialization decisions.

division of labor, such women would need to be 12.6 times as productive in domestic work than their husbands, even in the absence of children.

Our results suggest gender norms, rather than comparative advantage, as the likely explanation for the sexual division of labor.[9]

The remainder of the paper is structured as follows. Section 2 describes the three specialization indices in detail and Section 3 discusses data. Section 4 presents a rich descriptive profile of specialization. Section 5 outlines and tests the predictions of a Beckerian model of specialization and comparative advantage. Section 6 concludes.

2. Measuring Specialization and the Role of Absolute Advantage

In Section 5, we propose a formal structural model of time allocation. For now, consider only a couple's time allocation choice set. Each couple member (j) allocates their time to MW, DW and leisure (L) subject to the time constraint (normalised to 1):

$$MW_j + DW_j + L_j = 1, \quad j \in (1,2)$$

2.1 A Within-Household Specialization Index

Our first goal is to construct an index which summarises the extent to which members of a couple are specializing in their division of labor. This index should take its maximum value when one spouse does all of the household's market work: $MW_1 > 0$; $MW_2 = 0$, while their partner does all of the domestic work $DW_1 = 0$; $DW_2 > 0$. And the index should take its minimum value if a spouse's share of household market work equals their share of domestic work: $\frac{MW_1}{MW_1 + MW_2} = \frac{DW_1}{DW_1 + DW_2}$. This would occur if, for example, MW and DW are both shared equally by the members of the couple, but also if one member contributes none of their time in work of either type. In both of those cases, the household is not specializing.

[9] Not only in cases where women's earning are higher than males, as per Bertrand *et al.* (2015), and others.

With these principles in mind, we propose our first specialization index, SI_1. We believe this to be the first direct measure of within-household specialization, given that it combines time-use inputs from MW and DW for both couple members. Blind to sex, comparative advantage and its components, the index simply informs us whether couples are specializing in their division of labor.

$$SI_1 = \left| \frac{MW_1}{MW_1 + MW_2} - \frac{DW_1}{DW_1 + DW_2} \right| \quad (1)$$

The first term on the RHS is the share of couple's market work performed by person 1. The second term is the share of the couple's domestic work performed by the same person. The index takes its highest value (1) if one spouse does all of the MW and none of the DW, or vice versa.[10] As desired, it takes its lowest value (0) if their share of household market work is equal to their share of domestic work.[11]

The intuition of SI_1 can be expressed graphically, as in Figure (1). Here the horizontal (vertical) axis represents share of domestic (market) work performed by person 1. Each point represents a couple's possible time allocation combinations. The index takes the value of one at points at the top left corner and the bottom right corner of the graph (complete specialization), and zero on the dotted diagonal line (no specialization). In our sample, the mean of SI1 is 0.38, the locus for which is depicted by red lines in Figure 1. Some examples of points on this locus are (0.38, 0), (0.5, 0.12) and (0.5, 0.88).

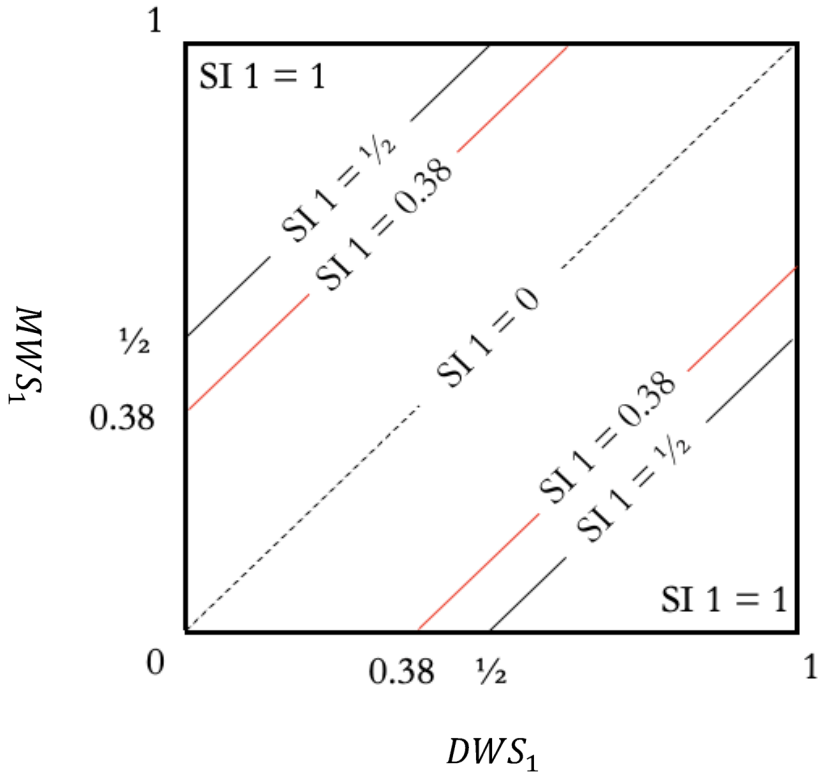
Compared to previous work, our index facilitates a more direct measure of specialization, as it incorporates time-use inputs for both couple members in both domestic and market work. In contrast, previous work has attempted to measure specialization using inputs from only one sector (for example, Nottmeyer, 2011; Jepsen & Jepsen, 2015; Stratton, 2005; Bonke et al., 2008).

[10] It is straightforward to show that the choice of which couple member to label as person 1 is arbitrary and the index takes the same value regardless:

$$\left| \frac{MW_1}{MW_1 + MW_2} - \frac{DW_1}{DW_1 + DW_2} \right| = \left| \left(1 - \frac{MW_1}{MW_1 + MW_2}\right) - \left(1 - \frac{DW_1}{DW_1 + DW_2}\right) \right| = \left| \frac{MW_2}{MW_1 + MW_2} - \frac{DW_2}{DW_1 + DW_2} \right|$$

[11] Leisure time (L) does not feature directly in the index. The index is not intended to measure fairness of time allocation. However as mentioned above, as L approaches one for one member of the couple (whilst remaining unchanged for the other member), the index will approach zero, since the other member of the couple would be doing the majority of both types of labor.

Figure 1: Map of specialization



2.2 Determining the role of absolute advantage

Whilst SI_1 measures the extent of specialization, it does not help to determine whether such specialization conforms with sex-norms or with absolute advantage in either sector. We propose two more Specialization Indices for this purpose. Both are based on the first index, but with minor tweaks.

The second specialization index (SI_2) measures whether couples divide their labor in a direction which conforms with sex norms (which may or may not in turn reflect AAD). Specifically, it measures whether heterosexual couples[12] divide their labor such that the female partner specializes in domestic work and the male partner in the labor-market, as per equation (2).

The third specialization index (SI_3) measures whether couples specialize to conform with AAM. This infers the couple divides their labor such that the couple member with the higher hourly wage does most of the MW, whilst their partner does most of the DW, as per equation (3).

[12] This index is relevant for heterosexual couples only. Gay and lesbian families, by virtue of being the same-sex, cannot divide their labor in this way.

$$SI_2 = \frac{DW_F}{DW_F + DW_M} - \frac{MW_F}{MW_F + MW_M} \quad (2)$$

$$SI_3 = \frac{MW_H}{MW_H + MW_L} - \frac{DW_H}{DW_H + DW_L} \quad (3)$$

SI_2 is hence equal to the female's share of DW minus her share of MW. SI_3 is defined as the share of MW done by the person with the higher hourly wage, minus their share of DW.

Unlike SI_1, these two indices range from -1 to 1. The greater range reflects the fact that unlike SI_1, these indices are intended to capture specialization as it conforms (or differs) to AA in either sector. A score of 1 implies the couple is fully specialized in a way that conforms with sex norms (in the case of for SI_2) or with AAM (in the case of SI_3). In the case of SI_2, this implies that the female is doing all of the DW and none of the MW. For SI_3, it implies that the couple member with the higher hourly wage does all of the MW and none of the DW. A score of -1 also implies complete specialization, but in the opposite direction predicted by sex or AAM. For SI_2, this is when the female partner does all of the MW and none of the DW. For SI_3, it implies the partner with the lower hourly wage completes all of the MW and none of the DW. For both indices, a score of zero implies there is no specialization occurring in the household.

The second and third specialization indices therefore incorporate elements of SI_1, this being the extent to which couples specialize, but they also impose a direction in which specialization conforms with a particular prediction. For these reasons, SI_1 is not directly comparable to the other two indices, however, SI_2 and SI_3 may be compared to each other to determine whether sex or AAM plays a greater role in within-family time-allocation.

3. Data

The data used in this study is drawn from Release 17 of the Household, Income and Labor Dynamics Australia (HILDA) Survey. HILDA collects data on a broad range of socio-economic factors, with a

focus on household structure and characteristics, employment and income. A nationally representative longitudinal dataset, the survey began in 2001 and re-interviews participants annually.

HILDA has a rare combination of features which make it ideal for our purposes. It includes time-use data on both MW and DW for both members of couples. Secondly, it identifies same-sex couples, and their sample is large enough for meaningful analysis. Thirdly, it is a longitudinal survey, which greatly reduces potential sample selection bias from missing wage information, as well as measurement error in hourly wages, which are constructed from self-reported earnings and hours.[13] We elaborate on these issues below.

3.1 Time-Use Variables

Our time-use data are drawn from HILDA's Self-Completion Questionnaire, on which respondents record how much time they typically spend in a range of activities per week. Commonly referred to as stylised estimates, such data are regarded as inferior to time diary data for some purposes. But we argue that they may actually be more suitable for our purposes than diary data.[14]

Our measure of DW combines time spent in outdoor tasks, childcare, housework and household errands. These variables are clearly delineated in the HILDA survey,[15] such that they are able to be

[13] To our knowledge, there is no dataset available for the US which has all of these features.

[14] In particular, stylised estimates have been shown to introduce systematic bias. For example, studies have consistently found that stylised estimates of housework time exceed diary estimates (Marini & Shelton, 1993; Baxter & Bittman, 1995; Bianchi, Milkie, & Sayer, 2000; Juster, Ono & Stafford, 2003). To the extent that this paper is focused on the variation between couples in time-allocation decisions, within the family home, such systematic biases are not relevant. Importantly, an array of studies comparing stylised and diary estimates have found little variation between population groups (Baxter & Bittman, 1995; Robinson, 1985; Marina & Shelton, 1993). Stylised estimates are in fact likely to be more accurate for our study. Diary information is usually collected over the course of one or two days. Time use on those days may be accurately recorded, but they may nevertheless provide a noisy signal of individuals' 'typical' time use allocations - in which we are interested.

15 Housework includes preparing meals, washing dishes, cleaning the house, washing clothes, ironing and sewing. Household errands includes shopping, banking, paying bills and keeping financial records. Outdoor tasks includes home maintenance (such as repairs, improvements), car maintenance and gardening. Childcare includes playing with your children, helping them with personal care, teaching, coaching or actively supervising them, getting them to childcare, school and other activities.

summed to form a single measure for time spent in domestic work.[16] These inputs are also generally consistent with previous definitions of domestic work in the literature. However, unlike previous research, our measure is indifferent to specialization by task type and considers only time spent in domestic work at the aggregate level.[17] In a similar manner, our measure of MW is the sum of time spent in paid work and commuting.

Online Appendix 6 shows that key results are not sensitive to the exclusion of outlying (arguably implausible) reported time use values.

3.2 Hourly Wage Variables

Relative hourly wages between couple members are our measure of AAM. A person's hourly wage in each wave is derived as the ratio of weekly earnings to self-reported weekly hours worked. It is hence subject to measurement issues, with at least three associated threats to validity. The panel nature of HILDA helps to reduce these threats greatly.

The first threat is potential sample-selection bias – couples who completely specialize have one person that does not participate in any market work, and so their hourly wage is not observed contemporaneously. However, the panel structure of HILDA goes a long way towards addressing this issue. Rather than relying on contemporaneous hourly wages, we instead use a within-person moving-average across waves. Specifically, for each person whose time use variables are observed at time *t*, we assign a wage equal to the median of this persons' non-missing observed wage across a five-year window: from *t-2* to *t+2*. This substantially reduces the sample loss due to missing wage data – an additional 7,311 couple-wave observations are included under this approach (as opposed to relying only on contemporaneous wage data), reflecting an additional 16% of the full SI_1 sample.[18] In Online

16 We assume no multi-tasking.

17 See for example Stratton (2005) and Bonke et al. (2007), who construct a single composite measure of domestic specialization by task type.

18 Couple-year observations are dropped if either couple member's hourly wage is missing. Amongst those dropped in our preferred approach, the majority had at least one partner who was self-employed (77%), while 43% included at least one partner who was not currently working. Online Appendix 5 shows sensitivity of key results to different approaches to deal with missing wage observations.

Appendix 5, we explore sensitivity of key results to different approaches to deal with missing wage observations, including using observed wages observed at more distant waves.

