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Zhiyang Jia, Thor O. Thoresen, Trine E. Vattø

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Explaining the Declining Labor Supply Responsiveness of Married Women

Abstract

While the consensus in the literature is that the labor supply of married women is more responsive than that of married men, there are indications that this gap is narrowing. Our estimations of a structural discrete choice labor supply model using repeated cross-sectional data confirms this trend for Norway – the gross wage elasticity for married women decreased from approximately 0.7 in 1997 to under 0.3 in 2019. We further demonstrate how a simulation procedure based on the labor supply model offers insights into the factors driving this decline. We identify four categories of explanations: changes in the sociodemographic composition of the population, changes in preferences and labor market options, wage changes, and tax scheme changes. Our analysis suggests that general wage growth over the period is the primary reason for the decline in responsiveness among married women.

JEL-Codes: C350, C510, H240, H310, J220.

Keywords: female labor supply responsiveness, discrete choice labor supply model, microsimulation.

Zhiyang Jia
Statistics Norway
Oslo / Norway
jia@ssb.no

Thor O. Thoresen
Statistics Norway
Oslo / Norway
tot@ssb.no

Trine E. Vattø
Statistics Norway
Oslo / Norway
tev@ssb.no

1 Introduction

Taxpayers' responsiveness to financial incentives has significant implications for optimal tax policy, as substantiated by the standard Mirrleesian framework. A prevailing regularity of the findings in the literature is that the labor supply of married females is more responsive than that of married males (Bargain and Peichl, 2016; Keane, 2022). Although the literature reports substantial within-gender variation in response estimates (Blundell and MaCurdy, 1999; Meghir and Phillips, 2010; Keane, 2011), the difference *between* genders seems to persist. However, several studies have pointed out that the gap has recently been reduced, as married females have become less responsive (Juhn and Murphy, 1997; Goldin, 2006, 2014; Blau and Kahn, 2007; Heim, 2007; Kumar and Liang, 2016; Bargain and Peichl, 2016; OECD, 2018).* Our study supports this finding, indicating a decrease in labor supply responsiveness among married Norwegian women over the last two decades.

But why is the responsiveness of married women growing closer to that of married men? According to standard economic theory, individuals decide whether to work and how much to work by comparing the value of their time in the labor market, given by their hourly wage rate, to the value they place on time spent at home (non-market time). The reduced responsiveness of married women might thus be attributed to both increased wages and lower valuation of non-market time. The aim of this paper is to investigate the various factors that influence the responsiveness of married women.

Shifts in traditional gender roles have received attention in that respect. Several studies, such as Blau and Kahn (2007), Goldin (2006, 2014), and Bertrand (2020), emphasize that men and women now share both household and market responsibilities more equally. As a result, more women are viewing employment as integral to their long-term career prospects, mirroring their male counterparts' attitudes. As women increasingly align with men in terms of career aspirations and commitment to the labor market, it is reasonable to expect this alignment to extend to labor supply responsiveness as well. Put differently, in terms of standard economic theory, it is conceivable that the values placed on market time and non-market time by men and women are becoming more similar, resulting in a reduced disparity in responsiveness.

However, the literature offers little evidence to explain the decline. This study addresses the narrowing response gap by providing a methodology and empirical examples for exploring factors influencing variations in labor supply responsiveness over time. Our novel method involves employing repeated estimations of a static structural labor supply model. In this paper, we use Norwegian data from 1997 to 2019 in the estimations. Then the estimates generated are used in a procedure based on sequences of simulations to identify the factors contributing to the observed decline in the responsiveness of married women.

We proceed in three steps. First, we obtain estimates of a discrete choice labor supply model (Dagsvik, 1994; Dagsvik, Jia, Kornstad, and Thoresen, 2014; Dagsvik and Jia, 2016) for each year in the period 1997–2019, by employing data from the Labour force survey (LFS) linked to annual income registers. We use a consistent model specification across the entire period to obtain yearly sets of model parameter estimates.

Second, we employ the estimated model for each year to simulate labor supply responses for

*One exception is Elder, Haider, and Orr (2023), in which the main finding is that labor supply elasticities have recently risen again for both married and single females in the US.

married males and married females, obtaining estimates for the uncompensated gross wage elasticity (Marshallian elasticity) over time. We find that the aggregate Marshallian wage elasticity for married females was more than halved, from around 0.7 in 1997 to below 0.3 in 2019. The male elasticity remained relatively stable at around 0.1 over the whole period, which means that the gender gap in responsiveness was substantially reduced between 1997 and 2019. We find a similar pattern for the compensated wage elasticity (Hicksian elasticity)[†] and for estimates of the extensive and intensive margins.

Third, we use the model estimates to discuss factors contributing to the reduced gap in responsiveness between married men and married women. In contrast to previous studies, which have reported declining trends in labor supply responsiveness after using micro data to estimate labor supply functions directly (see Blau and Kahn (2007), Heim (2007), and Kumar and Liang (2016)), we use the structural labor supply model to identify the contributory factors. At the outset, we establish a benchmark (or base) year, which is the first year of the period we consider (1997). A sequential simulation procedure is then operated to unravel the effects of each of the categories, which means that we bring in the explanations by turns before applying a Shapley approach to obtain average effects. The labor supply model and the accompanying simulation results specify the main explanatory factors. These are categorized into four groups: changes in the socioeconomic characteristics of the population, changes in estimated wage parameters, tax changes, and changes in preferences and opportunities in the labor market. We find that changes in wage rate predictions are the most important contributor to the falling elasticities. Changes in the socioeconomic characteristics of the population and changes in preferences and opportunities also contribute to the fall.

Moreover, we use our simulation model to examine each of the four categories more closely. For example, we see that a higher level of education for married females is likely the most important contributor in the category of changes in socioeconomic characteristics. In our model, a higher level of education will contribute to more opportunities in the labor market and higher predicted wages in the population. We also evaluate the extent to which the category of changes in the estimated wage rate predictions is driven by increased returns to education, or by a general rise in the wage level across all levels of education and experience. The latter appears to be the most important contributor to falling elasticties for married women, although we observe similar wage growth (but from a higher wage level) for males. To further explore the effects of the wage level, we obtain response estimates when the married women are instead assigned the wage of their male counterparts, and find that female elasticities still fall over time, but less steeply. Our results suggest that the wage level is important for labor supply elasticities, and indicate that a higher wage level is required for married females to exhibit the same low level of elasticities as seen for males.

The present study contributes to several strands of the literature. First, we add to the evidence on developments in the labor supply responsiveness of married women. Understanding labor supply responses is vital for devising optimal tax and transfer systems, as smaller elasticity estimates imply that progressive tax systems are less costly in terms of efficiency losses (Blau and Kahn, 2007; Diamond and Saez, 2011; Piketty and Saez, 2013). Thus, our study contributes to the labor sup-

[†]In discrete choice labor supply models, calculating the compensated effect is often considered complex (McFadden, 2001); thus, one does not often see discussion of results in terms of Hicksian substitution effects. However, recent advances in the literature (Dagsvik and Karlström, 2005; Dagsvik, Strøm, and Locatelli, 2021) have enabled us to derive elasticity estimates for the compensated effects as well.

ply research that explores the efficiency costs associated with different tax policies (Blundell and MaCurdy, 1999; Meghir and Phillips, 2010; Keane, 2011; Chetty, Guren, Manoli, and Weber, 2013; Keane, 2022). Importantly, since excess burdens are measured in terms of compensated effects, we also provide information regarding developments in the compensated response.

Second, the present study provides information on the mechanisms behind a specific pattern over time in labor supply responses. Thus, the empirical evidence is informative for policy-makers keeping track of developments in tax responsiveness. As policy-makers may manipulate instruments to reduce the efficiency costs of taxation (Slemrod and Kopczuk, 2002), information on the contribution of various factors is important.

Third, as the present study employs a discrete choice random utility model in the empirical investigation, this study adds to the literature on the use of discrete choice models in empirical tax analysis. A selection of applied studies using this modeling framework includes van Soest (1995), Aaberge, Dagsvik, and Strøm (1995), Keane and Moffitt (1998), Labeaga, Oliver, and Spadaro (2008), Blundell and Shephard (2012), and Geyer, Haan, and Wrohlich (2015). With the discrete choice approach, it is straightforward to deal with nonlinear and non-convex economic budget constraints and to apply fairly general functional forms for utility representation.[‡] In the present study, we argue that the specific discrete choice model version we use, the so-called "job choice" model (Dagsvik et al., 2014; Dagsvik and Jia, 2016), offers a useful framework. As this model extends the conventional discrete labor supply model of van Soest (1995), allowing for individuals in the labor market having a latent set of job opportunities, it widens the basis for simulations of alternative policies.[§]

The paper is organized as follows. In Section 2 we frame the topic of this paper in terms of previous literature contributions. Then, in Section 3 we provide the empirical background to our study by considering developments in participation and working hours for men and women over the time period we consider. Next, in Section 4, we present our framework for deriving response estimates, introducing the "job choice" labor supply model, and also presenting specification and estimation results. In Section 5, the model is used to describe the trend in gross wage elasticity, demonstrating that the response of married females has been in decline over the period 1997–2019. Most importantly, in Section 6, the reduced responsiveness of married females is discussed by employing the labor supply model to identify explanatory factors. The effects of changes in the sociodemographic composition of the population, wage growth, tax policy change, and shifts in preferences and opportunities in the labor market are discussed. Section 7 concludes the paper.

[‡]Admittedly, concerns have been raised about the ability of structural models to generate robust predictions about the effects of policy changes (LaLonde, 1986; Imbens, 2010). Models may be too stylized or may suffer from misspecification. More generally, such questions have prompted discussions about the advantages of structural modeling versus results derived from quasi-experimental research designs, see for example Angrist and Pischke (2010), Heckman (2010), and Keane (2010).

[§]Also Elder et al. (2023) discuss trends in labor supply responsiveness by obtaining wage elasticities through repeated estimations of discrete choice models. They discuss explanations by using the models in "counterfactual simulations".

2 Review of the literature

2.1 Different response measures

Our study is situated within the context of a limited body of research that examines the evolution of labor supply responsiveness over time. Before we present evidence from the literature on the responsiveness of female labor supply and discuss explanations for the gap between male and female responses, it is essential to precisely define the behavioral responses we are investigating.

A complication in this respect is that the labor supply literature offers estimates for a whole range of different elasticities. For example, the concept of elasticity varies depending on whether one adopts a static or dynamic perspective. In a static context, we often distinguish between the uncompensated (Marshallian) and the compensated (Hicksian) elasticities. In contrast, in an intertemporal or dynamic framework, the Frisch elasticity measures the transitory change in the hours of work, reflecting how agents plan to allocate their work effort across different periods of the life-cycle. Estimates for the Frisch elasticity are often higher, and in fact the definitions of these elasticities suggest that the Frisch elasticity is larger than both the Marshallian and the Hicksian elasticities in a life-cycle model (Keane, 2022).

