Spousal Labor Response to Primary Income: Identification and Heterogeneity*

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We present a new estimate for the elasticity of spousal labor supply in response to changes in the primary worker's income, the so-called "added worker effect." By leveraging firm-side information of the primary worker as an instrument, we isolate income changes that are uncorrelated with the spouse's productivity, addressing endogeneity bias. We find an economically meaningful role for the spousal labor supply, especially among young households with limited financial assets. We construct a heterogeneous agent model consistent with the estimated spousal employment response to design a government transfer program that effectively mitigates the negative income shock.

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1 Introduction

Do spouses increase their labor supply when the primary worker in the household loses income? Although it seems natural that families use labor supply to protect against income fluctuations, an extensive body of research has found little evidence in favor of the so-called "added worker effect" (e.g., Lundberg, 1985; Doepke and Tertilt, 2016).

At the same time, the literature recognizes substantial challenges in identifying the cross-elasticity of the spousal labor supply. A typical estimate may suffer from attenuation and endogeneity bias since (i) a significant portion of the earnings variation reflects predictable or transitory fluctuations that have little impact on household consumption, and consequently, spousal employment, and (ii) productivity changes are often correlated between spouses, as, for example, during a labor market recession (see, for example, Guvenen, 2007; Blundell, Pistaferri, and Preston, 2008; Busch et al., 2022).

A reliable estimate of the magnitude of the spousal labor supply across different types of households is important for designing large-scale government programs (e.g., Guner, Kaygusuz, and Ventura, 2023). For families able to self-insure through joint labor supply, public insurance may crowd out within-family insurance and diminish the impact of government interventions. In contrast, for families with limited ability to adjust spousal labor supply–due to low market productivity, caregiving responsibilities, or other constraints–government transfers can act as a key buffer against income shocks.

In this paper, we combine an empirical estimation framework and a quantitative structural model of labor supply with the following goals in mind. First, we present a new estimate for the cross-elasticity of spousal labor supply in response to unexpected primary income shocks that addresses the endogeneity bias. Second, we document how our estimate for the cross-elasticity of spousal labor supply varies across households. Third, we propose a more efficient transfer program that supports consumption and preserves employment.

Our estimation framework leverages detailed administrative data from Statistics Norway, which provides a unique background to better identify the cross-elasticity of spousal labor supply. The data includes comprehensive information on households' labor income, labor market status, and, more importantly, for our analysis, matches employees to their employers and provides firm-level data on income and balance sheet. To address the bias arising from predictable, transitory, and correlated income fluctuations, we use idiosyncratic fluctuations in the sales revenues of the primary worker's employer as an instrumental variable. This strategy isolates unexpected income shocks that are plausibly exogenous to the spousal labor supply decision. This type of instrument has proven successful in identifying income risk that is unanticipated and orthogonal to other household variables (e.g., Fagereng, Guiso, and Pistaferri, 2018), and, to our knowledge, this is the first article to use it to identify the added

worker effect (AWE).

We find that shocks to employers' sales partially pass through to workers' wages, validating the relevance of our instrument. Although the degree of pass-through is modest, implying that firm-related risk is a small component of overall household risk, it is sufficient to identify income shocks that are exogenous from the perspective of the spousal labor supply decision.

A second reason why the Norwegian panel is well suited to analyze the AWE is the availability of high-quality data on households' financial assets.[1] Combined with detailed demographic characteristics, we can identify and analyze the response of households with limited means to self-insure or with limited ability to adjust the spousal labor supply, e.g., financially constrained households and young families with children.

We find that spousal labor supply plays an important role for household self-insurance against income shocks–especially among young, poor households. Using our instrumental variable strategy, we estimate that a 10 percent decline in primary income increases spousal employment rate by 1.5 percentage points and spousal earnings by 4.2 percent. The response is more pronounced among poor households, where the spousal employment rate increases by 2 percentage points (33 percent larger than the average) and spousal earnings by 8.8 percent (more than twice the average). We also document substantial heterogeneity by age: for households between ages 25 and 39 the spousal employment rate increases by 2.7 percentage points (80 percent larger than the average), whereas households closer to retirement show no response to the income shock.

These estimates are economically significant and notably larger than those reported in the existing literature (reviewed in detail below), even though they are based on a country like Norway, which has both a relatively high employment rate for spouses and a generous welfare system. In contrast, when we use an ordinary least squares estimator, we find a negligible response of spousal labor supply to changes in primary income, consistent with previous findings in the literature.

As a natural next step, we use the estimated size and heterogeneity in the response to the spousal labor supply to inform the design of the government transfers system. To this end, we build a quantitative model of household labor supply that is consistent with our estimated responses of spousal employment from the micro data and use the model to propose a more efficient design of fiscal assistance programs.