Using a moving-average wage also arguably addresses the second threat to validity associated with measurement error, which is the possibility of noisy observations from misreported earnings or hours – which would lead to attenuation bias. If the wage is relatively stable over time but is reported with error, the 5-year moving-median wage may be a better measure. The third threat to validity is perhaps more subtle. It is the possibility that measurement error in hours of paid work mechanically leads to downward bias in SI_3. To illustrate, consider an individual who underreports hours worked. This person has an upward biased wage, and as a consequence is more likely to be coded as having a higher wage than their partner. But this person's share of paid work is also biased downwards and, consequently, so is SI_3. Fortunately, in every wave, HILDA collects time in paid work twice – once in the interviewer-administered Person Questionnaire, and again in the time-diary section of the subsequent Self-Completion Questionnaire. We use the first of these to construct the hourly wage, and the second of these to construct each specialization index. Whilst this does not eliminate the issue completely (since reporting error may be correlated between the two reports), it likely reduces its importance.

We also take further steps to deal with measurement error in wages. We drop extreme outliers – hourly wages below AUD $1.90 and over AUD $211[19]. We also test the sensitivity of the results to excluding observations where the hourly wage difference is relatively small: less than 5%, 10% and 50%.

These and all other variables are described in more detail in Online Appendix 2.

3.3 Sample Construction and Descriptive Statistics

We selected couple-year observations from waves 2 to 17,[20] where both members were aged 18-64. Couple-year observations were also excluded if either member did not return a

[19] These are the top and bottom 0.1% of the hourly wage observations after applying the moving average. In total, 100 couple wave observations were excluded as a result.

[20] We drop Wave 1 because the stylised time-use variables in the first wave differ from subsequent waves. In the first wave, time-use is measured in hours (as opposed to hours and minutes in later waves) and there is no variable for paid employment.

self-completion questionnaire. Couple-year observations where either partner had missing data for all of the time-use variables were excluded.[21] Couple-wave observations were also dropped if either partner had missing wage data even after applying the 5-year moving median wage window, including couples where at least one-partner was self-employed or not working.[22]

After dropping a small number of couple-year observations whose sampling weights are set to zero,[23] our full estimation sample consist of 45,337 couple-year observations from 7,649 unique couples.[24] The sample used for analysis of SI_2 is slightly smaller (44,697), since SI_2 is defined only for heterosexual couples. A smaller sample of 24,715 observations is used for analysis of SI_3 and for testing the Beckerian model in Section 5. This is from dropping waves 2, 16 and 17, necessary for constructing the moving-average wage (as described above), and from remaining missing wage information.

Table 1 displays the means for the variables used in the analysis for the full SI_1 sample.[25] The majority of couples are married and different-sex, with the average couple age at just under 43 years old. Additionally, almost half the couples in our sample have a dependent child under the age of 15 living in the household, and less than a quarter have a child between the ages of 0 to 4. On average, couples in our sample spend approximately 61 hours each week on domestic work, and 72 hours in paid employment collectively.

Table 1 shows that the mean of SI_2 is 0.278 is much higher than the mean of SI_3 (0.103). This implies that specialization conforms much more to sex-roles than it does with absolute advantage in the market – a theme that we explore in subsequent analysis.[26] It also shows the proportions of couples who have positive values of SI_2 and SI_3, respectively – that is, couples who specialize consistently with sex and

[21] In cases where only some time-use variables were missing, these were set to zero. This occurred frequently, for example, when individuals without children were asked how much time they spent caring for their children.
[22] We show our results are robust to potential sample-selection bias due to missing wage observations in Online Appendix 5.
[23] 223 couple-wave observations were dropped whose sampling weights were set to zero.
[24] This includes 249 observations from 61 gay couples, and 391 observations from 79 lesbian couples.
[25] Online Appendix Table A1.1 shows further descriptive statistics.
[26] A similar conclusion is made if the sample is restricted to couples with valid values for both SI_2 and SI_3. For this restricted sample, the mean of SI_2 is 0.218 and the mean of SI_3 is 0.105.

with AAM.[27] The results show that approximately 78% of couples specialize consistently with sex, while just 61% specialize consistently with AAM.[28]

Table 1: Descriptive statistics

Variable	*Mean*	*SD*
Married Heterosexual	0.812	(0.391)
Unmarried Heterosexual	0.176	(0.381)
Gay	0.006	(0.075)
Lesbian	0.006	(0.077)
SI_1	0.383	(0.270)
SI_2	0.278	(0.379)
$SI_2 > 0$	0.776	(0.417)
SI_3	0.103	(0.387)
$SI_3 > 0$	0.608	(0.485)
Couple Age	42.570	(10.452)
Couple Duration	16.190	(11.202)
Children Aged 0-4	0.239	(0.426)
Children Aged 5-9	0.215	(0.411)
Children Aged 10-14	0.210	(0.407)
Children < 15	0.485	(0.500)
Likely to Have [More] Children	3.653	(4.043)
Desires [More] Children	4.204	(4.045)
Log Relative Wage	0.389	(0.347)
Time-Use		
Market Work	72.185	(25.787)
Paid Employment	64.868	(23.463)
Commuting	7.317	(5.810)
Domestic Work	60.690	(38.034)
Housework	23.396	(13.789)
Household Errands	9.001	(6.898)
Childcare	20.386	(27.734)
Outdoor Tasks	7.907	(7.946)

[27] It is noted that couples with a positive value for SI_2 and/or SI_3 may not necessarily be specializing as much as a Beckerian model of comparative advantage may predict. However, this is not possible to determine, as AAD is immeasurable.

[28] A similar conclusion is made if the sample is restricted to couples with valid values for both SI_2 and SI_3. For this restricted sample, 76% have a positive value of SI_2 and 61% have a positive value of SI_3.

Table 2 displays the correlations between the three specialization indices. SI_1 and SI_2 are strongly positively correlated, with a coefficient of 0.624. The correlations between SI_3 and each of the other two indices are relatively weak, at around 0.3. This suggests that household specialization overall conforms strongly with sex-roles, much less so with AAM.

Table 2: Correlations between the specialization indices

	SI_1	SI_2	SI_3
SI_1	1.000		
SI_2	0.624	1.000	
SI_3	0.295	0.306	1.000

4. A Descriptive Analysis of Specialization, Sex and Absolute Advantage

We cannot directly test whether comparative advantage drives specialization, since productivity in domestic work is not measured. But we can examine whether specialization is affected by absolute advantage in market work, as measured by relative wages. We can also examine if specialization is consistent with sex – which, to some unknown extent, is an indicator of AAD, but may also reflect social norms. We are not aware of earlier work that has empirically examined the role of absolute advantage in specialization.

Panel A of Figure 2 shows the distribution of sex-based specialization. This heat-plot shows the bivariate density for the share of DW and MW undertaken by the female member of the heterosexual couples in our sample. It shows two dominant patterns of behaviour. Much of the data lies towards the middle of the plot, where the female partner undertakes between 30% and 55% of the total market work, and between 40% and 80% of the total domestic work. The highest density within this region is very close to a 50:50 split in both MW and DW, but this is only slightly higher than the surrounding region. By far the highest density occurs at the south-east corner, where the female partner undertakes 80% of the DW and none of the MW. This shows that a large portion of heterosexual couples in the sample which exhibit a sexualised division of labor. There are very few observations in which the

female does all of the MW (at the top of the Figure). In those cases, however, females also do close to half of the DW[29].

Panel B of Figure 2 is a density plot of the proportion of DW and MW undertaken by the partner with the higher hourly wage. It shows whether couples are specializing in a way that conforms with AAM. In some ways, this density plot is similar to the previous, with a high density in the centre of the plot and another in the direction predicted by absolute advantage. However, it is much more symmetric around the diagonal – with the density only slightly higher towards the north-west of the region compared to the south-east. Those couples conforming most strongly with AAM are in the north-west corner, where the member with the higher hourly wage undertakes most of the market work and only a small proportion of housework. But there is also considerable mass in the south-east corner, where the partner with the higher hourly wage undertakes very little of the market work and most of the housework, contrary to AAM.

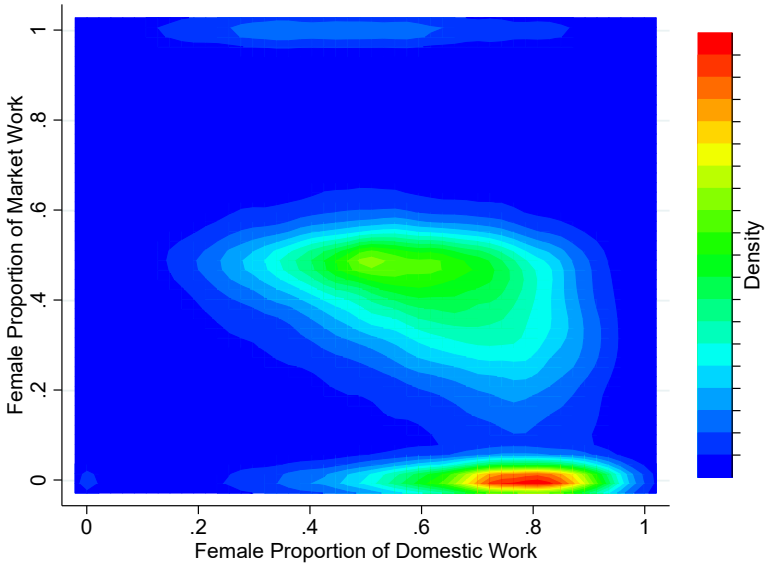
Panel C of Figure 2 is based on Panel B, but with the sample restricted to same-sex couples. Compared to Panel B, the density is even more concentrated in the centre of the plot, reflecting a very high level of equality in MW in particular. There is also no evidence of asymmetry in the density around the diagonal, and hence no sign that same sex couples conform with AAM.

These density plots highlight a great diversity in how couples allocate their time. For some, allocations conform with sex-roles, as well as with AAM. But many other couples make choices which are opposed to AAM in particular. Finally, many other households allocate their time relatively equally in both spheres, and hence do not specialize at all.

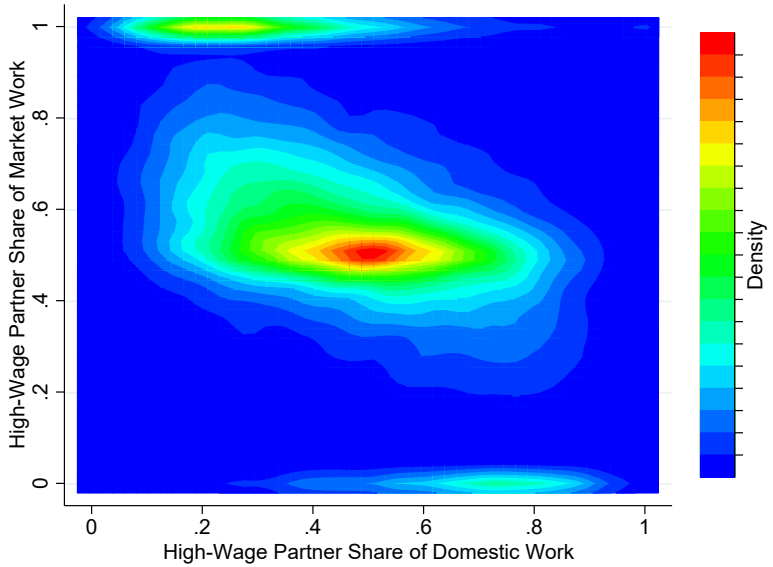
[29] Bittman et al. (2003) and Bertrand et al. (2015) find that married heterosexual women tend to contribute more to the household when their income exceeds that of their husband's, in order to compensate for deviating from prescribed social norms.

Figure 2: Within-Household Distribution of Work

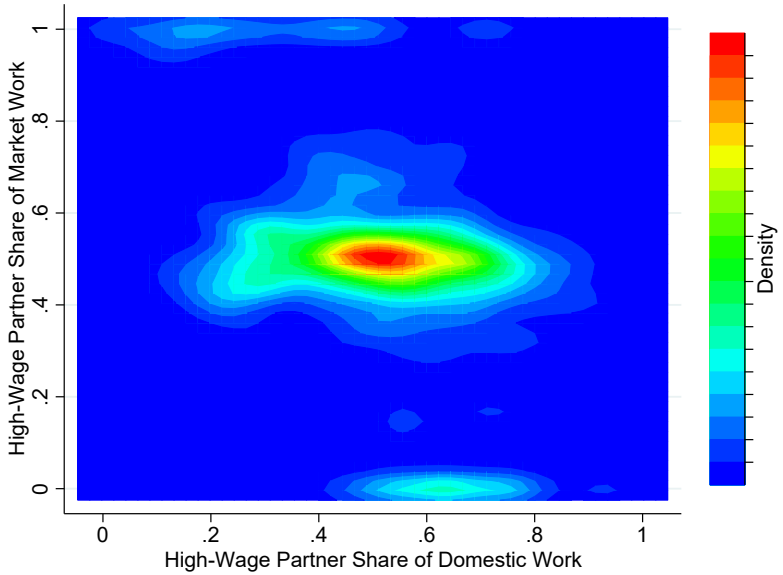
A: Share of Work Done by Female Partner



B: Share of Work Done by High-Wage Partner



C: Share of Work Done by High-Wage Same-Sex Partner



4.1 Specialization across couple-types

To the extent that same-sex couples cannot benefit from comparative advantage due to sex, we expect to observe less specialization in gay and lesbian households. However, whenever one partner has a comparative advantage in one sphere over the other, the couple may specialize to increase efficiency. AAM should therefore be relevant for same-sex households.