A related question pertains to distinguishing between micro and macro evidence (Chetty et al., 2013; Kleven, Kreiner, Larsen, and Søgaard, 2023). In the time series study of Mertens and Montiel Olea (2018) it is argued that indicators of real activity, such as GDP, investment and employment, respond significantly to changes in marginal taxes, and the authors find short-run macro-elasticities of around 1.2. This is a larger estimate than commonly found in micro studies, likely caused by macro studies to a larger degree reflecting dynamic responses to tax changes.[¶]

The present paper discusses labor supply responses generated by a static labor supply model. Reviews have been conducted on the estimates of responses in a static setting, including Blundell and MaCurdy (1999), Meghir and Phillips (2010), Keane (2011), McClelland and Mok (2012), Chetty et al. (2013), Bargain and Peichl (2016), and Neisser (2021). In general, establishing a consensus on the level of responsiveness proves to be difficult. The survey of Blundell and MaCurdy (1999) reports median own wage elasticities (across many studies) of 0.78 for married women, whereas median elasticities for men are considerably smaller, at 0.08.[‖] In the literature that measures income response to change in the net-of-tax rate, the so-called ETI (elasticity of taxable income) literature, it is concluded that ETI estimates are predominantly found in the range from 0.12 to 0.40 (Saez, Slemrod, and Giertz, 2012).[**] Similarly, Meghir and Phillips (2010) write (p. 204): "Our conclusion is that hours of work do not respond particularly strongly to the financial incentives

[¶]In the study of Kleven et al. (2023) it is argued that elasticities also allowing for "job switches" (within and between firms) result in larger response estimates. While Kleven et al. (2023) refer to elasticity estimates reflecting job switches as long-run macro elasticities, it follows from the "job choice" model of the present study, in which behavioral effects are (theoretically) considered to be job switches (see Section 4), that a change of job is a static micro behavioral adjustment. It is also noteworthy from our discrete choice modeling perspective that research addressing the disparity between micro and macro elasticities (Chetty, 2012) contends that "indivisible labor" is a main explanation for differences between macro and micro elasticities (Rogerson, 1988; Rogerson and Wallenius, 2009), leading to significant extensive margin responses and minor intensive margin responses. Indivisible labor is part of the reasoning behind the discrete choice labor supply model.

[‖]The survey of Bargain, Orsini, and Peichl (2014) reports mean value wage elasticity estimates of 0.43 for married women and 0.11 for married men.

[**]Neisser (2021) differentiates between before-deduction and after-deduction ETI estimates and refers to mean estimates of approximately 0.4 and 0.3, respectively.

created by tax changes for men, but they are a little more responsive for married women and lone mothers."

The standard response estimate of the structural labor supply model literature is defined as the elasticity of working hours with respect to the wage rate, where the wage rate may refer to both the before-tax and the after-tax wage. For example, according to the so-called Hausman model of labor supply (Burtless and Hausman, 1978; Hausman, 1981) working hours choices are explained by the net wage, whereas response estimates obtained from the discrete choice labor supply model (Aaberge et al., 1995; van Soest, 1995; Creedy and Kalb, 2005; Dagsvik et al., 2014) typically refer to change in the gross wage. However, in terms of intensive margin effects, and as long as the agents do not change tax bracket because of the wage change, the gross and net wage elasticity will differ by the same factor over time (Creedy and Mok, 2019).

2.2 The response gap between genders is narrowing

Several studies report that the disparity in labor supply responsiveness between genders has been reduced. Goldin (2006) describes the period from the 1990s to the present as the "quiet revolution" in the involvement of US females in the labor market.[††] She argues that the increased integration of women into the labor market is evident in ongoing adjustments to the parameters of the Slutsky equation, suggesting that both income and substitution elasticities declined for all educational groups of women during the 1980s and 1990s.

Furthermore, Blau and Kahn (2007), Heim (2007) and Kumar and Liang (2016) are studies that have utilized micro data to confirm the decline in the labor supply response of married females in the US during Goldin's "quiet revolution" period. Blau and Kahn (2007) observed a reduction of 50–56 percent in married women's own (gross) wage elasticity over the period 1980–2000. They noted a steady decline in wage elasticities, measured as the mean number of hours in each period, from 0.77–0.88 in 1980 to 0.58–0.64 in 1990, and further down to 0.36–0.41 in 2000. Additionally, married women's cross-wage elasticity decreased from around -0.35 in 1980 to -0.20 in 2000.[‡‡]

Heim (2007) arrives at similar findings for the period 1978 to 2002, showing a decline in various elasticities: hours wage elasticity decreased from 0.36 to 0.14, hours income elasticity from -0.053 to -0.015, participation wage elasticity from 0.66 to 0.03, and participation income elasticity from -0.13 to -0.05. Kumar and Liang (2016) find evidence in support of a decline in married females' labor supply elasticities on the participation margin but less evidence in support of a decline on the hours margin. The participation wage elasticity declined from 0.8 in the early 1980s to 0.4 in the early 2000s.

The gender gap in responsiveness is a topic of discussion within macroeconomic approaches too; see Guner, Kaygusuz, and Ventura (2012), Bick and Fuchs-Schündeln (2018), and Badel and Goyal (2024). These macroeconomic models hinge on female labor force participation being influenced by households' balancing domestic responsibilities against women's income prospects. For example, Badel and Goyal (2024) use Markov chains to simulate the future dynamic path of the global distribution of gender labor force participation gaps, based on country data from the last 30 years. Their simulation results suggest that the process of bridging gender gaps is slow and they

[††] According to Goldin (2006) this is the fourth of several phases, starting in the late nineteenth century.

[‡‡] Cross-wage elasticity measures the responsiveness of spouse to a change in the wage of the other spouse.

predict that global gender gaps will never completely close, even in the long run.

2.3 Limited evidence to explain a diminishing gap in responsiveness

As described in the Introduction, standard economic theory implies that individual decision-making involves comparing the value of time in the market, as determined by the hourly wage rate, with the value the individual assigns to time spent at home. When the value of market time is greater than that of household work or leisure, individuals choose to participate in the labor force and optimize the number of working hours in the market. This implies that valuation of non-market time relative to market time for male and females is likely a crucial issue. Differences in gender behavior can be attributed to a wide range of factors, ranging from biology to environmental influences (Bertrand, 2011). Before delving into our approach in more detail, we briefly highlight some explanations postulated in the existing literature, including cultural norms, growing career focus, and the effects of government policies.

The literature on gender differences suggests that there are some preference differences between genders. For example, Croson and Gneezy (2009) refer to gender differences in risk preferences, social (other-regarding) preferences, and competitive preferences. A factor possibly driving the narrowing of the gender gap in responsiveness is the erosion of traditional gender roles, leading to a more equitable sharing of household and economic duties between men and women. According to both Goldin (1990) and Blau and Kahn (2007), this evolution can be linked to increasing divorce rates and heightened career orientation among married women, reducing their reliance on personal and spousal wages. Changes in norms may also play a crucial role in explaining gender disparities in labor market outcomes (Blau and Kahn, 2017). However, since social norms can either complement or underlie gender-specific attributes like preferences or personality (Elster, 1989; Maxwell and Wozny, 2021),[§§] differentiating between preferences and norms is challenging.

Turning to more tangible characteristics, the rise in female education can be expected to contribute to more gender equality in responsiveness. Despite arguments suggesting that women still opt for educational paths leading to lower anticipated earnings in the labor market compared to men (Bertrand, 2018, 2020), the prevailing notion is that higher level of education signals an increasing career focus among women (Goldin, 2006).

As we will discuss shortly, labor supply responsiveness cannot be analyzed separately from labor supply participation. Previous research has indicated that higher participation rates contribute to a decline in the labor supply responsiveness of agents (Blau and Kahn, 2007; Bastani, Moberg, and Selin, 2021). This may simply be because higher employment levels imply smaller pools of people who can be incentivized to enter the labor force. In other words, with fewer married women on the margin between participating and not participating in the labor force, their own and cross-wage labor supply elasticities are becoming more like married men's.

Furthermore, children is expected leading women to place a lower value on market time, which therefore likely results in more responsiveness among women. Recent work highlights the importance of parenthood for the observed gender gap in labor market outcomes; see Kleven, Landais, and Søgaard (2019), Andresen and Nix (2022), and Kleven, Landais, Posch, Steinhauer, and Zweimüller

[§§]Understanding gender identity is (of course) a large question, see discussions in Akerlof and Kranton (2000), Goldin (2002), and Bertrand (2011).

(2024). In light of this, the trend for increased subsidies for formal childcare, in many countries and Norway included, may have played a role in bolstering female labor market participation and also contributed to the decline in labor supply responsiveness.

Blau and Kahn (2007) and Heim (2007) discuss possible explanations for recent decreases in married women's labor supply responses in the US.[¶¶] Both papers focus on sociodemographic factors, such as number of children, as possible explanations for the substantial decline in women's responsiveness. The estimated elasticities are examined to assess the extent to which changes in the composition of the population of married women, including variations in their age distribution, education, and childbearing patterns, can account for the observed decrease. However, the results of the decompositions suggest that these factors explain very little of the decline. Consequently, both papers point to shifts in preferences across birth cohorts in favour of work as a likely reason for the observed decline.

Finally, there is reason to mention the effect of tax policy. Elasticities are calculated by incrementing gross wages, as is common in the literature. This implies that higher tax rates result in smaller net wage increments, mechanically translating into lower gross wage elasticities. Bargain et al. (2014) investigate the extent to which the observation that high-tax countries imply smaller net wage increments could explain the cross-country differences. However, their findings indicate that this is not the main explanatory channel for the differences they observe in gross wage elasticities.

3 Developments in participation and working hours over time

As already discussed and as pointed out by Blau and Kahn (2007) and Bastani et al. (2021), we expect there to be a connection between decisions regarding participation and working hours and wage responsiveness. The increase in labor supply (in terms of participation and full-time work) among females may thus be considered to indicate reduced labor supply elasticities.[***] It is therefore useful to present official statistics on developments in participation and working hours over time before going into more detail on our methodological approach to estimating responsiveness over time.