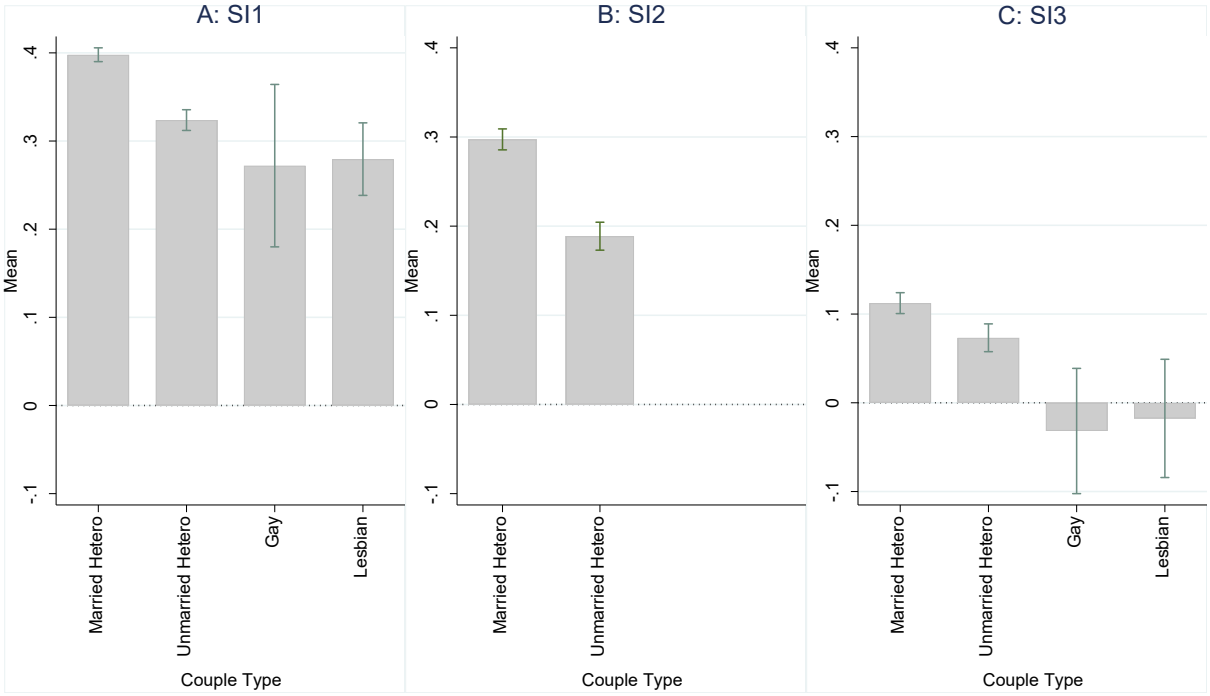
Previous work on couple-type differences in specialization has generally found same-sex couples specialize less than their heterosexual counterparts in the labor market (Black et al., 2007; Antecol & Steinberger, 2013; Giddings et al., 2014). Furthermore, married heterosexual couples exhibit by the far the largest degree of market-work specialization, ahead of unmarried heterosexual and same-sex couples (Jepsen & Jepsen, 2015). Marriage has been shown to encourage specialization and financial pooling due to its contractual nature (Badgett, 2001). This is supported by analyses showing the adoption of unilateral divorce laws in US states in the 70s and 80s reduced investment in marriage-specific human capital (Stevenson, 2007).

Figures 3 shows means of the specialization indices for a range of couple types: married heterosexual, unmarried heterosexual, gay and lesbian.[30] Panel A shows that specialization is prevalent across all couple types. Married heterosexual couples specialize much more than same-sex couples, with unmarried heterosexual couples midway between. This is consistent with earlier work (Giddings et al., 2014; Jepsen & Jepsen, 2015; Black et al., 2008). There are a number of possible explanations for this. However, in Online Appendix 3 we show that these differences are mostly explained by the presence of children, and especially young children.[31]

[30] Whilst Australia enacted legislation in December 2017 allowing same-sex marriage, this would only apply to the most recent wave of the HILDA survey. Further, as HILDA survey data is generally collected in September each year, it is unlikely any same-sex couples identified as married in wave 17 would be legally recognised as such at the time. Less than 4% of all gay couple wave observations and 2% of lesbian couple wave observations identified as married in the data. Of these, only six same-sex couple wave observations were drawn from wave 17 survey data.

[31] Other contributing factors may include marriage – to the extent that it protects the couple member specializing in the home via alimony or child support, this may enable married heterosexual couples to specialize more than unmarried heterosexual couples (Stevenson & Wolfers, 2007). Secondly, differences may reflect differences in the prevalence of child rearing across couple types. Whilst advances in reproductive technologies have enabled same-sex couples to more easily rear children, particularly for

Figure 3: Specialization by Couple Type



Panel B of Figure 3 shows the mean of SI_2 for married and unmarried heterosexual couples, respectively.[32] Similarly to SI_1, married heterosexual households specialize consistently with gender considerably more so than unmarried heterosexual households.

Panel C shows the mean for SI_3 for each couple type. The most striking results are for same-sex couples. For them, there is no evidence at all of specialization consistent with AAM. This in turn suggests that comparative advantage is irrelevant in their time allocation decisions, since sex plays no role. An alternate explanation is that productivity in market work is very strongly correlated with (unmeasured) productivity in domestic work. This would imply that AAM is unrelated to comparative advantage, which seems unlikely. Either way, the results suggest that the theory of comparative advantage does not at all explain the time allocation decisions made by same sex couples. This in turn raises the question as to whether, or why, only heterosexual couples would allocate their time in a way that reflects comparative advantage. Amongst heterosexual couples,

lesbian couples via a sperm donor, our data indicates that same-sex families still have far fewer children than comparable heterosexual families (see Online Appendix 1). Finally, differences in preferences may also explain some of the variation observed between same-sex and heterosexual families. For example, gay households are much more likely to outsource household tasks compared to heterosexual families (Goldberg, 2013).

[32] SI_2 is undefined for same-sex couples.

the mean of SI_3 is also much lower than the mean SI_2, confirming that sex plays a much larger role than AAM.[33]

In Online Appendix 3 we show that differences in observable characteristics (including children) do little to explain why heterosexuals are more likely to specialize consistently with AAM. The likely explanation is the role of sex in shaping AAM. For heterosexual couples, AAM is likely to be influenced by gendered human capital investment. In other words, for heterosexuals, AAM is confounded by sex, while for homosexual couples AAM does not seem to play a role in time allocation decisions.

A threat to the validity of the SI_3 analysis is that wage differences may only be small for some couples. For such couples, the relationship between AAM and comparative advantage may be weak. We can test the sensitivity of the results by restricting the sample to couples who have large wage differences. Table 3 shows the results when the wage gap is at least 5%, 10%, 20% and 40%.

Table 3: Mean of SI_3 by couple type and minimum wage gap

	Couple Type			
	Married Heterosexual	Unmarried Heterosexual	Gay	Lesbian
	A. > 5% wage gap			
Mean SI_3	0.124	0.079	-0.039	-0.023
(SE)	(0.007)	(0.008)	(0.038)	(0.041)
N 22,375	*16,284*	*5,783*	*115*	*193*
	B. > 10% wage gap			
Mean SI_3	0.135	0.091	-0.055	-0.007
(SE)	(0.007)	(0.008)	(0.040)	(0.047)
N 19,788	*14,516*	*5,018*	*97*	*157*
	C. > 20% wage gap			
Mean SI_3	0.161	0.115	-0.069	0.008
(SE)	(0.008)	(0.010)	(0.047)	(0.071)
N 14,750	*11,040*	*3,529*	*75*	*106*
	D. > 40% wage gap			
Mean SI_3	0.216	0.156	-0.072	-0.139
(SE)	(0.011)	(0.016)	(0.071)	(0.159)
N 6,676	*5,215*	*1,405*	*32*	*24*

[33] Similar conclusions are made if the sample is restricted to couples with valid values for both SI_2 and SI_3. For married heterosexual couples in this restricted sample, the mean of SI_2 is 0.236 and the mean of SI_3 is 0.112. For unmarried heterosexual couples, the mean of SI_2 is 0.145 and the mean of SI_3 is 0.073.

The most important results are qualitatively similar for any of these restrictions. In particular, there is no evidence of specialization by AAM for same sex couples. For heterosexual couples, the mean of SI_3 increases as the exclusion threshold is raised. Amongst heterosexual couples whose wage differs by at least 40%, mean SI_3 is 0.22 for married couples and 0.16 for unmarried couples. Nevertheless, we again note that for heterosexual couples, AAM may be an outcome of gender norms rather than an independent driver of specialization. It is for this reason that the results for homosexual couples are particularly insightful. For them at least, comparative advantage does not seem to explain time allocation decisions at all.

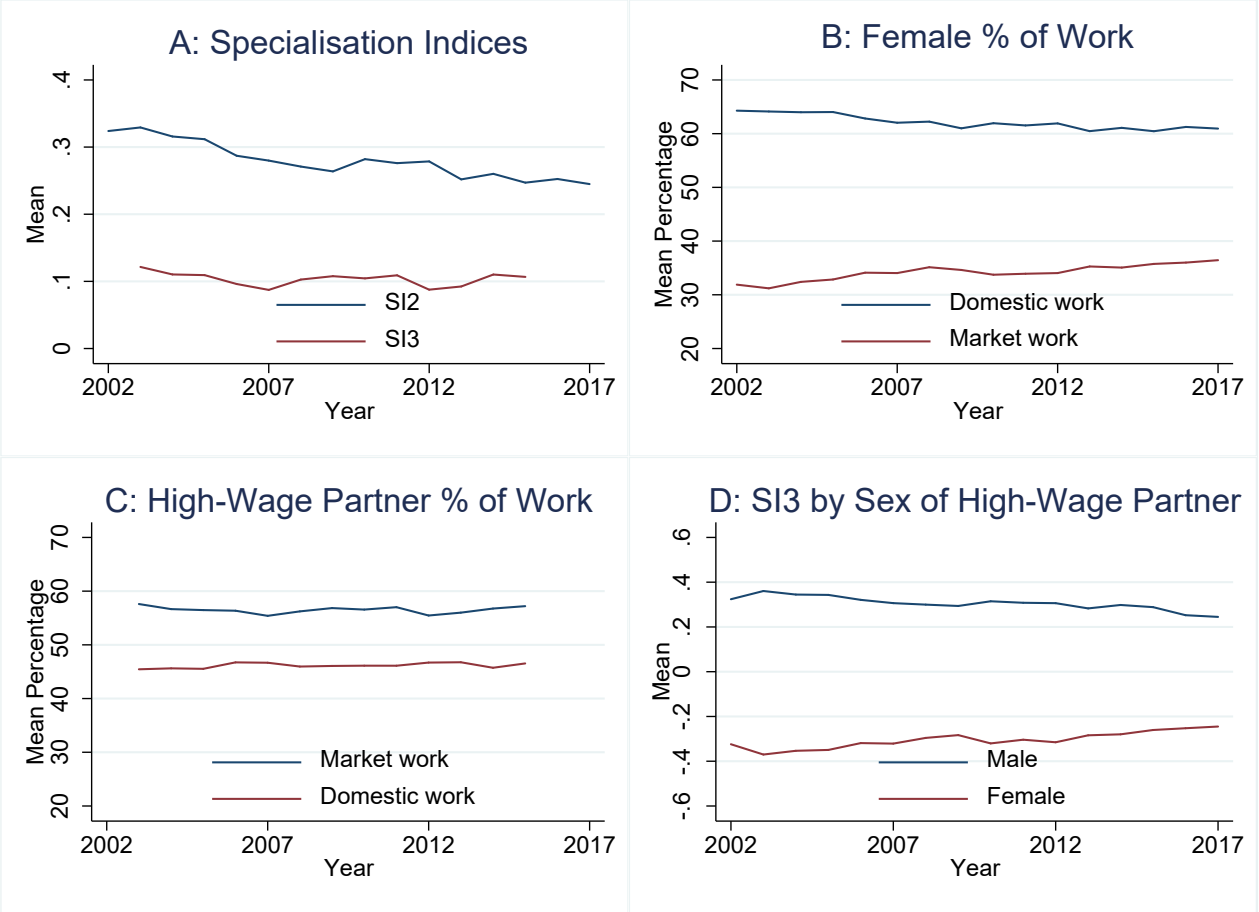
4.2 Sex-based and AAM-based Specialization Over Time

Female labor-supply has increased considerably over the past sixty or so years and continues to grow relative to males. This increase has been attributed to a number of concurrent economic and social developments (see Goldin, 2006; Goldin, 2014; Blau & Kahn, 2016). In particular, declining female fertility and the growing availability of birth control, alongside increasing labor-market opportunities for women, have enabled women to participate more in paid work (see Section 1 for a detailed discussion). This is consistent with the patterns in our data. Panel A of Figure 4 shows that sex-based specialization (SI_2) has declined considerably, from 0.32 in 2002 to 0.24 in 2017.