Numerous studies refer to a diminishing gender gap in workforce participation, both in the US (Blau and Kahn, 2007, 2013, 2017; Goldin, 2014; Bertrand, 2020) and elsewhere (OECD, 2021; Hérault and Kalb, 2022; Badel and Goyal, 2024). Figure 1 demonstrates a similar trend in Norway in the period we consider. Female participation has come closer to male levels since 1997, and the difference is only around 5 percentage points in 2019.[†††]

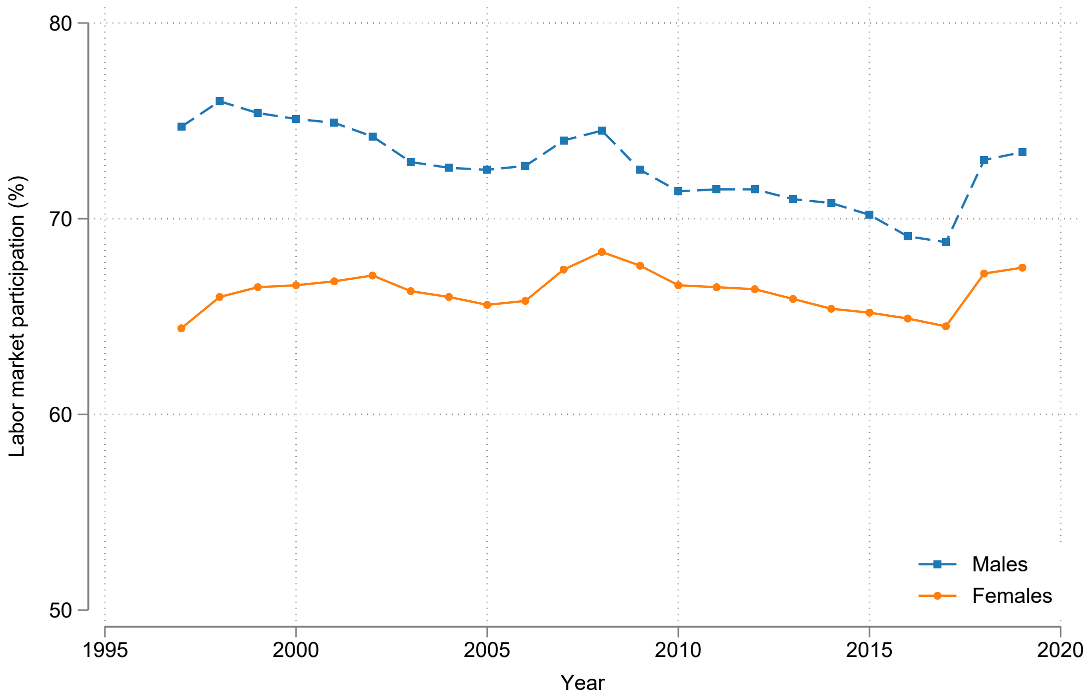
The gender disparity in the working hours of the employed is also decreasing, albeit fairly slowly, as illustrated in Figure 2. Interestingly, the main reason for a somewhat smaller gap in 2019 compared to 1997 is that males have reduced their working hours. On average, females worked just

[¶¶] Blau and Kahn (2007) distinguish between movements along the labor supply function or to which extent the labor supply function itself has changed.

[***] Presumably, increase participation and full-time work among females reflects increased gender equality in general. For example, Ellingsæter and Kitterød (2023) find that Norwegian fathers dedicated more time to both household chores and childcare in 2010 compared to 1980, even after adjusting for changes in fathers' demographics, such as increased educational attainment.

[†††] This trend extends from the mid-seventies, a period when female participation rates were below 50 percent. Since we lack data on the participation of married men and women, we provide evidence for the broader categories of men and women.

Figure 1: Labor market participation by men and women, 1997–2019



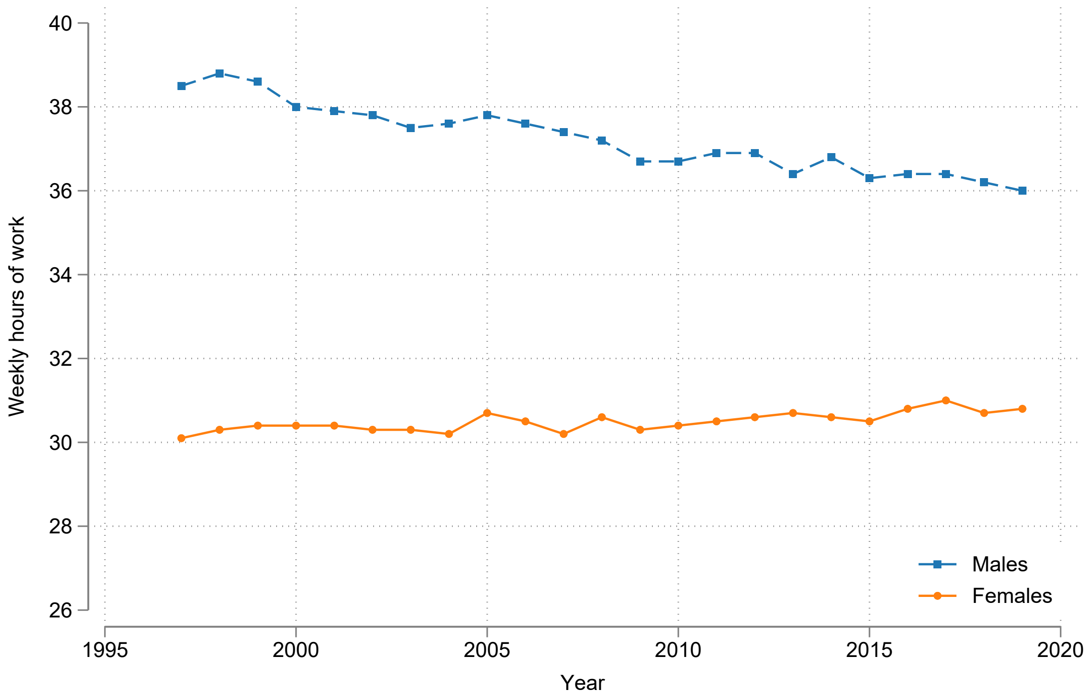
Notes: Employed aged 15-74 as share of the population, based on data from the Labour force survey (LFS) (Statistics Norway, 2024). There is a break in the time series in 2006, when the lower age threshold was reduced from 16 to 15.

over 30 hours per week through the entire period. This might not be what one would anticipate from a country often considered one of the most gender-equal countries in the world. However, despite Norway's high ranking in overall gender equality (Schwab, Samans, Zahidi, Leopold, Ratcheva, Hausmann, and Tyson, 2017), the country ranks around the OECD28 median in terms of the male-to-female difference in "usual working hours" (OECD, 2021).[‡‡‡]

Furthermore, it is noteworthy that females work fewer hours than males across all age groups, as illustrated in Figure 3. This figure underscores the notion that female part-time work cannot be attributed solely to the childcare responsibilities of mothers. Rather, the disparity in working hours between females and males seems to persist across generations and throughout the life-cycle.

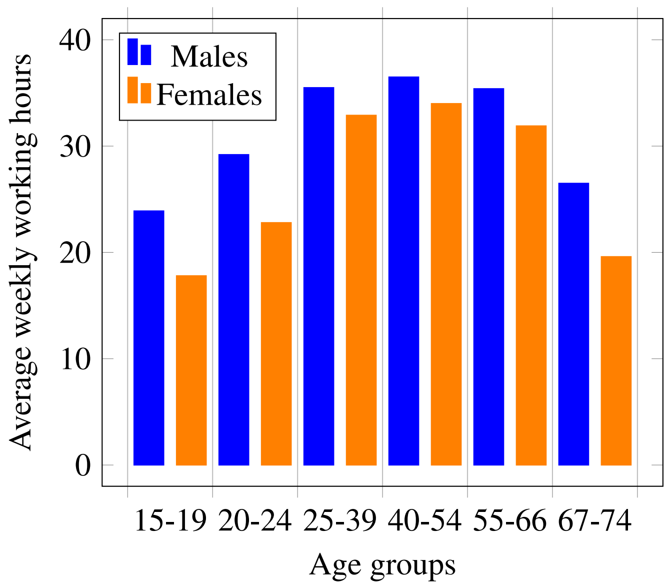
[‡‡‡]Indeed, the persistence of "stubborn gaps" in terms of gender labor market gaps raises questions about the difficulty of completely closing them (OECD, 2018).

Figure 2: Average weekly working hours for employed men and women, 1997–2019



Notes: Figures from register-based employment data (Statistics Norway, 2023a). A person is defined as employed if he/she worked at least one hour in the reference week.

Figure 3: Average weekly working hours for employed men and women by age, 2019



Notes: Figures from the Labor force survey (Statistics Norway, 2024).

4 Estimation of a discrete choice labor supply model

4.1 The job choice model

Whereas previous studies of female labor supply responsiveness, such as Blau and Kahn (2007), Heim (2007), Bishop, Heim, and Mihaly (2009), and Kumar and Liang (2016), obtain elasticity estimates by analyzing cross-sectional or panel data directly, our empirical investigation is based on the estimation and simulation of a structural labor supply model. We employ a discrete choice model referred to as the "job choice" model (Dagsvik, 1994; Dagsvik et al., 2014; Dagsvik and Jia, 2016)[§§§] and focus on response estimates for married couples.[¶¶¶]

The essential elements of the job choice model are as follows: agents have preferences for job types (or non-pecuniary job attributes), hours of work and consumption (disposable income). Hours of work is treated as a fixed job-specific attribute, i.e., given a job, hours of work follows. The agent faces two types of constraints. First, the agent faces a standard economic budget constraint. Second, the agent selects a job from a limited (latent) choice set of available jobs. The choice sets are agent-specific and may be characterized as endogenous for the labor market as a whole (determined outside our model), but exogenous for the given worker in our model.

Without any loss of generality, the main elements of the model can be explained from the perspective of a single decision-maker. Let $U(C,h,z)$ denote the utility function of the household, where C denotes household consumption (disposable income), h is hours of work, $z = 1,2,...$, indexes labor market opportunities (jobs) and $z = 0$ indexes the non-market option. A job z, is associated with a specific number of hours of work. The variation in the choice sets of jobs could reflect variations in qualifications and availability. The utility function has the structure

$$U(C,h,z) = v(C,h)\,\varepsilon(z), \tag{4.1}$$

for $z = 0,1,2,\ldots$, where $v(.)$ is a positive deterministic function and $\varepsilon(z)$ is a positive random taste-shifter. The random taste-shifters capture the effect of unobserved heterogeneity in preferences over non-pecuniary attributes that affect preferences across agents and across alternatives. Whereas the functional form of the deterministic part of the utility, $v(C,h)$, can be very general, the separability condition in equation (4.1) is crucial. The random taste-shifters are assumed to be independent and distributed according to the Frechet c.d.f. $\exp(-1/x)$, $x > 0$. The motivation for this particular distribution function is that it leads to labor supply choice probabilities that satisfy Luce's choice axiom, also known as the Independence from Irrelevant Alternatives assumption (IIA).

The modeling framework for couples is similar to the case for a single-person household. Taking the unitary model as the point of departure, let $U(C,h_F,h_M,z)$ denote the utility function of a

[§§§]See also Thoresen and Vattø (2015) and Rees, Thoresen, and Vattø (2023) for applied work utilizing the "job choice" model. The model is also part of the LOTTE system of microsimulation models (Jia, Larsen, Lian, Nesbakken, Nygård, Thoresen, and Vattø, 2024), used to predict labor supply effects of changes in the personal income tax in the tax policy-making process of Norway.

[¶¶¶]Unfortunately, we do not have information on cohabitation. We will return to a discussion of the implication of not having information on cohabiting females when discussing explanations for the decline in responsiveness in Section 6.2.

See for example McFadden (1984) for further discussion of standard results of the random utility discrete choice model.