Despite the rise in female labor-supply, there has not been an equally sharp decline in women's domestic work time.[34] This is typified by discussions of the 'second shift' for women and the persistence of the gender wage gap at the point when couples have children (Kleven et al., 2019; Goldin, 2014). This is confirmed in Panel B, which shows the female MW and DW proportions by year.[35] The proportion of housework undertaken by the female partner has decreased (by about three percentage points), but their market work has increased has relatively more (by about 5 percentage points). This increase in women's market work time is around 70% larger than the associated decrease in female domestic work.

[34] This trend is prevalent globally. See OECD (2020) for the latest data.
[35] By construction, the male proportions of MW and DW are mirror-images of Figure 4.

Figure 4: Specialization (SI_2 and SI_3) Over Time



In contrast, the extent to which specialization conforms with AAM (SI_3) is not only small, but has remained roughly constant (Panel A). Furthermore, the share of work done by the partner with the higher wage has also stayed constant (Panel C).

To further explore the role of sex and absolute advantage, Panel D shows the mean of SI_3 over time by sex of the partner who has the higher hourly wage, amongst heterosexual couples. The 'female' series is always negative, implying that specialization is not consistent with AAM if the female has the higher wage. One potential explanation is large female absolute advantage in domestic work. However, the extent of this specialization 'away from her absolute advantage in market work' has declined considerably over time. This result again points to gender being the primary driver of household time allocation decisions.

4.3 Specialization over time

We have explored the role of absolute advantage in within-household specialization across couple-types and patterns over time. We now turn our attention to examining the extent of within-household specialization overall.

Given that sex-based specialization has declined over time and specialization according to AAM has remained stagnant, we would expect that on balance, specialization will have declined over time. This is consistent with previous work on declining labor-market specialization (for example, Giddings et al.; 2014). This is indeed what we find.

The extent of specialization has declined over the survey period. Panel A of Figure 5 shows the mean of SI_1 by survey wave, depicting a gradual decrease from 2002 to 2017. At its highest, the mean of SI_1 is 0.42 in 2003 and decreases considerably by 14% to 0.36 in 2017.

This trend seems to be driven primarily by changes in market work time. Panel B of Figure 2 shows trends in the 'concentration' of market work and domestic work. Market work concentration (for a given household) is defined as:

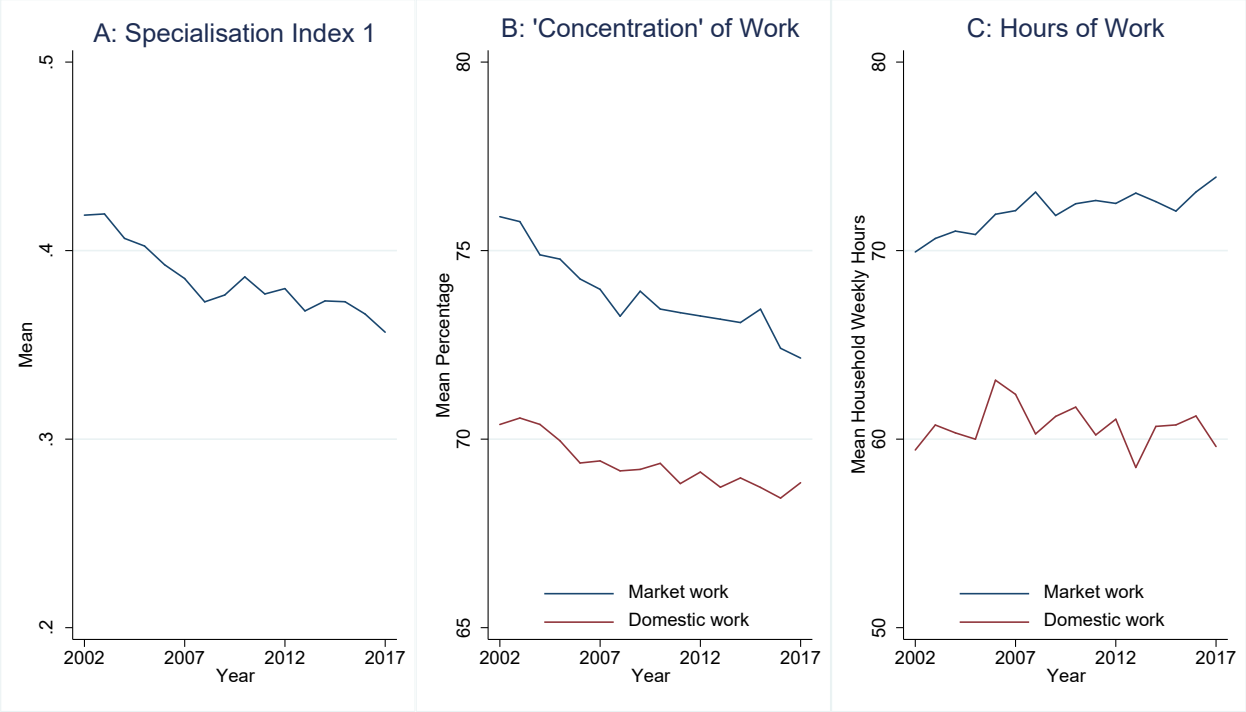
$$MWC = \frac{Max(MW_1, MW_2)}{MW_1 + MW_2} \times 100\% \quad (4)$$

MWC takes its maximum value of 100% if one person does all of the market work and a minimum value of 50% if market work is shared equally. Similarly for domestic work concentration:

$$DWC = \frac{Max(MW_1, MW_2)}{MW_1 + MW_2} \times 100\% \quad (5)$$

The overall sample mean of MWC is 74%, implying that one partner does 74% of the market work in an average household. The mean of DWC is 69%, implying that one person does 69% of the domestic work in an average household. Panel B of Figure 2 shows that the mean MWC and DWC have both declined over time. However the decline has been about twice as large for MWC.

Figure 5: Specialization (SI_1) Over Time



Panel C of Figure 5 shows mean hours spent by couples in market work and domestic work in each year. The data show no discernible trend in mean domestic work hours.[36] While previous research has documented the impact of labor-saving technologies on overall time spent in domestic production (Stevenson & Wolfers, 2007), it's likely the impact would have peaked in the mid-late 1900's, outside our period of analysis.

In contrast, market work hours have increased over time, reaching almost 74 hours in 2017. Consistent with this, both couple members participate in paid work in a growing share of couples. An average of 1.7 members per couple were employed in 2017, up from 1.6 in 2002.

4.4 Specialization and the Arrival of Children

Children are central in most discussions of specialization. Children are often cited as the greatest determinant of a heterosexual couple's division of labor (Lundberg & Rose, 2000; Bonke et al.,

[36] At a finer grain of detail, the data show some decline in mean time spend in 'housework', and in 'outdoor tasks', offset by slight increases in time spent on 'errands' and 'childcare' – all of which are included as components of our measure of domestic work.

2008; Dalmia & Sicilian, 2008) and recent studies have shown children also play a role in how same-sex families divide their labor (Antecol & Steinberger, 2013; Giddings et al., 2014; Martell & Roncolato, 2016). Children have also been shown to act as the catalyst for the gender wage gap (Goldin, 2014; Bertrand, Goldin & Katz, 2010).

As Giddings et al. (2014) suggest, since children are "usually a deliberate choice on the part of the parents, especially same-sex couples, it is potentially misleading to consider children as exogenous to household's time allocation decisions" (p. 529). For similar reasons, it is problematic to treat changes in time use allocations before and after the arrival of children as causal.

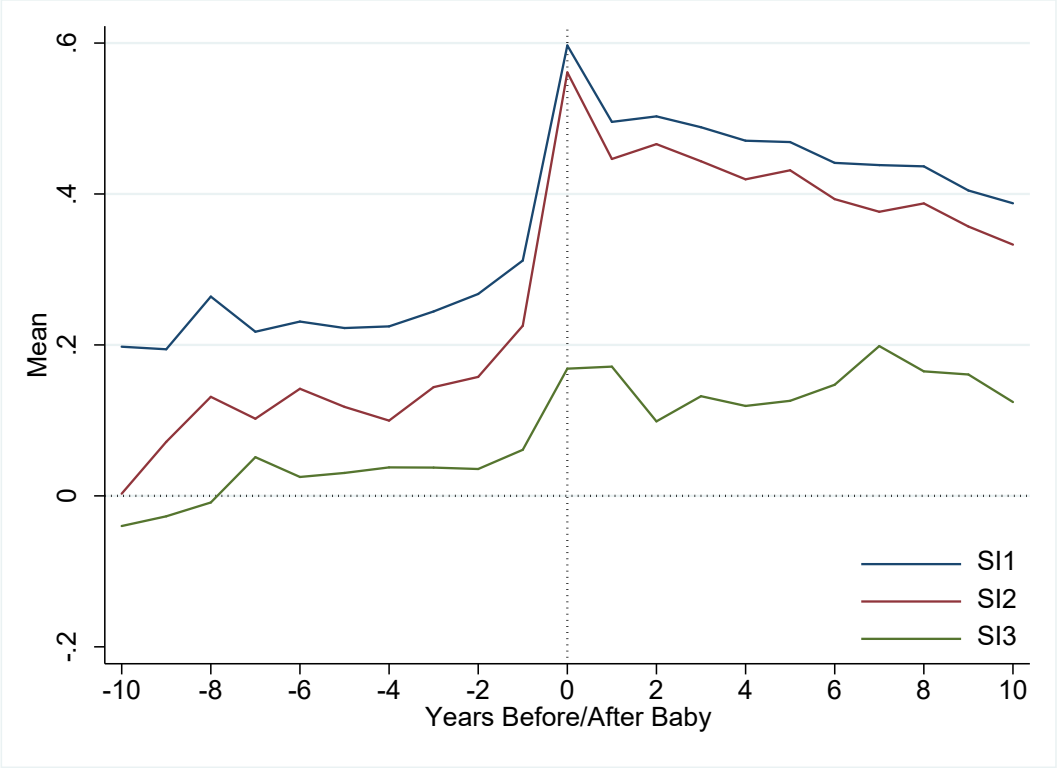
Whilst acknowledging these issues, Figure 6 shows the mean of each specialization index in the years before and after the arrival of children.[37] As expected, the arrival of children is associated with a very sharp increase in specialization overall (SI_1) from 0.31 in the year prior to the birth/adoption of the child up to 0.60 at its arrival. In subsequent years, specialization declines gradually. However, even after ten years, specialization does not decline to the point that it equals its pre-child levels.

The trend for SI_2 largely mirrors the trend in SI_1, especially in the years after a child is born. In the ten years prior to the arrival of the child, sex-based specialization is quite low, but it increases from close to zero ten years prior to around 0.2 in the year prior to arrival. This increase may reflect the fertility intentions of the parents, as families prepare for the arrival of their child.

In contrast, SI_3 shows no such discontinuity. The arrival of children – a huge positive shock in the demand for domestic labor – induces sex-based specialization, which seems to have little to do with AAM. Further, there seems to be no AAM-based specialization prior to the arrival of children.

[37] For couples with more than one recorded new child during 2002-2017, we include only the first such child.

Figure 6: Specialization before and after children



5. Testing the Beckerian Model of Comparative Advantage

We have shown above that patterns of within-household specialization appear to have little to do with absolute advantage in the market, and much to do with sex. In this section, we continue this investigation, taking a more structural approach. We specify a modified Beckerian model of time allocation and outline its predictions, and examine whether it can explain the patterns of gendered specialization that we see in the data. There are considerable theoretical and empirical challenges involved in testing the model, which we seek to clearly discuss. Ultimately, we again see little evidence that comparative advantage plays an important role in specialization decisions.

5.1 Predictions of a Beckerian Model

Couple i seeks to maximise domestic production for a single commodity Z_i as a function of purchased inputs (x) and domestic work time by each member of the couple (t_{mi} and t_{fi}):

$$Z_i = x_i^a t_{mi}^b t_{fi}^c \quad (6)$$

This is a Cobb-Douglas production function as per Becker (1973).[38] The parameters b and c represent relative productivity in domestic work for the male and female, respectively. These too are individual-specific, although we supress this from the notation for now.

Each couple maximises Z by choosing the amount of time each member allocates to market work and to domestic work (which we refer to collectively as work time). Leisure time is determined outside of, and has no explicit role in the model.[39] Allocations of leisure time may or may not be efficient or equitable, but this as irrelevant to assessing the role of comparative advantage as determinant of gendered specialization. Total time in work is specific to every individual, so that for the male in couple i, work time (T_{mi}) is the sum of domestic work time (t_{mi}) and market work time (l_{mi}), and similarly for the female. These are the time constraints:

$$t_{mi} + l_{mi} = T_{mi} \quad (7)$$
$$t_{fi} + l_{fi} = T_{fi} \quad (8)$$

The production function imposes complementarity between domestic work of the male and the female (t_{mi} and t_{fi}). But there is no complementary in male and female market work (l_{mi} and l_{fi}), since x_i is equal to the couple's earnings:

$$x_i = w_{mi} l_{mi} + w_{fi} l_{fi} \quad (9)$$

In this model, an efficient time allocation maximizes Z_i subject to the time constraints in (7) and (8) and the budget constraint in (7). Substituting (7), (8) and (9) into (6), household i's problem is to maximise:

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[38] In Online Appendix 4 we consider a more general class of CES production functions, which we draw upon when we interpret the empirical results later in this section.

[39] This is different to a standard Beckerian model, in which all time is allocated either to market work or domestic work. However, the conclusions of this section are the same if all time is assumed allocated either to market work or domestic work. We return to the role of leisure time in our discussion of equation (14) below.

$$Z_i = [w_{mi}(T_{mi} - t_{mi}) + w_{fi}(T_{fi} - t_{fi})]^a \; {t_{mi}}^b \; {t_{fi}}^c \tag{10}$$

Taking logs:

$$\ln Z_i = a \ln[w_{mi}(T_{mi} - t_{mi}) + w_{fi}(T_{fi} - t_{fi})] + b \ln \; t_{mi} + c \ln \; t_{fi} \tag{11}$$

The first order conditions are:

$$\frac{\partial \ln Z_i}{\partial t_{mi}} = \frac{-aw_{mi}}{w_{mi}(T_{mi} - t_{mi}) + w_{fi}(T_{fi} - t_{fi})} + \frac{b}{t_{mi}} = 0 \tag{12}$$

$$\frac{\partial \ln Z_i}{\partial t_{fi}} = \frac{-aw_{fi}}{w_{mi}(T_{mi} - t_{mi}) + w_{fi}(T_{fi} - t_{fi})} + \frac{c}{t_{fi}} = 0 \tag{13}$$

Equations (12) and (13) imply:

$$\frac{t_{fi}}{t_{mi}} = \frac{c}{b} / \frac{w_{fi}}{w_{mi}} \tag{14}$$

which is independent of the total time each person spends working (T_{fi} and T_{mi}), confirming that the amount of leisure time each member has does not impact the models' predicted relative domestic work time allocation. Note also that the right hand side of Equation (14) is female absolute advantage in domestic work ($\frac{c}{b}$), divided by female absolute advantage in market work ($\frac{w_{fi}}{w_{mi}}$), which equals female comparative advantage in domestic work. That is,

$$\frac{t_{fi}}{t_{mi}} = \frac{AAD_{fi}}{AAM_{fi}} = CA_{fi} \tag{15}$$

Finally, we take the logged version of equation (14), and allow b and c to be couple-specific, recognising that AAD is likely to vary greatly between couples:

$$\ln \frac{t_{fi}}{t_{mi}} = \ln \frac{c_i}{b_i} - \ln \frac{w_{fi}}{w_{mi}} \tag{16}$$

5.2 Testing the Beckerian Model

Testing whether the theoretical prediction above is consistent with our data is challenging. Nevertheless, we are able to make strong conclusions about the ability of the Beckerian model to explain the patterns in the data. We begin by outlining how we navigate these challenges:

a) The first complication is that we do not observe AAD, which is the first term on the RHS of (16). Further to this, we do not know whether AAD is correlated with AAM, or the size of this correlation. To scrutinise equation (16), we are limited to studying the bivariate relationship between $\ln\frac{t_{fi}}{t_{mi}}$ and $\ln\frac{w_{fi}}{w_{mi}}$. We can however, infer what AAD would need to be for equation (16) to hold at various values of the observed variables.

b) AAM (the second term on the RHS of 16) is likely endogenous. In particular, wages are a function of decisions in the past to invest in human capital (especially time spent in market work), and there is likely to be strong serial correlation in such time use decisions. This is especially likely to affect women's wages and time use, since men typically work full-time for most of their working-age. This implies that any observed relationship between relative domestic work time and AAM is biased away from zero. As we will show, however, this direction of bias is favourable, since the observed relationship is already very small. We can also gain further insights into this potential bias by separately considering male and female time use as a function of AAD.

c) The Beckerian model above assumes a Cobb-Douglas production function, which imposes a substitution elasticity of 1 between male and female domestic work. This has no empirical justification. Online Appendix 4 shows that relaxing this assumption with a class of CES production functions yields solutions which are similar to (16), but with s (the elasticity of substitution) appearing as a coefficient to both terms on the RHS (see equation A7). Since we do not know the true elasticity of substitution, this complicates the interpretation of both the slope and the intercept in the relationship between $\ln\frac{t_{fi}}{t_{mi}}$ and $\ln\frac{w_{fi}}{w_{mi}}$, which we examine below. We are able to navigate this complication by considering what the relative wage would have to be for predicted parity in housework. At this point, the elasticity of substitution is not relevant. For the Beckerian model to hold, AAD must exactly equal AAM, regardless of the elasticity of substitution.

d) Finally, measurement error in the relative wage would bias the slope the relationship between $\ln\frac{t_{fi}}{t_{mi}}$ and $\ln\frac{w_{fi}}{w_{mi}}$ towards zero. As discussed in Section 3, there is good reason to believe that

measurement error in wages is relatively minor, especially since we exploit panel data and take a local average of several observed wages for each person-year time-use observation.

Figure 7 shows the actual non-parametric relationship between $\ln\frac{t_{fi}}{t_{mi}}$ and $\ln\frac{w_{fi}}{w_{mi}}$. Each point represents the mean of the former for each percentile of the latter, with a superimposed linear fit. This fit is suggestive of a negative linear relationship, which is qualitatively consistent with the Beckerian model, and this is confirmed in regression analysis (Table 4).[40]

Perhaps the main feature of Figure 7 is that women do much more housework than males at every percentile of the relative wage distribution. For example, at wage parity, the fitted value is 0.446, implying that women do 56% more housework than their husbands. Even at the 99th percentile of the relative wage distribution, where women's wages are 2.4 times higher than their partners', women still do 44% more housework. It seems that no matter how large her wage advantage, a woman always has an even larger expected advantage in domestic work, if the Beckerian model holds.

A naïve interpretation of the Beckerian model outlined above would conclude that at wage parity, women are on average 56% more productive in the home, whilst at the extreme end of relative wage advantage, women are 3.5 times as productive in domestic work as their husbands (drawing on equation 16). This implies a very strong correlation between AAM and AAD. But this pattern of results could also be consistent with a different (smaller) elasticity of substitution between male and female housework. The estimated slope of the relationship in Figure 7 is -0.095. We could instead assume the elasticity of substitution is 0.095 (as per equation A7 in Online Appendix 4) and that AAD and AAM are uncorrelated. This would imply that women are 109 times more productive than their husbands in domestic work (regardless of their relative wage). This uncertainty over the elasticity of substitution and the correlation between AAD and AAM the makes it is clear that another approach is needed to interpret these results.

[40] For this analysis, we exclude observations in the top and bottom 0.5% of the relative wage distribution. The top 0.5% of the distribution in particular is characterised by outlying high values of female/male relative housework. We believe this is because extreme values in the relative wage distribution result from measurement error rather than the actual relative wage. If however, we include those observations, the main results are even stronger. These results are available on request.

Figure 7: Relative domestic work time by relative wage

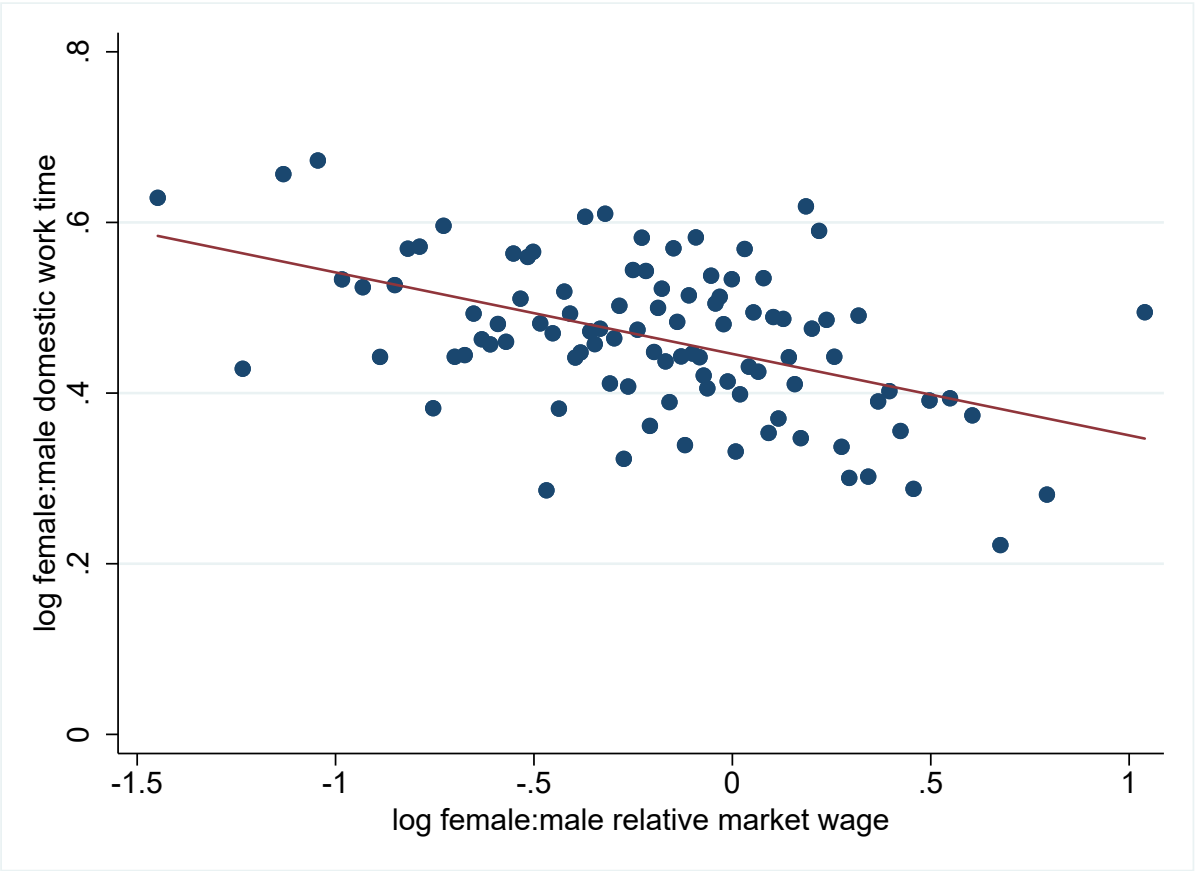


Table 4: Regressions of log relative domestic work time on log relative wage

	(1) No controls	(2) With controls
	A: All couples	
log (female wage / male wage)	-0.095***	-0.101***
	(0.030)	(0.029)
Constant	0.446***	0.434***
	(0.015)	(0.021)
N	24,003	23,622
	B: Couples without children	
log (female wage / male wage)	-0.115***	-0.099**
	(0.040)	(0.041)
Constant	0.291***	0.277***
	(0.020)	(0.030)
N	12917	12718

Notes: This table presents results from regression models which correspond to Figure 7, and equations (16) and (A7). Control variables include quadratics in female age and male age, duration of relationship, and number of children aged 0-5, 5-9 and 10-14, respectively. Standard errors in parentheses clustered on coupleID.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A more fruitful approach is to ask how large a woman's wage advantage would have to be for parity in domestic work time to be expected. This exercise requires extrapolation well outside the support of the data. However it avoids some complications, since it does not require assumptions as to the elasticity of substitution, or the correlation between AAD and AAM. Predicted parity in domestic work occurs when a woman's wage is 109 times higher (and hence that her domestic productivity is also 109 times higher).[41] This is clearly extremely high. If we restrict the sample to couples without children (drawing on Table 4 Panel B), this falls to 12.6. Whilst considerably smaller, this is still an extreme value, well outside of the support of the data.

These results are a consequence of the weak relationship between the relative wage and relative housework time. As mentioned above, however, the relative wage is likely endogenous to this relationship. But the direction of resulting bias is favourable to the emerging conclusion. For example, it is entirely possible that endogeneity explains all of this relationship (i.e. that relative wages are a consequence of earlier time use decisions, rather than a determinant of current time use decisions). If so, this would suggest that comparative advantage has no role at all in explaining gendered time use patterns.