We follow the traditional "common preference model" and assume that the couple maximizes a joint utility funchousehold, where h_F and h_M are hours of work for the female (F) and male (M) spouses, respectively, and $z = (z_F, z_M)$ indexes the combination of jobs for the couple in the household. As with one-person households, assume that $U(C, h_F, h_M, z) = v(C, h_F, h_M)\,\varepsilon(z)$, with interpretation that is analogous to the single-agent case above. The budget constraint can now be written as

$$C = f(h_F w_F, h_M w_M, I), \tag{4.2}$$

where w_F and w_M are wage rates for the male and female spouses, respectively, I is non-labor income, and $f(.)$ is the function that transforms gross income into household disposable income. Let $\phi(h_F, h_M | w_F, w_M, I)$ be the joint density of hours of work for the female and male spouses in the household, for given wage rates and non-labor income (I). The empirical counterpart of this density is the fraction of couples where the husband works h_F hours and the wife works h_M hours, within the sub-population of couples with wage rates and non-labor income equal to (w_F, w_M, I). Then, under the IIA assumptions we obtain the conditional density of (h_F, h_M), which equals

$$\phi(h_F, h_M | w_F, w_M, I) = \frac{v(f(h_F w_F, h_M w_M, I), h_F, h_M)\, m_F(h_F)\, m_M(h_M)}{\sum_{x,y} v(f(x w_F, y w_M, I), x, y)\, m_F(x) m_M(y)}, \tag{4.3}$$

where $m_F(h_F)$ and $m_M(h_M)$ are the number of feasible jobs, with offered hours h_F for the female and h_M for the male. $m_F(0)$ and $m_M(0)$ are normalized to 1.

The model is not non-parametrically identified; see Dagsvik and Jia (2016) for detailed discussion. Identification is achieved through functional form assumptions with respect to the utility function and the opportunity measure, which we will return to below.

4.2 Empirical specification

4.2.1 Hours of work and wage regression

For all individuals, we specify eight feasible weekly-hours-of-work options, $h \in \{0, 4, 12, 20, 28, 37.5, 45, 50\}$. Since we estimate the model for couples, this implies that each couple has 8×8 possible combinations of working hours. However, as there is less support for non-work by both spouses in our data sample, we exclude this option. This means that there are $8 \times 8 - 1 = 63$ possible combinations of working hours for the couple. We assume that the wage rate is individual-specific and not job-specific. Individual wages are predicted from a wage regression, with education and experience as the main explanatory variables. We also allow for unobserved heterogeneity across individuals by introducing a random effect in the wage equation.

tion subject to pooled budget constraints. However, the model can also be interpreted as a special case of the collective labor supply model (Chiappori, 1988, 1992), where bargaining power remains unaffected by labor market choices.

In Dagsvik et al. (2014), it is argued that this loosens the restrictive form of the model that follows from the IIA property.

4.2.2 The utility function

Following Dagsvik and Jia (2016), we assume that the deterministic part of the (joint) utility function can be represented by a Box-Cox function with the following form,

$$\log v(C, h_F, h_M) = \beta_C \left(\frac{\left[10^{-4}(C - C_0)\right]^{\alpha_1} - 1}{\alpha_1} \right) + \left(\frac{(L_F)^{\alpha_F} - 1}{\alpha_F} \right) X_F \beta_F \\ + \left(\frac{(L_M)^{\alpha_M} - 1}{\alpha_M} \right) X_M \beta_M + \beta_{MF} \left(\frac{(L_M)^{\alpha_M} - 1}{\alpha_M} \right) \left(\frac{(L_F)^{\alpha_F} - 1}{\alpha_F} \right), \tag{4.4}$$

where C_0 is a subsistence level for consumption, set at approximately NOK 40,000. $L_k, k = F, M$ represent leisure for gender k, with $L_k = 1 - \frac{h_k}{70}$, and αs and βs are unknown parameters. Note that we have subtracted a subsistence level, which allows for sleep and rest, equivalent to about 70 hours per week. X_k is a vector of an intercept and taste-modifiers given by age, age squared, number of children below and above 6 years of age for the female and male of the couple, respectively. Disposable income, C, is measured as the sum of the annual household wage incomes after tax, household capital income after tax, and transfers such as child benefits.

4.2.3 The job opportunity measure

Although the sets of jobs that are available to the respective workers are latent (to the researcher), the discrete choice methodology enables us to represent the choice sets of job opportunities in the model. The job opportunity measures, $m_F(h_F)$ and $m_M(h_M)$, representing labor market restrictions, can be regarded as sufficient statistics for the choice sets of available jobs (Dagsvik and Jia, 2016).

The job opportunity measures are further specified for gender k in the couple and ($k = F, M$), as $m_k(h_k, w_k) = \theta_k g_k(h)$. θ_k is interpreted as the normalized total number of jobs (relative to non-participation) and we allow it to depend on the individual's years of education, S, where $log\theta_k = \gamma_{k1} + \gamma_{k2} S$. $g_k(h)$ is the fraction of jobs available to the agent with offered hours of work equal to h, independent of individual characteristics. The latter assumption can be justified because restrictions on hours are to a large extent considered to be determined by labor market institutional regulations and negotiations between employer and worker organizations. More precisely, we let $g_k(h)$ be uniformly distributed among the various working hours options, except for two possible peaks (estimated within the model) for full-time and part-time jobs. The full-time peak corresponds to 37.5 hours per week, while the part-time peak is set at 20 hours per week.

4.3 Data description and model estimation

4.3.1 Data

The labor supply model is estimated using cross-sectional data sets for all years from 1997 to 2019. Each data set is obtained by linking the LFS (Statistics Norway, 2024) to administrative information from Income and wealth statistics for households (Statistics Norway, 2023b) by unique individual identification numbers. The LFS provides detailed information about employment and hours of

This corresponds to approximately 4,100 euros and 4,500 US dollars according to average exchange rates for 2019: 1 EUR = NOK 9.85 and 1 USD = NOK 8.80. Levels are adjusted by the consumer price index.

work for a representative sample of individuals and their spouses. The income data add additional information on annual wage income and other income sources, as well as information on family composition, children, education, etc.

The LFS provides data on both actual and formal working hours in primary and secondary jobs, along with demographic characteristics and occupation details. Respondents are asked to classify themselves as either self-employed or employees. Households where one adult earns self-employment income exceeding NOK 80,000 (adjusted for 1997 prices) are excluded from the analysis. A person is considered to be working if he/she reports working at least one hour per week. Working hours are calculated as total formal hours worked in both primary and secondary jobs (if applicable). In cases where this information is unavailable but the respondent is active in the labor market, data on actual working hours is utilized.

Age restrictions are imposed, allowing only couples where both spouses fall within the age range of 26 to 62 years to be included in the analysis. This restriction is motivated by the fact that individuals under the age of 26 are often engaged in education, while those over 62 years frequently opt for early retirement.

We obtain measures of hourly wage rates by dividing annual labor income by (formal) hours of work.

4.3.2 Estimation results

It is important to note that the parameters for preferences and opportunities are estimated jointly, while the wage regressions are estimated separately prior to the main estimation.

The log wage rate is assumed to be a function of worker's years of education, experience (in quadratic terms) and marital status. We use median regression instead of OLS to avoid sensitivity of estimates sensitivity to potential outliers in our sample. The estimation results for wage regressions are shown in Table A1 in Appendix A for three selected years, 1997, 2008 and 2019.

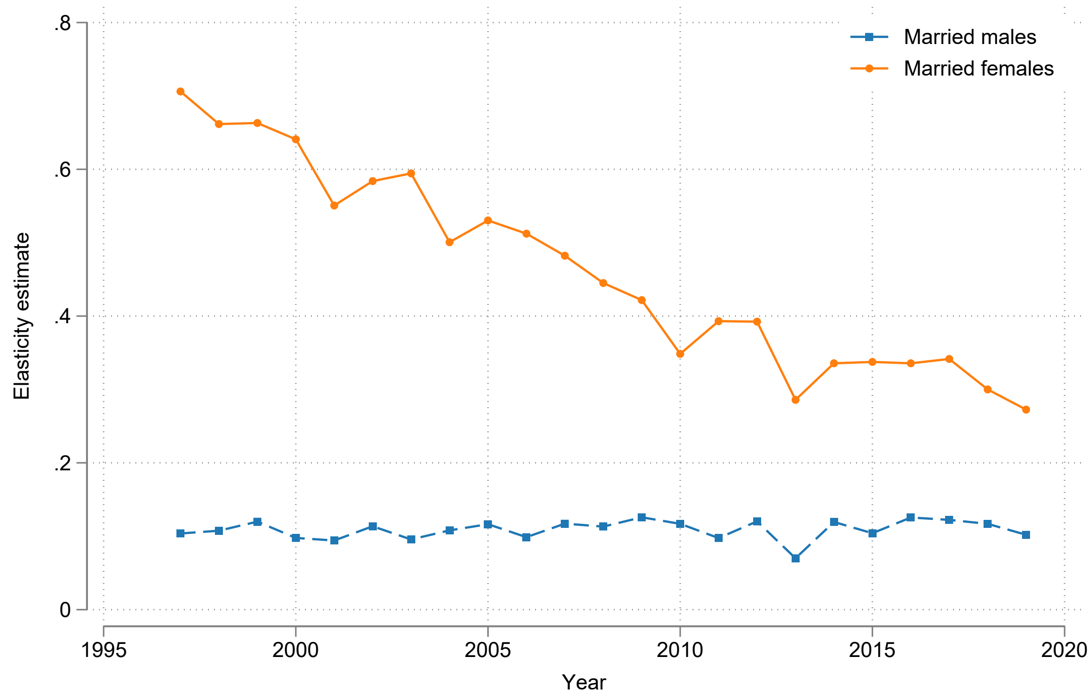
The job choice model is estimated using the maximum likelihood method. The estimated parameters of the model are reported in Table A2 in Appendix A for year 2019. In order to illustrate model performance, Figure A1 (in Appendix A) displays observed fractions and predicted probabilities for discrete ranges of female working hours across selected years from 1997 to 2019. We find that the model fits the data well for all years. Across all years, utility functions exhibit concave shapes and increase with consumption and leisure, and the job opportunity measure has the expected sign. Furthermore, we find evidence of individual heterogeneity in preferences and job opportunities. In particular, the estimated parameters show preference heterogeneity depending on the presence and ages of children.

5 Declining labor supply elasticities for married women

5.1 Evidence of the Marshallian elasticity

The labor supply elasticity estimates for each year from 1997 to 2019 serve as the starting point for the empirical investigation. It follows from the methodological framework of the present study that elasticities are simulated, comparing expected working hours in a benchmark simulation with an alternative simulation in which we increase the individual wage rates by 1 percent. We report

Figure 4: Gross wage Marshallian elasticity estimates for married men and married women, 1997–2019



Notes: Elasticity estimates are obtained from discrete choice labor supply model simulations. Estimates are obtained by increasing the gross wage by 1 percent and comparing the aggregate labor supply under this alternative to a benchmark with no wage increase.

so-called aggregate elasticity estimates, which are derived by dividing the mean percentage increase in working hours by the mean percentage increase in wages.

Figure 4 reports the estimated (total) Marshallian own wage elasticity for both married males and married females over the period 1997–2019. Despite some fluctuations from year to year, the figure illustrates a distinct downward trend for married women. Wage elasticity is reduced by more than half, from around 0.7 in 1997 to below 0.3 in 2019. In contrast, no significant change is observed for married males; their wage elasticity estimates remain relatively stable at a low level, hovering around 0.1 throughout the period. Thus, these results clearly affirm the convergence of the labor supply responsiveness of married females and married males, consistently with previous studies such as Blau and Kahn (2007) and Heim (2007).