Indeed, we find suggestive support for this endogeneity explanation if we separately consider mens' and womens' housework time. Since most men work full-time, the endogeneity of relative wages is more likely to generate a (spurious) relationship for females than for males. We separate the LHS of Equation (16) into two components, which respectively address men's and women's responses to relative wages:

$$\ln t_{mi} = -\ln \frac{c_i}{b_i} + \ln \frac{w_{fi}}{w_{mi}} \tag{17}$$

$$\ln t_{fi} = \ln \frac{c_i}{b_i} - \ln \frac{w_{fi}}{w_{mi}} \tag{18}$$

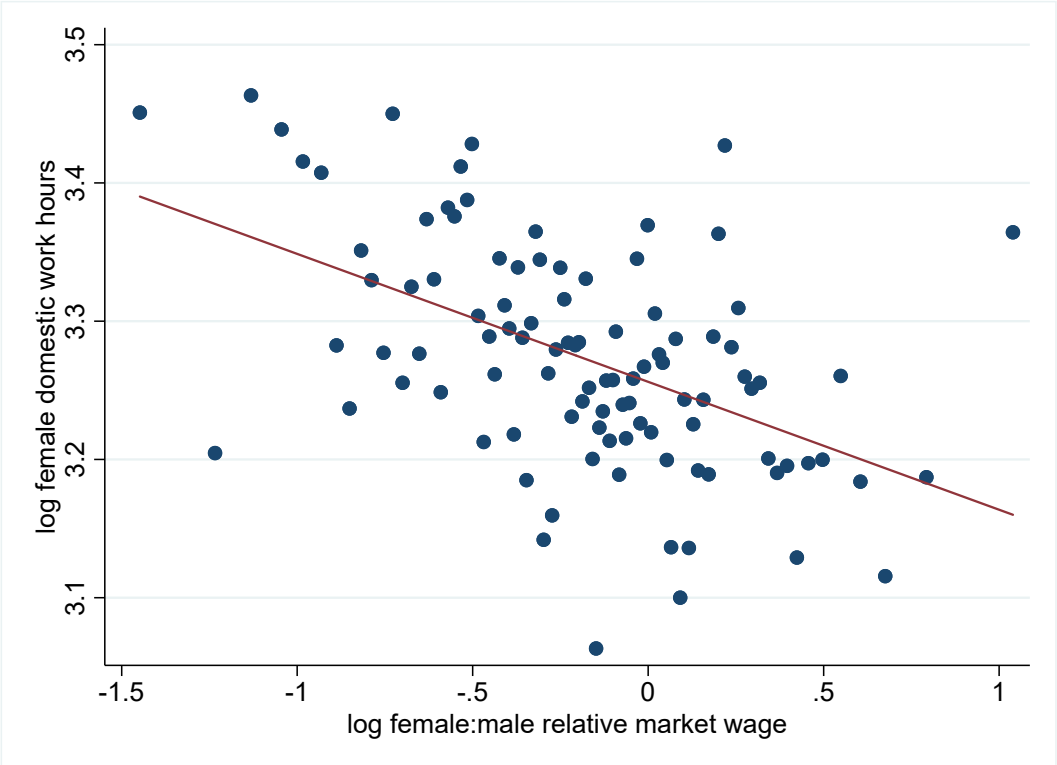
Figure 8 shows the binned-mean plots corresponding to (17) and (18), for males, and females respectively. Visually, there is no apparent relationship between male housework time and the relative wage. In contrast, there is a clear negative relationship for females.

[41] It is not a coincidence that this number (109) is the same as under the CES interpretation above. But the interpretation here is different.

Figure 8: Domestic work time and relative wage by sex

A: Males

B: Females



Results from corresponding regression models shown in Table 5 confirm this. As mentioned, this discrepancy may reflect endogeneity related to earlier female time use decisions. Whether or not this is the case, these results strongly suggest that AAM has no role at least men's domestic time use allocation, which immediately contradicts the predictions of models which assume that households allocate their productive time efficiently.

Table 5: Regressions of log domestic work time on log relative wage

	(1) No controls	(2) With controls
	A: Log male domestic work	
log (female wage / male wage)	0.003	0.009
	(0.024)	(0.023)
Constant	2.811***	1.012***
	(0.013)	(0.154)
N	24,098	23,713
	A: Log female domestic work	
log (female wage / male wage)	-0.094***	-0.093***
	(0.027)	(0.021)
Constant	3.255***	1.106***
	(0.014)	(0.137)
N	24,118	23,731

Notes: This table presents results from regression models which correspond to Figure 8, and equations (17) and (18). Control variables include quadratics in female age and male age, duration of relationship, and number of children aged 0-5, 5-9 and 10-14, respectively. Robust standard errors in parentheses are clustered on coupleID.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Overall, we reach the same conclusion as our earlier analysis – that AAM has little or no role in specialization decisions, contrary to the predictions of a Beckerian model.

6. Conclusion

Family economics has evolved considerably since Becker's seminal contributions. To our knowledge, however, Becker's explanation for the sexual division of labor - comparative advantage within households – has not previously been empirically scrutinised directly. Within-household specialization has not even been directly measured.

This paper has sought to address these gaps. We have shown that comparative advantage plays little or no role in explaining the sexual division of labor through two complementary analyses. First, drawing on newly developed specialization indices, we found that specialization conforms much more with sex than with AAM. The small role that AAM seems to have is likely overestimated, since current AAM may simply reflect earlier time use decisions which affect human capital, and are in turn driven by gender norms. Amongst same-sex couples (for whom this complication is not relevant) AAM plays no role at all in specialization. Secondly, we illustrate and test the predictions of a formal Beckerian domestic production model. Whilst there are considerable challenges in testing this model directly, we find that a woman would need to be 109 times more productive in market work than her husband before reaching expected parity in domestic work. Even this estimate is likely severely biased downwards due to endogeneity of relative wages to earlier time use decisions. Furthermore, only women's domestic work time seems to respond to relative wages, whilst men's does not respond at all. This provides further support for the endogenous AAM interpretation, since such endogeneity is likely to affect women more than men, since womens' market work hours vary much more.

By default, we conclude that gender norms are the likely explanation for the sexual division of labor – not only in the case where women's earnings are higher than males (as per Betrand *et al.*, 2015 and others).

Our specialization indices allow us to make a number of additional observations. Within-household specialization behaviour is diverse, and does not always conform with AAM or with sex. Some couples specialize completely but many do not specialize at all. Overall, the degree of specialization has fallen somewhat over recent decades, primarily due to a reduction in sex-based specialization. This reduction is in turn driven primarily by more equal participation in market work, and to a lesser extent by more equal division of domestic work. There are considerable differences between couple-types in the extent of specialization, but these are almost

completely explained by the presence of children (and to a lesser extent expectations of having children in the future).

We have attempted to contribute to the understanding of specialization and the sexual division of labor in the 21st century. However, the role of men and women in contemporary society is changing rapidly, largely due to technology, but also due to broader institutional reforms accommodating such development (consider, for example, the introduction of paternity leave in many organizations). Perhaps more than most other fields of economics, it is necessary to continually revisit the role of gender at home and at work, and the implications this has for couple-behaviour more broadly. With non-traditional households becoming more prevalent in society (for example, same-sex, polyamorous, single-parent, childless, *etc.*), and our understanding of gender becoming more complex, typical household structures will continue to shift, and the study of such behaviour will become more relevant. Thus more work is needed, and needed often, for this field to keep pace with societal change more broadly.

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Online Appendices for 'Rethinking Specialisation and the Sexual Division of Labour in the 21st Century'

Appendix 1 Additional Descriptive Statistics

Table A1.1: Descriptive statistics by Couple Type (Mean and Standard Deviation)

Variable	Married Heterosexual	Unmarried Heterosexual	Gay	Lesbian
SI_1	0.398	0.324	0.272	0.279
	(0.271)	(0.258)	(0.256)	(0.242)
SI_2	0.297	0.189	n/a	n/a
	(0.379)	(0.368)		
$SI_2 > 0$	0.795	0.690	n/a	n/a
	(0.404)	(0.463)		
SI_3	0.112	0.073	-0.032	-0.018
	(0.396)	(0.348)	(0.284)	(0.360)
$SI_3 > 0$	0.617	0.578	0.480	0.482
	(0.486)	(0.494)	(0.502)	(0.501)
Couple Age	44.023	36.076	40.169	38.813
	(9.855)	(10.661)	(9.803)	(9.625)
Couple Duration	18.427	6.072	6.201	7.034
	(10.814)	(6.367)	(4.931)	(5.526)
Children Aged 0-4	0.248	0.206	0.003	0.152
	(0.432)	(0.404)	(0.059)	(0.359)
Children Aged 5-9	0.233	0.144	0.007	0.078
	(0.423)	(0.351)	(0.083)	(0.268)
Children Aged 10-14	0.230	0.129	0.000	0.038
	(0.421)	(0.335)	(0.000)	(0.191)
Any Children < 15	0.518	0.357	0.007	0.221
	(0.500)	(0.479)	(0.083)	(0.415)
Likely to Have [More] Children	3.113	5.518	2.130	3.925
	(3.925)	(3.920)	(2.488)	(3.800)
Desires [More] Children	3.700	5.923	3.179	4.724
	(3.984)	(3.790)	(3.150)	(4.000)
Log Relative Wage	0.403	0.337	0.342	0.246
	(0.355)	(0.314)	(0.333)	(0.181)
Time-use (hours in a typical week, per couple)				
Domestic Work	63.159	50.881	26.560	46.437

	(37.372)	(39.328)	(13.546)	(38.950)
Housework	24.400	19.245	13.313	18.658
	(13.863)	(12.732)	(6.844)	(10.596)
Household Errands	9.212	8.114	7.622	7.848
	(7.016)	(6.311)	(6.125)	(5.529)
Childcare	21.446	16.302	1.713	14.263
	(27.686)	(27.639)	(7.477)	(30.890)
Outdoor Tasks	8.100	7.220	3.912	5.668
	(7.837)	(8.487)	(4.280)	(6.163)
Market Work	71.462	75.380	76.994	71.804
	(25.627)	(26.167)	(27.060)	(27.443)
Paid Employment	64.210	67.778	69.692	64.018
	(23.330)	(23.756)	(24.086)	(25.317)
Commuting	7.251	7.603	7.302	7.786
	(5.790)	(5.895)	(5.030)	(6.285)

Appendix 2 Description of Variables

Table A2.1: Description of Variables

Variable	HILDA Identifier	Construction
Hourly Wage	wscmei jbmhruc	Hourly wages defined as current weekly gross wages in main job divided by hours usually worked per week in main job. For each individual, we construct hourly wages based on their median non-missing hourly wage in a five-year window; 2 year preceding and 2 years following the current wave. Hourly wages are restricted to between AUD $1.90 and AUD $211.
Couple Type	hhpxid hgsex mrcurr	Couples are matched together based on their unique partner identifier. Gay and lesbian households are determined when corresponding partners are the same-sex, whilst heterosexual couples are different-sex. Both heterosexual partners must be recorded as married to be classified as such, else the couple is listed as unmarried. Couple type is equal to one if classified as married heterosexual, two if unmarried heterosexual, three if gay and four if lesbian.
Children Aged 0-4	hhd0_4	Dummy variable equal to one if there are one or more dependent children between the ages of 0 and 4 living in the household, zero otherwise.
Children Aged 5-9	hhd5_9	Dummy variable equal to one if there are one or more dependent children between the ages of 5 and 9 living in the household, zero otherwise.
Children Aged 10-14	hhd1014	Dummy variable equal to one if there are one or more dependent children between the ages of 10 and 14 living in the household, zero otherwise.
Couple Duration	orcdur mrcdur mrplvt	For unmarried heterosexual and same-sex couples, duration is equal to orcdur (current de-facto duration). For married heterosexual couples, duration is equal to mrcdur (current marriage duration) plus mrplvt (years living together before present marriage).
Likely to Have [More Children]	icexpct	Constructed using the average score of both couple members per couple wave observation. Considers whether the respondent is likely to have children in the future. Ranges from zero to 10.
Desires [More] Children	iclike	Constructed using the average score of both couple members per couple wave observation. Considers whether the respondent would like to have children in the future. Ranges from zero to 10.
Conservatism	atwkmpl	Constructed using the average score of both couple members per couple wave observation. Asks respondents whether they consider men to make better political leaders than women on a scale of 0 (strongly disagree) to 7 (strongly agree). Variable only available in waves 5, 8, 11 and 15. *Note:* When analysis was only restricted to these waves, the inclusion of this variable does not change the estimated coefficient for unmarried couples.
Additional Explanatory Variables used in Regression Models for SI_1		
Couple Age	hgage	Constructed by taking the average age of both couple members.
Couple Age Squared	hgage	Constructed by squaring the couple age variable.

Log Relative Wage (SI_1)		Equal to the absolute value of the log of relative wages between couple members i.e. | ln (hourly wage partner 1 / hourly wage partner 2) |
Additional Explanatory Variables used in Regression Models for SI_2		
Female Age	hgage	The age of the female partner.
Male Age	hgage	The age of the male partner.
Female Age Squared	hgage	Constructed by squaring the female age variable.
Male Age Squared	hgage	Constructed by squaring the male age variable.
Log Relative Wage		ln (hourly wage male partner/ hourly wage female partner)
Additional Explanatory Variables used in Regression Models for SI_3		
Age Higher Hourly Wage Earner	hgage	The age of the partner with the higher hourly wage.
Age Lower Hourly Wage Earner	hgage	The age of the partner with the lower hourly wage.
Age Squared – Higher Hourly Wage Earner	hgage	Constructed by the squaring the age of the higher hourly wage earner variable.
Age Squared – Lower Hourly Wage Earner	hgage	Constructed by the squaring the age of the lower hourly wage earner variable.
Log Relative Wage (SI_3)		ln (hourly wage of the partner with the higher hourly wage/ hourly wage of the partner with the lower hourly wage)

Appendix 3 Correlates of Specialisation

This appendix shows a results from a set of regression models, each with a specialisation index as the dependent variable. These models serve two purposes. First, to examine whether differences in specialisation between couple types can be explained by other observed characteristics. Second, identifying the correlates of specialisation will help to understand its drivers. We begin by showing regression results for specialisation as a whole, then for sex-based specialisation and AAM, respectively.

We estimate regressions as per the following specification:

$$SI_{it} = \alpha + \beta_c + \gamma_t + \tau \boldsymbol{X}_{it} + \varepsilon_{it}$$

Where SI_{it} is the outcome variable, representing one of the Specialisation Indices for couple *i* at time *t*, β_c is a couple type effect, with married heterosexual couples as the omitted reference group. The models include wave fixed effects (γ_t, omitting Wave 2) and a vector of couple-level time-varying observed characteristics[42] ($\boldsymbol{X_{it}}$) which are included sequentially) and ε_{it} is the error term. For all analyses, we show robust standard errors, clustered at couple level, to account for likely serial correlation.

Table A3.1 shows results for SI_1. The first column shows the results without including any of the **X** controls. These are essentially raw differences between couple types, controlling only for wave fixed effects. The differences mirror those shown in the Section 4 of the main paper. Columns 2 and 3 show that those couple-type differences are largely unexplained by simple demographic differences – namely age and couple duration.

In Column 4, we introduce a control for the presence of young children, aged 0-4. This is by far the single best predictor of specialisation. The results suggest that a young child increases SI_1 by 0.22. This is consistent with Figure 5. Furthermore, this variable appears to explain most of the difference between couple types in the extent of specialisation. It explains more than two-thirds

[42] This includes age, age squared, couple duration, children, fertility intentions and log of relative wage. For a detailed description of how each control variable is constructed, see Appendix 2.

of the difference between married and unmarried couples, around half of the difference between married heterosexuals and gay couples, and more than half of the difference between married heterosexuals and lesbian couples.

In Column 5 we also include controls for older children. They also have large and significant effects on SI_1 – albeit much smaller effects than do young children, as expected. With the inclusion of these controls, the differences in specialisation between couple types are smaller, with none of the couple-type coefficients significant at the 5% level.

Next, Column 6 includes controls for fertility intentions and expectations. These do not appear to have strong independent relationships with SI_1. Despite this, their inclusion further decreases the couple-type coefficients, and particularly for lesbian couples. This may be due to lesbian couples' high stated fertility expectations.

In Column 7, we also control for the absolute difference in hourly wage rates between couples. The results show a strongly significant positive relationship between the size of this gap and SI_1. But the estimated coefficient is small. Ceteris paribus, SI_1 is only 0.1 units higher for a couple whose hourly wages differs by 171%, as compared to a couple whose members have the same hourly wage as each other. We return to this theme in the analysis of SI_2 below. The inclusion of the relative wage variable does not change the couple-type coefficients greatly.

Overall, differences in the extent of specialisation between couple types are mostly explained by the presence of children, and to a lesser extent, expectations and desires around future fertility.

Table A3.1 Estimates from SI_1 regressions

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	0.432***	0.577***	0.584***	0.417***	0.603***	0.548***	0.450***
	(0.006)	(0.044)	(0.045)	(0.041)	(0.043)	(0.064)	(0.065)
Unmarried Heterosexual	-0.0728***	-0.0780***	-0.0750***	-0.0236**	-0.0194*	-0.0142	-0.00859
	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Gay	-0.122**	-0.122**	-0.140**	-0.0578	-0.0347	-0.0404	-0.0244
	(0.047)	(0.047)	(0.050)	(0.049)	(0.049)	(0.036)	(0.026)
Lesbian	-0.117***	-0.118***	-0.112***	-0.0565**	-0.0391*	-0.00698	0.0442
	(0.022)	(0.022)	(0.022)	(0.018)	(0.018)	(0.021)	(0.025)
Couple Age		-0.00713***	-0.00743***	-0.00664**	-0.0178***	-0.0159***	-0.0127***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Couple Age Squared		0.00829**	0.00800**	0.0106***	0.0247***	0.0224***	0.0161**
		(0.003)	(0.003)	(0.002)	(0.003)	(0.005)	(0.005)
Couple Duration			0.000661	0.00223***	0.00179***	0.00242***	0.00184*
			(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Children Aged 0-4				0.220***	0.221***	0.224***	0.208***
				(0.006)	(0.006)	(0.006)	(0.007)
Children Aged 5-9					0.0665***	0.0607***	0.0472***
					(0.006)	(0.006)	(0.007)
Children Aged 10-14					0.0462***	0.0487***	0.0271***
					(0.006)	(0.007)	(0.008)
Likely to Have [More] Children						-0.00121	0.0000398
						(0.002)	(0.002)
Desires [More] Children						0.00122	-0.000668
						(0.002)	(0.002)
Log Relative Wage (SI_1)							0.102***
							(0.010)
N	45337	45337	44567	44567	44567	27375	15118
R-squared	0.017	0.018	0.018	0.112	0.126	0.169	0.184

Notes: Standard errors in parentheses clustered on coupleID. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We now conduct a similar analysis for SI_2, shown in Table A3.2. The only changes we make are to exclude homosexual couples (for whom SI_2 is undefined), and to enter the age of each member (age of male and age of female) separately.

The estimated effects of children are even larger for SI_2 than for SI_1. Having a single young child is associated with an increase in SI_2 by 0.271, and the estimates for older children are also strongly significant.

However, these full set of controls do not explain all of the difference in SI_2 between married and unmarried heterosexual couples: half of the raw gap remains unexplained. We considered whether differences between couple types in gender attitudes may explain the gap, but they do not seem to.[43]

The most striking finding comes in Column 7. Here the estimated coefficient of relative wages is 0.1. This implies that if a woman's wage were to increase by one log point relative to her husband's, the extent of sex-based specialisation would go down by just 0.1. We further explore the role of AAM for sex-based specialisation in Section 7.

[43] HILDA includes questions on gender attitudes in only some waves (Waves 5, 8, 11 and 15). When the analysis is restricted to these waves, the inclusion of variables for conservative gender attitudes does not change the estimated coefficient for unmarried couples.

Table A3.2 Estimates from SI_2 regressions

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	0.341***	0.131	0.142*	-0.0663	0.193**	0.398***	0.344***
	(0.009)	(0.069)	(0.070)	(0.065)	(0.069)	(0.091)	(0.095)
Unmarried Heterosexual	-0.106***	-0.124***	-0.121***	-0.0580***	-0.0533***	-0.0559***	-0.0530***
	(0.010)	(0.011)	(0.012)	(0.011)	(0.011)	(0.012)	(0.012)
Female Age		-0.0176**	-0.0180***	-0.0142**	-0.0243***	-0.0218***	-0.00655
		(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)
Male Age		0.0310***	0.0309***	0.0284***	0.0229***	0.00673	-0.00604
		(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)
Female Age Squared		0.0236***	0.0236***	0.0224***	0.0354***	0.0330***	0.0134
		(0.006)	(0.006)	(0.006)	(0.006)	(0.009)	(0.010)
Male Age Squared		-0.0419***	-0.0419***	-0.0379***	-0.0313***	-0.00954	0.00459
		(0.006)	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)
Couple Duration			0.000703	0.00256**	0.00198*	0.00207*	0.00113
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Children Aged 0-4				0.271***	0.276***	0.291***	0.270***
				(0.008)	(0.009)	(0.009)	(0.010)
Children Aged 5-9					0.0747***	0.0829***	0.0638***
					(0.009)	(0.010)	(0.011)
Children Aged 10-14					0.0761***	0.0777***	0.0527***
					(0.009)	(0.010)	(0.011)
Likely to Have [More] Children						-0.000440	0.001000
						(0.003)	(0.003)
Desires [More] Children						0.00197	-0.000773
						(0.002)	(0.003)
Log Relative Wage							0.100***
							(0.010)
N	44697	44697	43980	43980	43980	26975	14,887
R-squared	0.016	0.035	0.035	0.107	0.120	0.173	0.185

Notes: Standard errors in parentheses clustered on coupleID. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We now estimate similar regressions for SI_3 (shown in Table A3.3). The main insight from these results is that observable characteristics explain less than half of the differences in SI_3 between heterosexual couples and same-sex couples. They do however, explain most of the difference between married and unmarried heterosexual couples. Put differently, whilst observables explain the couple-type differences in the extent of specialisation (as per SI_1), they do not explain why heterosexuals are more likely to specialise consistently with AAM. The obvious explanation seems to be the role of sex in shaping AAM. As argued earlier, for heterosexual couples, AAM is likely to be influenced by gendered human capital investment. In other words, for heterosexuals, AAM is confounded by sex, while for homosexual couples AAM does not seem to play a role in time allocation decisions.

Turning to the coefficient estimates in Table A3.3, children and especially young children continue to have a strong effect. However, these are much smaller than for SI_1 and SI_2. In other words, children induce couples to specialise in a way that is consistent with sex-roles far more than they induce couples to specialise in AAM. This is perhaps unsurprising, since the presence of young children is the foundation for theories of sex-based AAD, and perhaps the origin of cultural gender-roles as well.

Table A3.3 Estimates from SI_3 regressions

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	0.130***	-0.0955	-0.110	-0.143*	-0.0147	-0.00996	-0.0629
	(0.012)	(0.069)	(0.071)	(0.071)	(0.074)	(0.117)	(0.114)
Unmarried Heterosexual	-0.0388***	-0.0340**	-0.0259*	-0.0107	-0.00807	0.00294	0.00828
	(0.010)	(0.011)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)
Gay	-0.143***	-0.161***	-0.143**	-0.118*	-0.105*	-0.0887	-0.0815
	(0.035)	(0.046)	(0.051)	(0.050)	(0.049)	(0.049)	(0.051)
Lesbian	-0.130**	-0.143***	-0.135**	-0.121**	-0.110*	-0.101	-0.0780
	(0.041)	(0.041)	(0.044)	(0.045)	(0.046)	(0.060)	(0.062)
Age (Higher Hourly Wage Earner)		0.0406***	0.0404***	0.0407***	0.0369***	0.0294***	0.0268***
		(0.006)	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)
Age (Lower Hourly Wage Earner)		-0.0300***	-0.0292***	-0.0298***	-0.0336***	-0.0246***	-0.0221**
		(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Age squared (Higher Hourly Wage Earner)		-0.0305***	-0.0307***	-0.0304***	-0.0256***	-0.0144	-0.0133
		(0.007)	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)
Age squared (Higher Hourly Wage Earner)		0.0181**	0.0165*	0.0177**	0.0225***	0.00570	0.00388
		(0.007)	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)
Couple Duration			0.00114	0.00161*	0.00131	0.00370**	0.00360**
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Children Aged 0-4				0.0648***	0.0680***	0.0747***	0.0707***
				(0.013)	(0.013)	(0.013)	(0.013)
Children Aged 5-9					0.0397***	0.0412**	0.0387**
					(0.014)	(0.013)	(0.013)
Children Aged 10-14					0.0357***	0.0188	0.0172
					(0.014)	(0.013)	(0.013)
Likely to Have [More] Children						0.00208	0.00236
						(0.003)	(0.003)

Desires [More] Children						-0.00346	-0.00315
						(0.003)	(0.003)
Log Relative Wage (SI_3)							0.192***
							(0.020)
N	24715	24715	24286	24286	24286	15058	15058
R-squared	0.003	0.039	0.039	0.043	0.046	0.068	0.091

Notes: Standard errors in parentheses clustered on coupleID. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix 4 Extension of the Theoretical Model to a More General Class of Production Functions

In this Appendix, we extend the analysis in Section 5 (which draws on a Cobb-Douglas production function) to the more general class of CES productions functions. The CES production function which corresponds with (6) is:

$$Z_i = x_i^{\beta}\left[at_{mi}^{r}+(1-a)t_{fi}^{r}\right]^{1/r} \quad \text{(A1)}$$

Where $\frac{1}{1-r} = s$, where s is the elasticity of substitution between t_{mi} and t_{fi}.
Productivity in domestic work for the male and female are represented by a, and $1-a$ respectively. As with the Cobb-Douglas function, these productivities are relative, and are individually specific.