5.2 Is there a decline in the Hicksian elasticity too?

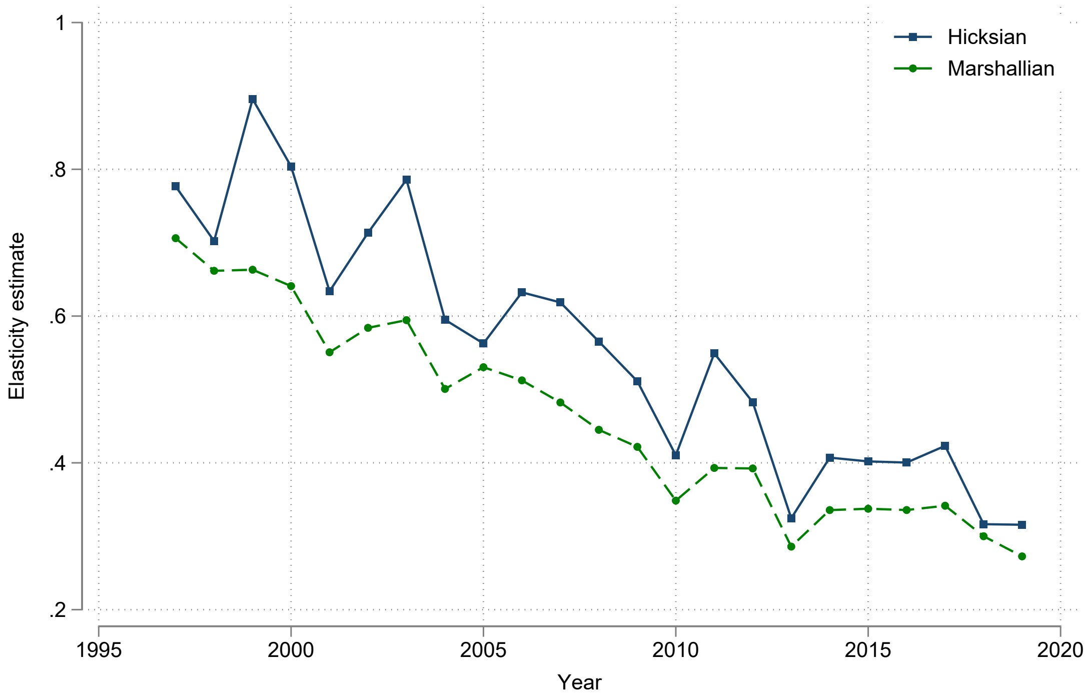
As the excess burden or the deadweight loss of tax policy change is conventionally measured in terms of compensated effects, we investigate the extent to which the compensated (Hicksian) elas-

A slightly different approach is to estimate the individual elasticities first, and then compute the average of the individual elasticities.

More details on the elasticities, including differentiating between extensive and intensive margin responses, as well as cross-wage elasticities are reported in Table A3 in Appendix A. We find no systematic changes in the cross-wage elasticities over time.

A similar declining pattern for married women and stable responses for married men are also found by Raavand (2017) on Norwegian data, using a reduced form identification strategy to recover elasticity estimates.

Figure 5: Gross wage Marshallian and Hicksian elasticity estimates for married women, 1997–2019



Notes: Marshallian elasticity estimates are obtained from discrete choice labor supply model simulations. Estimates are obtained by increasing the gross wage by 1 percent and comparing the aggregate labor supply under this alternative to a benchmark with no wage increase. The Hicksian elasticity estimates are obtained following the method proposed by Dagsvik et al. (2021).

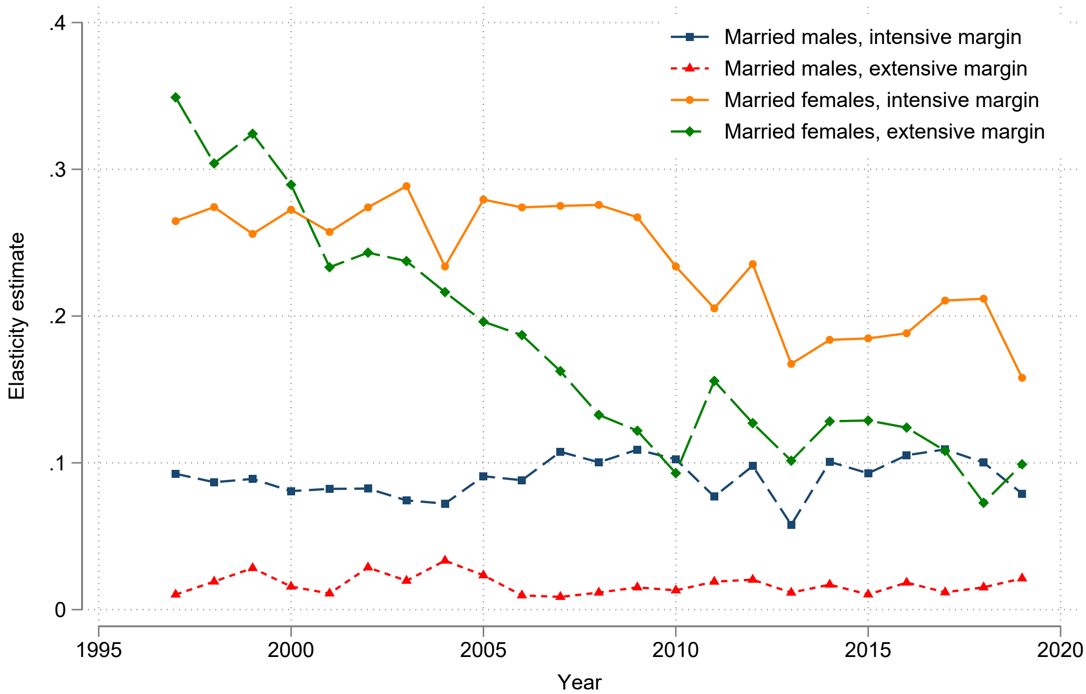
ticity of females follows the same downward trend as observed for the Marshallian response. A main empirical challenge is that the traditional Slutsky equation does not generally apply when the random utility discrete choice model is employed in empirical work. In a discrete choice model, the labor supply function is a non-differentiable stochastic function that cannot be expressed in closed form. Nevertheless, Dagsvik and Karlström (2005) and Dagsvik et al. (2021) demonstrate how one may compute the the marginal Hicksian effects of aggregate labor supply, such as the marginal effect of the probability of working and of mean hours of work. Drawing on these contributions, we derive estimates for the Hicksian elasticity.

Estimates of the Hicksian elasticity for married females are reported in Figure 5, alongside the Marshallian elasticity estimates for the same group. The figure shows that over time the pattern for the Hicksian elasticity basically parallels developments in the Marshallian elasticity. Although displaying more pronounced fluctuations, the overall trend in the Hicksian elasticity closely aligns with that of the Marshallian effect. Given that estimates of the compensated effects are relatively close to the uncompensated effects, this suggests that income effects are small.

5.3 Declining elasticities at both the extensive and the intensive margin

In Figure 6 we explore developments in the Marshallian elasticity by differentiating between the effects on the extensive and intensive labor supply margins. The extensive margin effect for married men consistently remains lower than the intensive margin effect, and remains relatively flat

Figure 6: Gross wage Marshallian and Hicksian elasticity estimates for married men and married women. Extensive and intensive margins, 1997–2019



Notes: Elasticity estimates are obtained from discrete choice labor supply model simulations. Estimates are obtained by increasing the gross wage by 1 percent and comparing the aggregate labor supply under this alternative to a benchmark with no wage increase. The extensive margin response reflects the effects on the probability of working, whereas the intensive margin response reflects working hours conditioned on participation.

throughout the period from 1997 to 2019. For married women, elasticities at both the extensive and the intensive margin decline. The most significant drop occurs at the extensive margin, as also seen in Kumar and Liang (2016). At the beginning of the period, the extensive margin elasticities exceed those of the intensive margin, but this changes after the year 2000, when the intensive margin elasticities begin to dominate. In the next section, we will focus on the total Marshallian elasticities without splitting responses into extensive and intensive margins.

6 Explaining the reduced responses of married women

6.1 Identification of explanatory factors by simulations

We now redirect our focus to the central question addressed in this paper: explaining why labor supply responses diminish over time. We frame our discussion in terms of the characteristics of the job choice labor supply model, contending that employing a structural model enhances understanding of the factors contributing to the decline in elasticity estimates. Previous studies, such as Blau and Kahn (2007) and Heim (2007), have used regressions on micro data directly in their empirical investigations, which makes it more difficult to disentangle the different mechanisms.

Considering the elements of the job choice model, our focus revolves around four categories of explanations for the decline in the gross wage elasticity of married females: (i) changes in the sociodemographic composition of the population; (ii) changes in wage rate predictions; (iii) tax policy changes; (iv) shifts in preferences and changes in labor market opportunities. We do not distinguish between preferences and labor market opportunities for two reasons. First, while the job opportunity measure is a key component of the job choice model, identifying labor market options from preferences relies on functional form assumptions, as individual labor market opportunities are not directly observable. Second, within the discrete choice framework, the magnitude of estimated utility and labor market option parameters is determined by the variance of the error term at the year of estimation (McFadden, 1984). However, normalizing the overall scale of utility in this way may have detrimental implications when effects are analyzed over time. Therefore, to address these concerns, we choose to connect the preference parameters to the parameters representing the demand side factors of the labor market.

The identification strategy relies on comparing predicted gross wage elasticities for various restricted model versions, where we sequentially introduce new contributing factors. In the following we elaborate on how we derive estimates of the contributions of the four categories of explanatory factors by focusing on a specific sequence or order. We will return to how we obtain our main results, which are independent of the specific order of the explanatory factors.

The benchmark year for our time series is 1997, characterized by an estimate of the labor supply response of married females, e_{1997}. For a given year, t, after 1997, $t \in [1998, 1999, ..., 2019]$, e_t refers to elasticities derived from simulations of the "full model" (the results of which can be seen in Figure 4). Essentially, our method separates out the effects of different explanations for the decline in this overall gross wage elasticity from the benchmark year (1997) to year t.

In the first simulation, for each year from 1998 to 2019, we keep all model parameters fixed at their values in the benchmark year (1997), but employ year-specific datasets in the simulations, thereby producing a set of gross wage elasticities denoted e_{t1}. The difference in response from the benchmark response (e_{1997}) in this first step is therefore attributed to differences in data samples used in the estimations of the model. This contribution to changes in labor supply elasticities, measured as $e_{t1} - e_{1997}$, is caused by changes in the sociodemographic composition of the population, as all other potential contributing factors remain constant and consistent with those in the benchmark year.