Substituting the same constraints as previously: (7), (8) and (9) into (A1), the couple's problem is to maximise:

$$Z_i = [w_{mi}(T_{mi}-t_{mi}) + w_{fi}(T_{fi}-t_{fi})]^{\beta}\left[at_{mi}^{r}+(1-a)t_{fi}^{r}\right]^{1/r} \quad \text{(A2)}$$

Taking logs:

$$\ln Z_i = \beta \ln[w_{mi}(T_{mi}-t_{mi}) + w_{fi}(T_{fi}-t_{fi})] + {}^{1}/_{r} \ln\left[at_{mi}^{r}+(1-a)t_{fi}^{r}\right] \quad \text{(A3)}$$

The first order conditions are:

$$\frac{\partial Z_i}{\partial t_{mi}} = \frac{-\beta w_{mi}}{w_{mi}(T_{mi}-t_{mi})+w_{fi}(T_{fi}-t_{fi})} + \frac{at_{mi}^{r-1}}{at_{mi}^{r}+(1-a)t_{fi}^{r}} = 0 \quad \text{(A4)}$$

$$\frac{\partial Z_i}{\partial t_{fi}} = \frac{-\beta w_{fi}}{w_{mi}(T_{mi}-t_{mi})+w_{fi}(T_{fi}-t_{fi})} + \frac{(1-a)t_{fi}^{r-1}}{at_{mi}^{r}+(1-a)t_{fi}^{r}} = 0 \quad \text{(A5)}$$

Equations (A4) and (A5) imply:

$$\frac{t_{fi}}{t_{mi}} = \left[\frac{(1-a)}{a} \Big/ \frac{w_{fi}}{w_{mi}}\right]^{s} \quad \text{(A6)}$$

Or in logs:

$$\ln \frac{t_{fi}}{t_{mi}} = s \ln \frac{(1-a)}{a} - s \ln \frac{w_{fi}}{w_{mi}} \qquad \text{(A7)}$$

This implies a linear relationship between the log relative domestic time allocation and log relative wage, similarly to the Cobb-Douglas production function as per equation (16). The only substantive difference between equations (A7) and (16) is s, the elasticity of substitution between male and female domestic work: s appears as a coefficient on both terms on the right side of equation (A7). The other apparent difference between the equations is only notational: with $\frac{(1-a)}{a}$ in (A7) and $\frac{c}{b}$ in (16) both representing female:male relative productivity in domestic work.

Appendix 5 Sensitivity analysis – treatment of missing wage observations

This Appendix shows results of sensitivity tests which aim to address potential sample-selection bias due to missing wage observations. Such issues do not affect the analysis of SI_1 or SI_2 a, since they do not rely on wage observations. But they may affect the SI_3 analysis and the assessment of the Beckerian theoretical model. In the main analysis, we have already partially addressed this issue, drawing on the panel dimension of the data. Specifically, rather than drawing only on contemporaneous observations of wages, we have used each person's median observed wage over a 5 year period. Nevertheless, for many couple-year observations, at least one member does not have a wage observation over such a 5-year period, and so they are dropped the analysis. Here we have taken three alternate approaches to deal with such missing data, which lead to progressively larger samples.

Extending the five-year wage window

First, for individuals with a missing wage in the main analysis, we extend the 5-year window as far as necessary until we observe a non-missing wage observation. Under this approach, our sample for SI_3 grows from 24,715 to 31,127, an increase of 26%. As shown in Table A5.1, the mean of SI_3 increases only marginally under this approach, from 0.103 to 0.119. The means of SI_3 by couple type are also quite similar, as are the remaining couple-type differences after observed characteristics are held constant.

Imputing a wage for self-employed persons

Next, we impute a crude wage for self-employed people for whom we still do not have an hourly wage observation. For them, we assign a wage equal to the median weekly own-business income for Australian business owners, divided by 37.5, using ABS data.[44] This approach increases the sample by a further 3,056 observations. Column (3) of Table A5.1 shows that key results drawn from this sample are very similar to those from the original sample.

Assigning the minimum wage to remaining observations

Finally, we assign the minimum wage for any remaining people who do not yet have an hourly wage observation. These are people who are not self-employed, and who did not work as employee

[44] ABS 2018, Cat No. 2071.0. This data was collected during the 2016 Australian census. For earlier (later) years, we deflate (inflate) this hourly wage estimate by 3.5% per annum.

at any wave of their time in the HILDA survey (or did not provide a valid response to the questions about earnings and hours worked in any given wave). This imputation adds another 2,831 couple-year observations for the SI_3 analysis, for a total of 37,014 observations. Key results from this sample are shown in Column (4) of Table A5.1. These are, in most respects, again very similar to those from the original sample. The exception to this is the coefficient for gay couples in Panel C, which (whilst remaining statistically insignificant) has a different sign to the earlier columns.

Table A5.1: Sensitivity of key results to treatment of missing wage observations

	Original sample (1)	Extended sample 2 (2)	Extended sample 3 (3)	Extended sample 4 (4)
A: Number of couple observations				
No. of couples with non-missing wage	24,715	31,127	34,183	37,014
B: Mean of SI_3				
Overall	0.103	0.119	0.109	0.147
by couple type:				
Married heterosexual	0.112	0.130	0.120	0.160
Unmarried heterosexual	0.073	0.075	0.068	0.095
Gay	-0.032	-0.040	-0.016	0.051
Lesbian	-0.018	0.010	-0.004	0.009
C: Couple-type differences in SI_3 (relative to married couples) after controlling for observed characteristics				
Unmarried heterosexual	0.008	-0.006	-0.009	-0.002
Gay	-0.082	-0.101*	-0.048	0.015
Lesbian	-0.078	-0.060	-0.083	-0.074

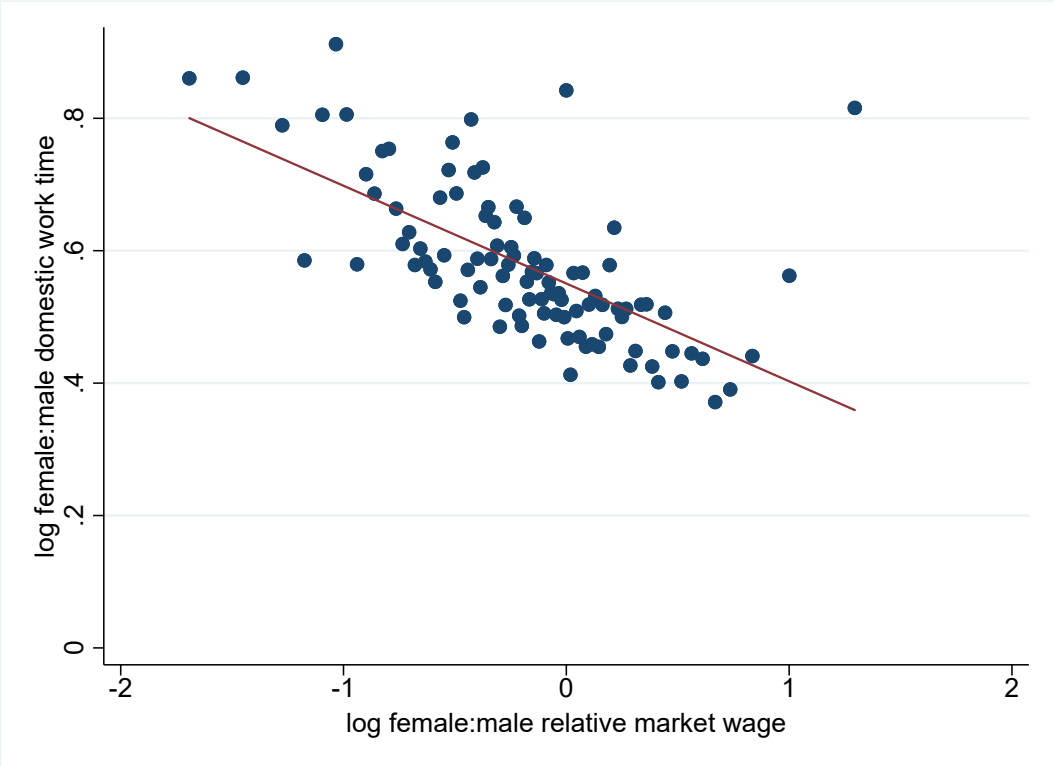
Notes: The extended samples allocate non-missing wages using an increasing liberal approach as described in the text. Estimates have been weighted, consistent with the main analysis. The results shown in Panel C correspond with the coefficients of each couple type in Column (7) of Table A3.3.

Relationship between relative domestic work time and log relative wage

The analysis in section 5 is also subject to potential sample selection bias due to missing relative wage observations. The relationship between relative work time and the log relative wage drives the key results in that section. This relationship is similar in the extended samples described above.

As an example, this is demonstrated in Figure A5.1 for Extended Sample 4. The pattern is qualitatively similar. The linear fit which corresponds with this figure implies that a woman would need to be 46 times more productive in market work than her male partner before reaching expected parity in domestic work. This is lower than the results in the main analysis, but still very high.

Figure A5.1: Log relative domestic work time by log relative wage, Extended Sample 4



Appendix 6 Sensitivity analysis – outlying reported time-use

This Appendix addresses sensitivity of key results to the treatment of extreme outliers in time use data - specifically, any observations whose reported time in paid work and domestic work exceeds the reasonable limits of non-sleeping time.

Assuming eight hours of sleeping time every day, this leaves a maximum of 112 hours that are able to be allocated between paid work and domestic labour, in line with Becker's full income hypothesis (1991). For just 1,981 couple-wave observations, the sum of at least one partner's reported hours in housework and domestic work exceeds 112 hours, reflecting less than 5% of the full sample.

Estimates testing the sensitivity of key results to the treatment of outliers are shown in Table A6.1.

After dropping extreme outliers, the mean of SI_1 declines marginally from 0.383 to 0.379. With respect to the regression estimates for SI_1, the exclusion of outliers does not change the couple-type coefficients greatly, and certainly not qualitatively, with differences in the extent of specialisation between couple types being mostly explained by observed characteristics, consistent with the main analysis.

For SI_2, after excluding outliers the sample decreases to 41,179, equal to 92% of the original SI_2 sample, and thus reflecting a proportionally higher decline in sample size compared to the first index. Despite this, the changes to both the mean and couple-type coefficients remain negligible. The overall mean for SI_2 declines marginally to 0.265, and the coefficient for unmarried heterosexual couples does not change at the three decimal place level in either size or statistical power.

Table A6.1: Sensitivity of key results to exclusion of time-use outliers

	SI_1		SI_2		SI_3	
	Original sample (1)	Excluding outliers (2)	Original sample (3)	Excluding outliers (4)	Original sample (5)	Excluding outliers (6)
	A: Number of couple observations					
No. of couples with non-missing wage	45,337	43,356	44,697	41,179	24,715	22,869
% of original sample	100%	95.63%	100%	92.13%	100%	92.53%
	B: Mean					
Overall	0.383	0.379	0.278	0.265	0.103	0.101
by couple type:						
Married heterosexual	0.398	0.394	0.297	0.285	0.112	0.111
Unmarried heterosexual	0.324	0.318	0.189	0.172	0.073	0.069
Gay	0.272	0.272	n/a	n/a	-0.032	-0.032
Lesbian	0.280	0.274	n/a	n/a	-0.018	-0.027
C: Couple-type differences (relative to married couples) after controlling for observed characteristics						
Unmarried heterosexual	-0.00859	-0.0065	-0.053***	-0.053***	0.008	0.007
Gay	-0.0244	-0.0211	n/a	n/a	-0.082	-0.079
Lesbian	0.0442	0.0457	n/a	n/a	-0.078	-0.087

Notes: The results in column (1), (3) and (5) of Panel C correspond with the coefficients of each couple type in Column (7) of Tables 5, 6 and 7 respectively. Estimates have been weighted consistent with the main analysis.

Finally, for SI_3, the sample excluding outliers is 22,869, reflecting 93% of the original sample. The mean of SI_3 decreases marginally for all couple types, with the overall mean declining from 0.103 to 0.101. Similarly, the exclusion of outliers does not change the couple-type coefficients greatly.

Overall, this indicates our results are robust to the treatment of time-use outliers, across all three indices.

The relationship between relative domestic work time and the log relative wages is shown in Figure A6.1. It is very similar to that of the main sample (Figure 7).

Figure A6.1: Log relative domestic work time by log relative wage, excluding time use outliers