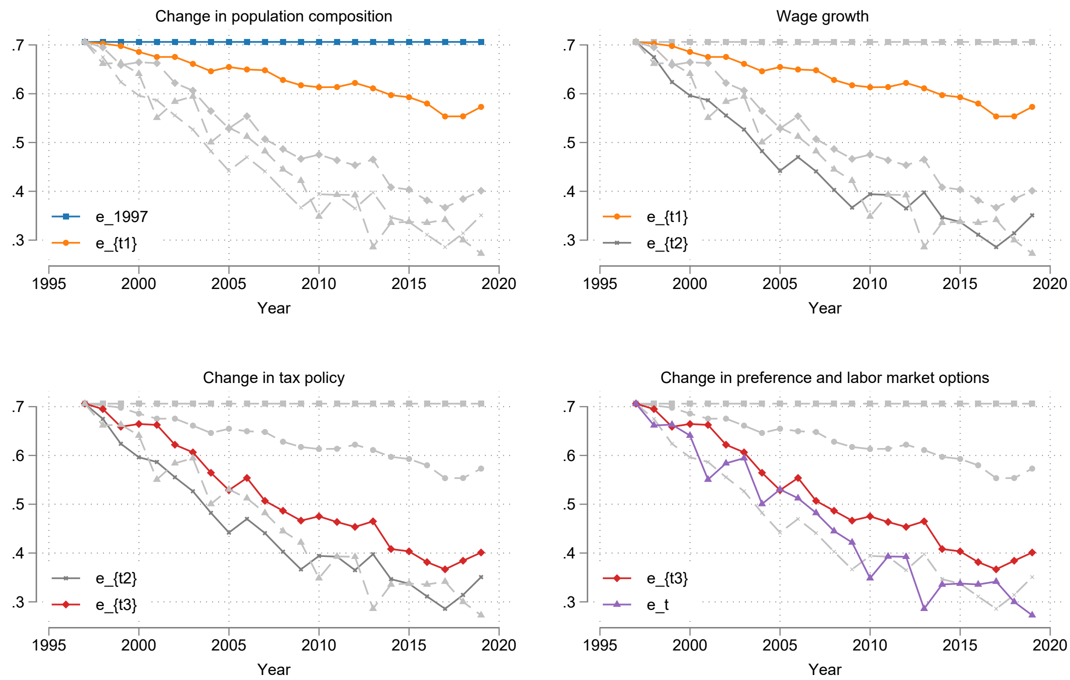
In simulation two, we introduce a new element into the process. In addition to using year-specific datasets, as in step one, we now incorporate predicted wages based on the year-specific wage regressions into the response simulations. This yields a new set of elasticity estimates, denoted e_{t2}. Consequently, the simulation results from this second step provide estimates of the contribution attributable to wage growth over time. Since we are comparing the new set of simulations to the elasticities from the first step, $e_{t2} - e_{t1}$, the contribution from wage growth is identified as an increment to the set of previous simulations.

In simulation three, we measure the effects of changes in the tax scheme over the period. This means that we no longer hold the tax schemes fixed, but let them be represented by the yearly tax schemes. The effects of tax scheme changes are then obtained from $e_{t3} - e_{t2}$.

In this simulation, we apply 1997 tax rules to the wage income of year t (since the tax scheme remains fixed at the 1997-level). To account for inflation and maintain consistency, we use the consumer price index to deflate wage income back to the 1997-level.

If wage growth contributes to the decline in response between say 1997 and 1998, the corresponding factor would have a negative sign.

Figure 7: Illustration of effects of each step of the simulation procedure



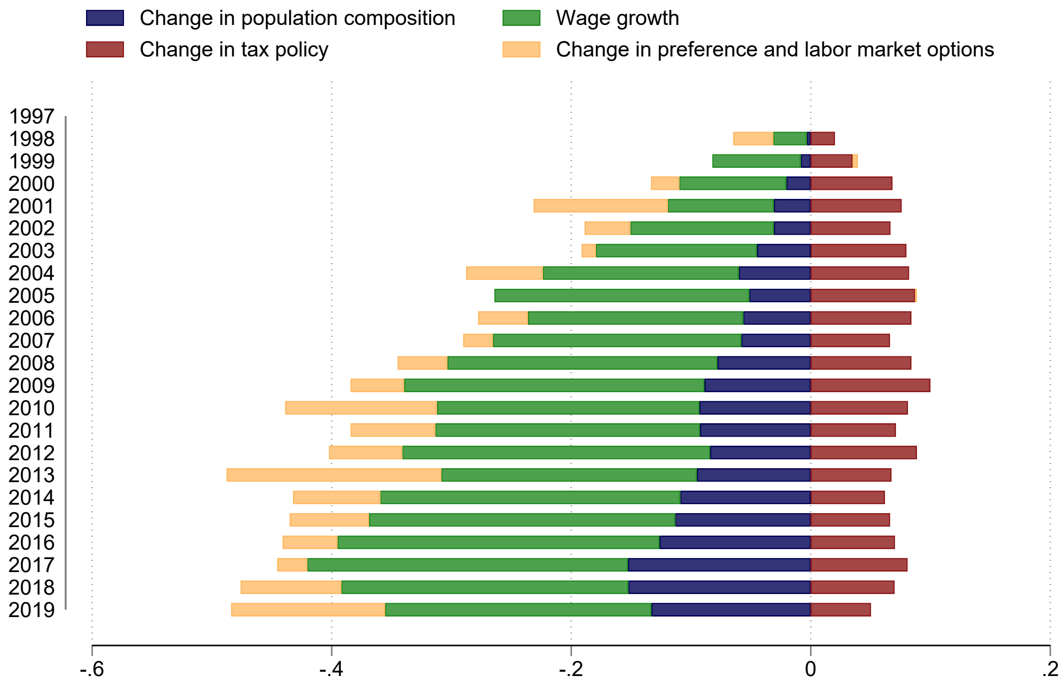
Notes: e_t represents the estimated gross wage elasticity in year t, while e_{1997} represents the estimated elasticity in the the benchmark year, 1997. e_{t1} is obtained by keeping all model parameters fixed at their values in 1997 but using the year-specific datasets. e_{t2} is based on e_{t1} with the additional change resulting from using year-specific wage regressions. Similarly, e_{t3} is based on e_{t2} with the additional change of using year-specific utility and labor market options parameters. The figure represents the mean changes when the Shapley decomposition procedure is employed.

Finally, the contribution of the last component, referred to as change in preferences and labor market opportunities, is observed as $e_t - e_{t3}$. Figure 7 illustrates how each step in the simulation procedure affects the responsiveness over time.

However, results are likely to be path-dependent, meaning that the order in which the different explanatory categories are introduced could influence the outcome. For instance, the factor positioned initially in the sequence tends to have a disproportionately larger influence on the outcome. To mitigate the bias introduced by the sequencing of factors, we employ the Shapley decomposition procedure (Shorrocks, 1999) to compute the impact of each factor for all possible sequences. Specifically, we calculate the average contributions from all 24 possible distinct sequences. The results when the Shapley procedure is employed are presented in Figure 8, which shows that wage growth is the most important factor behind the decline in response. The figure also shows that changes in the sociodemographic composition of the population and changes in preferences and labor market options have made significant contributions to falling elasticities for married women, whereas, notably, tax policy has contributed to the opposite – to higher responses. Next, we discuss the contributions of each of the four explanatory categories in more detail.

On applications of the Shapley-procedure, see also Lambert (2013), Chantreuil and Trannoy (2013), and Shorrocks (2013).

Figure 8: Contributions to changes in elasticities over time



Notes: Results of the procedure based on simulations of a discrete choice labor supply model. The Shapley decomposition procedure is used to compute the impact of each factor for all possible sequences, yielding average effects over all possible sequences.

6.2 Explanatory factors

6.2.1 Changes in the sociodemographic composition of the population

In the following we consider how the four distinct explanatory factors impact the labor supply responsiveness of married women. The contributions of the four categories, as depicted in Figure 8, are measured in terms of the decline in wage elasticity after 1997. Recall that the total reduction in responsiveness in 2019 compared to 1997 is approximately 0.4, as the elasticity response was approximately 0.7 in 1997, compared to 0.3 in 2019.

The data composition category pertains to shifts in sociodemographic factors within the data samples utilized for model estimations, encompassing alterations in characteristics such as age, children and education. We find that this category contributes significantly to the observed decline in elasticities: the difference between the first and last years of the period is a reduction of more than 0.1. Furthermore, the data composition factor exhibits an approximately constant relative contribution to the (over time) decline in Figure 8.

Figure 9 presents graphical representations of the trends in key variables observed in the data samples utilized for the model estimations. Panel (A) of the figure illustrates a consistent rise in age during the initial phase of the period, from 1997 to 2005, followed by a more variable trend in the latter part of the period. Related to this, there are fewer children aged 0 to 5, but a higher number, aged 6 to 18, by the end of the period. As the presence of small children tends to increase

As discussed in Section 2.3, Heim (2007) focuses on effects of children and other sociodemographic factors as explanations for the substantial decline in women's responsiveness in the US. Findings suggest that demographic characteristics account for only a small portion of this decline.

the disutility of working, this composition effect can potentially lead to diminished responsiveness. However, as we return to below, there were changes in the childcare market in the period under consideration which may have neutralized this effect.

We have taken a closer look at the effect of education working through the data composition factor. As illustrated in Panel (B) of Figure 9, although the education level is increasing for married males as well, the increase is stronger for females. This implies that the average length of education for married women is overtaking that of males. In our data this happens in 2010. For a constant set of of wage and preference parameters, more women with higher education implies, on average, higher wages, which may, ceteris paribus, result in weaker responses.

We also carried out additional simulations to further explore compositional effects. We used the methodology to further discuss the effects of education by obtaining simulation results for different education levels. We compared our results to those of a simulation in which female education levels are held constant at the 1997 level throughout the period. The results are reported in Figure B1 in Appendix B. Given that education also has effects through the number of options in the labor market and through wages, the simulations were carried out keeping these other channels unchanged at the benchmark levels. We find a less significant decrease in responses when education is fixed at the 1997 level, and thus conclude that increased education plays an important role in the data composition category to explain falling elasticities. According to the simulation results, the elasticity in 2019 would have been 0.05 larger if the education of married females had been kept at the 1997 level.

6.2.2 Wage growth

Figure 8 shows that the most substantial effect contributing to the decrease in responsiveness for married women is attributed to changes in wage rate predictions. Changes in the estimated wage regression parameters account for no less than half of the overall decline for almost all the years. In 2019, its contribution is a reduction in elasticity of approximately 0.2 from a total reduction of around 0.4.

Panel (C) of Figure 9 depicts the growth in real wage rates during the period under consideration. It shows developments in the predicted expected log wage rate for both males and females aged 40 with 13 years of schooling. The figure shows that wage rates have increased for both genders over time, which could be attributed to increased productivity in the labor market over time. Whereas male wage elasticity remained constant at 0.1 throughout the period, see Section 5, our results suggest that wage growth over the period had a substantial effect on female responsiveness. We also confirmed this connection between the wage level and responsiveness by conducting an additional simulation exercise where we assigned a male wage to the females. Results are reported in Figure B2 in Appendix B. In elasticity estimates obtained under this counterfactual simulation alternative, we observe a noticeable reduction in female responsiveness. The declining pattern over time persists, but it is considerable less steep, which clearly suggests that women's wage level is an

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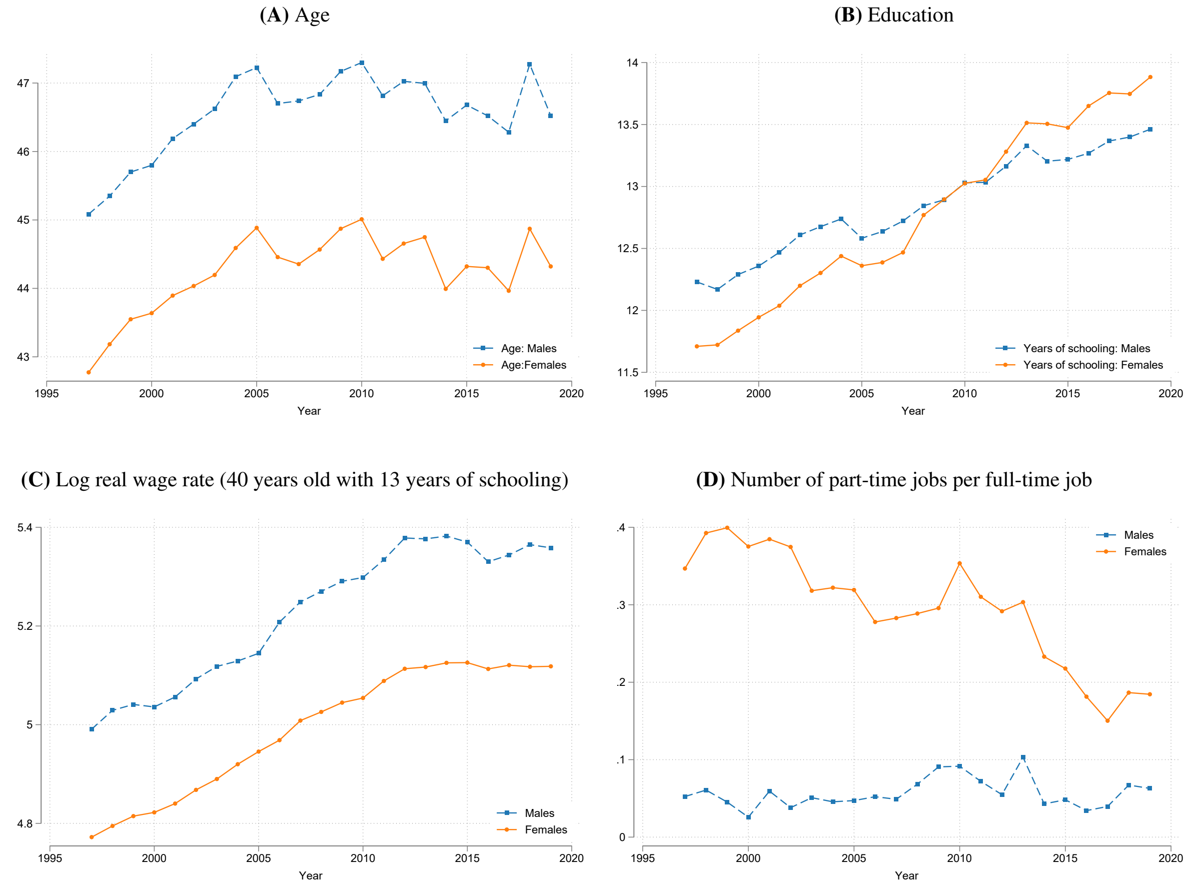
Aaberge et al. (1995) find that female labor supply responses are declining in household income. However, Bargain et al. (2014) find no dependence on wage in their survey of labor supply responses.

In practice, this is done by letting female wages be determined by the male wage regression, see Section 4.2 and Appendix A. Thus, only the parameters of the wage regression is changed in order to assign new wages to the married women.

Figure 9: Developments in age, education, wage rates, and part-time/full-time job ratios, for females and males, 1997–2019



Notes: Graphical representations of the trends in key variables observed in the data samples utilized for the model estimations. Panels (A) and (B) show the average age and average years of schooling, Panel C shows the logarithm of predicted real wage rates, and Panel (D) shows the estimated ratio between the number of part-time vs full-time jobs available.

important contributor to the decline in womens' responsiveness.

In Section 6.2.1 we discussed the effect of education working through data compositional changes, where increased female education was shown to contribute to the narrowing of the gender gap. Here we instead explore the extent to which the estimation results of the model wage equation, as described in Section 4.2.1, unveil any shifts in the returns attributable to education and experience over time. Table A1 in Appendix A documents a slight increase in return to education for both males and females over time. However, general wage growth (as reflected in changes in the constant parameter) seems to be considerably more important than the increased return to education over time.

6.2.3 Changes in preferences and labor market options

Figure 8 shows that the category that represents preference shifts and change in labor market options also contributes to the decline in elasticities – the effect is around 0.1 (when 2019 is compared to 1997). However, the influence of this category fluctuates more over time than the other explanatory factors. There does not seem to be a clear increasing trend, such as that seen for both the data composition and wage growth categories.

We anticipate that changes in norms and an increased focus on female career orientation will be reflected in the preference category. So although the literature suggests that changes in norms and female career orientation significantly impact response development (see Goldin (2006) and other studies reviewed in Section 2.3), we find little evidence that this is the main driver of reduced female responsiveness in Norway in recent decades. On the other hand, we cannot completely rule out the possibility that a trend toward greater gender equality may underlie many of the other shifts we are observing in the other categories here, for example the general productivity increase in wages.

6.2.4 Tax changes

In contrast to the other explanatory factors, tax changes over the time period have consistently contributed to *increased* responsiveness; see Figure 8. Although the increase between 1997 and 2019 is relatively small (less than 0.1), it implies that the decline in labor supply responsiveness (after 1997) would have been larger if there had been no changes in the tax scheme over time.

This is likely mainly due to a reduction in the average tax rate during the period under consideration. As described in Section 2.3, the tax effect works through the fact that we measure responses by gross wage elasticities. When the tax rate is reduced, the net wage change is higher, which, ceteris paribus, implies a higher response in working hours for the same change in gross wage.

The top marginal tax rate has hovered around 50 percent throughout much of the period from 1997 to 2019, with slightly lower rates observed in the latter part of the period. However, given the limited fluctuations in rates and the fact that the top rate affects only a portion of taxpayers, we anticipate that the top marginal tax rate has had little impact on responsiveness.

Another aspect of taxation that has garnered attention in the literature is the joint taxation of couples (tax class 2), as for example discussed by Bick and Fuchs-Schündeln (2018). This scheme was entirely phased out for married couples over the period, with all taxpayers now being taxed individually. Nonetheless, since few couples were subject to joint taxation in 1997, we expect this aspect to have exerted little influence on the observed responsiveness trends.

6.2.5 Some caveats

Note that we address empirical estimates for married couples only, as we lack data from the LFS on cohabiting couples. As the number of cohabitants has increased over time (Lappegård and Noack, 2015), one may suspect that estimates of choices over time may be influenced by this, as there is a possibility that unobserved factors acting concurrently influence decisions regarding marriage and labor market behavior. Blau and Kahn (2007) implement various methodologies to address this issue in their analysis of US data. They find that the declining pattern persisted even after adjusting for selection into marriage.

If there is correlation between the decision to marry and labor market behaviors after controlling for observable characteristics, it may affect changes in preferences and labor market options. How-

Recall that Bargain et al. (2014) found no effect of taxes in their cross-country survey of elasticity estimates.

Norway's personal income tax system transitioned to a dual income tax system in 1992 (Sørensen, 2005). A dual income tax system combines a low proportional tax rate on capital income with progressive tax rates on labor income.

Note that it is also not clear in which direction the abolition of joint taxation would affect married women's elasticities.

ever, as we have seen, the preference/labor market options category has relatively little influence on the observed decline in labor supply elasticities over time. Moreover, our wage regressions are based on both married and unmarried individuals, which means that estimates of wage growth over time are likely not affected by the changing pattern in selection into marriage. Thus, we assume that the wage and tax components are not much affected by a decline in marriage rates. Since these two factors account for most of the changes according to our analysis, we argue that selection into marriage is not the primary reason for the observed decline. This is what Blau and Kahn (2007) find in their analysis too.

It should also be noted that the period under investigation is characterized by a large expansion in the coverage rate of center-based childcare, in combination with considerable reductions in parental fees (Thoresen and Vattø, 2019). However, we do not find evidence that the propensity for non-market work of married couples with small children has changed relative to that of women with older children. This seems to suggest that the childcare expansion is not a major factor influencing our results.

7 Conclusion

As in the case of research utilizing data from the United States (Blau and Kahn, 2007; Heim, 2007), we find a significant decline in the labor supply elasticity of married women in Norway in recent decades (1997-2019). By way of comparison, the labor supply elasticities of married men remain stable at a low level. This means that we see substantial convergence between the labor supply responsiveness of married males and females.

In contrast to prevailing reduced form approaches in the existing literature, we employ a structural discrete choice labor supply model to describe the labor supply behavior of married couples. We find a decline in responsiveness for married women in terms of both the Marshallian and the Hicksian elasticities. The reduction in women's labor supply responsiveness to wages implies that the effects of using financial incentives, such as tax policies, to encourage married females to supply labor might be weaker. However, it also indicates that the distortionary effects of tax policies have diminished over time.

Most notably, we use the model and estimation results to identify the contributing factors via a simulation exercise. We explore various influences on the labor supply responsiveness of married females, categorizing them into four groups: sociodemographic compositional changes, wage growth, tax policy changes, and shifts in preferences and opportunities in the labor market.

Our findings indicate that wage growth, specifically, has played a substantial role in reducing responsiveness. Furthermore, socioeconomic and demographic changes in the data composition have evidently impacted the decline in responses, but less than wage growth, whereas changes in the category of preferences and labor market options have had relatively limited effects. Conversely, tax scheme changes have contributed to higher response estimates over time.

In contrast to studies that point to change in norms and career orientation to explain the diminishing gap between the labor supply responsiveness of married men and women, our results point to

There are structural models that combine labor supply decisions and access to childcare. This evidence also support that responses of Norwegian parents with preschool children are smaller in 2010 than in 1998, when elasticity estimates of Kornstad and Thoresen (2007) and Thoresen and Vattø (2019) are contrasted.

an increased return to market work as the primary factor underlying falling labor supply elasticities for married women. However, we cannot rule out the possibility that general wage growth in the labor market may have been influenced by shifts in norms and increased emphasis on careers among married females.

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Appendix

A Estimation results for the job choice labor supply model

Table A1 and Table A2 present estimation results for the wage regression and the full model, respectively, whereas Figure A1 describes the fit of the model for selected years.

Table A1: Estimates of wage equations, males and females, 1997, 2008, and 2019

	Males			Females		
	1997	2008	2019	1997	2008	2019
Constant	4.043	4.603	4.692	3.942	4.407	4.653
	(0.037)	(0.043)	(0.041)	(0.029)	(0.031)	(0.031)
Experience	0.019	0.018	0.028	0.016	0.015	0.014
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Experience^2 (x100)	-0.030	-0.033	-0.045	-0.024	-0.023	-0.016
	(0.004)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)
Education	0.049	0.045	0.055	0.048	0.050	0.056
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Married	0.052	0.075	0.037	-0.021	-0.013	-0.017
	(0.010)	(0.012)	(0.012)	(0.007)	(0.008)	(0.008)
Std error of error term	0.182	0.201	0.213	0.147	0.150	0.153
No. of observations	5,622	4,803	4,720	5,749	5,138	4,804

Notes: Estimation results are based on median regressions on log wage rate. The sample includes workers who are between 26 and 62 years old, have non-labor income of less than NOK 80,000 (in 1997 prices) and are covered by the Labor force survey of the given year, irrespective of their marital status. Standard errors in parentheses.

Table A3: Gross wage Marshallian labor supply elasticities for individuals in couples, 2019

	Female own wage	Male own wage	Female cross-wage	Male cross-wage
Participation (ext. margin)	0.099	0.021	-0.002	-0.006
Hours cond. on working (int. margin)	0.158	0.079	-0.047	-0.005
Total elasticity	0.273	0.102	-0.046	-0.010

Notes: The elasticities reflect the simulated percentage change (average across individuals) in the probability of participation (extensive margin) and working hours conditional on working (intensive margin) when the hourly wage rate is increased by one percent for all wage earners. The cross-wage elasticities reflect the labor supply responsiveness when the spouse's wage rate is increased by one percent.

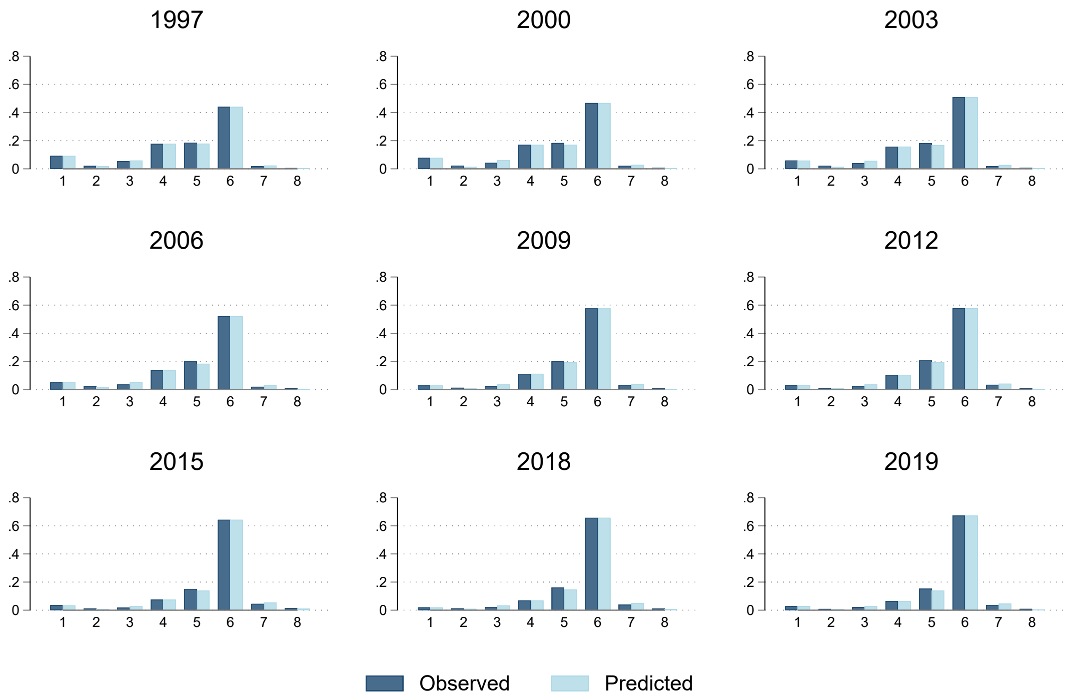
Table A2: Estimates of the parameters for preferences and labor market options, married couples, 2019

	Parameter	Married couples	
		Estimate	Std Error
Preferences			
Consumption			
Exponent	α_1	0.7813	0.076
Scale 10^4	β_C	0.6453	0.208
Female leisure			
Exponent	α_F	-1.6194	0.416
Constant	β_{F1}	6.2556	3.201
Log(age/10)	β_{F2}	-5.4935	3.676
Log(age/10) squared	β_{F3}	1.9800	1.315
No. children aged 6 years or under	β_{F4}	0.2142	0.117
No. children over 6 years	β_{F5}	0.1136	0.070
Male leisure			
Exponent	α_M	-0.4285	5.618
Constant	β_{M1}	0.9190	7.993
Log(age/10)	β_{M2}	-0.9472	2.735
Log(age/10) squared	β_{M3}	1.6682	0.444
No. children aged 6 years or under	β_{M4}	0.2206	0.241
No. children over 6 years	β_{M5}	0.0084	0.149
Leisure interaction	β_{MF}	0.6459	0.445
Labor market options			
Females			
Constant	γ_{F1}	0.1650	1.474
Education	γ_{F2}	0.4560	0.536
Part-time peak		-0.1677	0.125
Full-time peak		1.5225	0.103
Males			
Constant	γ_{M1}	1.9703	1.891
Education	γ_{M2}	1.3481	0.705
Part-time peak		-0.1314	0.286
Full-time peak		2.6345	0.114
Number of observations		1,619	
Log likelihood		-2,983.8	
McFadden's ρ^2		0.55	

Notes: The consumption subsistence level is set at C_0=40,000. The leisure subsistence level is set at L_0=5,110

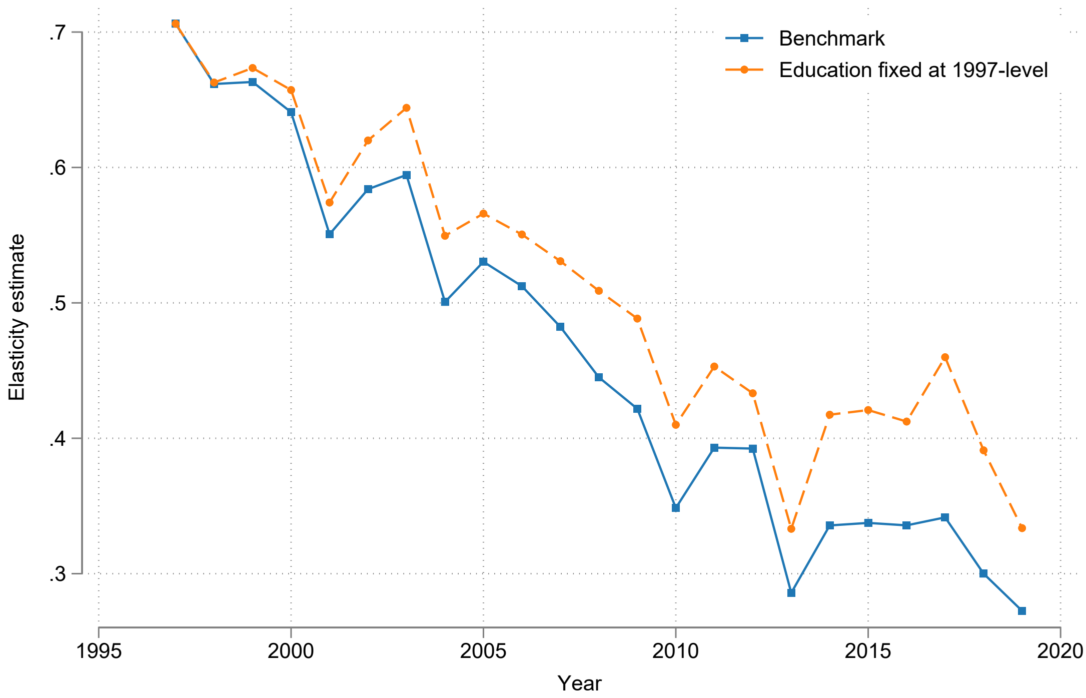
B Additional results

Figure A1: Observed and predicted labor supply of married women, selected years



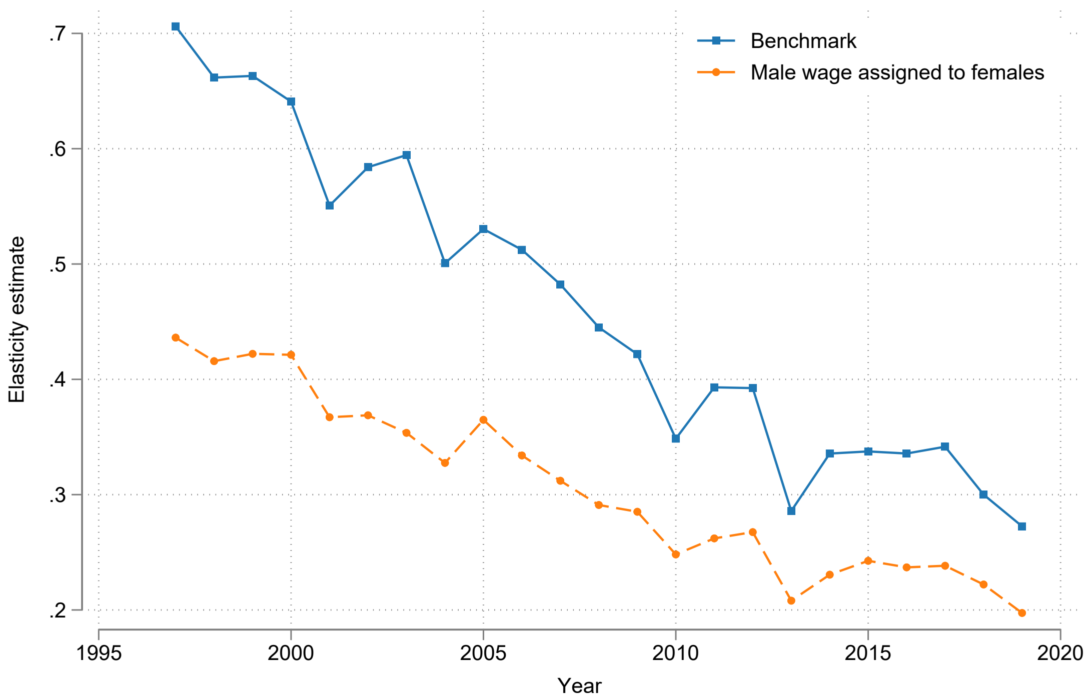
Notes: Predicted probabilities obtained from the discrete choice labour supply model compared to actual choices in the data samples used in the estimation. The numbers on the horizontal axes refer to choices, see Section 4.2 for the corresponding figures for working hours.

Figure B1: Elasticity estimates when married women's education levels are fixed at the 1997 level



Notes: Elasticity estimates are obtained from discrete choice labor supply model simulations. The benchmark estimates are similar to those in Figure 4 and are compared with estimates obtained when the education levels of married women are fixed at the 1997 level.

Figure B2: Elasticity estimates when married women are given "male wages"



Notes: Elasticity estimates are obtained from discrete choice labor supply model simulations. The benchmark estimates are similar to those in Figure 4 and are compared with estimates obtained when married women are assigned male wages. Female wages are determined using male wage regression (see Section 4.2 and Appendix A) which means that only the wage regression parameter is changed in order to assign new wages to married women.