The model is a life cycle model with heterogeneous two-member households (e.g., Guner, Kaygusuz, and Ventura, 2020; Wu and Krueger, 2021). Each household consists of a primary worker and a spouse. Households decide in every period how much to consume, save, and the labor supply of each member. Labor supply decisions occur along both the employment

[1]Norway imposes an annual net wealth tax on the worldwide assets of its residents, requiring households to report their wealth to the tax authority.

margin and the amount of hours of work given labor market participation. To generate an active employment margin, we assume new workers have to incur a one-time entry cost (e.g., training, moving costs, or search costs).

We incorporate a rich structure in the income process of households. First, households have a fixed type (skill) throughout the life cycle. Second, each earner accumulates human capital while employed (e.g., Blundell, Costa Dias, et al., 2016). Third, workers face multiple idiosyncratic productivity shocks that vary in persistence—transitory versus persistent—and in their correlation between spouses—correlated versus orthogonal.

Households self-insure against income fluctuations using labor supply and the household's assets. In addition, a government provides public insurance in two forms: there is a welfare system that gives out transfers for low-income households and a social security system for retirees. In every period, the government sets the tax rate to balance its budget.

The model aligns well with the salient aspects of the Norwegian data. First, the model reproduces the employment rates throughout the life cycle. Second, the model reproduces the average working hours and transition rates between employment and non-employment for primary workers and spouses. Third, the model captures the cross-sectional variance of earnings and consumption along the life cycle. Fourth, the model matches the average holdings of household assets relative to income.

Although not targeted, the model generates an added worker effect broadly comparable to the data: a 10 percent decline in primary worker's earnings increases the spousal employment rate by 1.3 percentage points in the model versus 1.5 in the data. The model is less successful in capturing the response of working spouses: spousal earnings rise 2.7 percent in the model versus 4.2 in the data. The model also gives a realistic account of heterogeneity in the cross-elasticity of the spousal labor supply, over wealth and age: young and poor households exhibit much stronger responses, as in the data.

Armed with a model that generates a reasonable degree of self-insurance via labor supply, we evaluate alternative designs of government subsidies when households experience an unexpected income shock. Specifically, we introduce an unexpected productivity decline for primary workers for a fraction of households and solve for the transitional dynamics under various degrees of government assistance. In the absence of any government intervention, affected households counteract the decline in consumption using the labor supply of the secondary earner, as well as running down their assets. The additional government transfers make households less dependent on their spousal labor supply.

We propose an alternative transfer scheme that can improve efficiency. The transfer system we propose is tied to the employment status of the households (e.g., granting a larger amount to dual earners). By making the transfer conditional on employment status, this policy effectively

mitigates the decline in consumption from the income shock while preserving employment. The conditional transfer program provides almost the same welfare as the unconditional one, with a smaller budget.

Primarily, our paper contributes to the empirical literature on the AWE which spans over forty years of research. The consistent finding is a weak or non-existent spousal labor supply response. Earlier studies by Lundberg (1985) and Maloney (1987) found no measurable impact of husband's unemployment on wife's hours and employment probability. Cullen and Gruber (2000) find little evidence of a response in the wife's labor supply to the unemployment of the husband due to the unemployment benefits assistance.

More recently, using data from several European countries, Bredtmann, Otten, and Rulff (2018) find that husband's employment status is not significantly affecting women's probability of becoming employed but is significantly affecting the women's probability of searching for a job. Similarly, using data from the Current Population Survey, Guner, Kulikova, and Valladares-Esteban (2025) find that women married to men who become unemployed show a negligible increase in their probability of moving to employment. Birinci (2024) finds no statistically significant change in spousal earnings following the loss of the husband's job during the Great Recession. Casella (2022) emphasizes the role of past labor market experience and finds a stronger participation of spouses with work experience during the last five years.[2]

Based on administrative data from Austria, Halla, Schmieder, and Weber (2020) unravel the role of different channels that affect the response of the spousal labor supply using plant closure events of the primary worker. Plant closures generally occur gradually and may well have been foreseen by workers, which may explain why the authors find small spousal labor supply responses (see, for example, Stephens, 2002).

The reason why our analysis finds a substantial impact of the primary worker's income on spousal employment and earnings is that we rely on an instrument (sales revenue of the primary worker's employer) that has proven successful in identifying the income risk that is unanticipated and orthogonal to other household variables (e.g., Fagereng, Guiso, and Pistaferri, 2018). In addition, our millions of observations with detailed information on financial assets and household demographics helps us identify groups that are vulnerable to income risk, such as young households and low-wealth households – consistent with Bacher, Grübener, and Nord (2025) who find larger spousal responses for young households.

Also, consistent with our empirical findings, Autor et al. (2019) finds a strong negative response of spousal labor supply to disability insurance receipts in Norway. Albanesi and Prados (2022) find that spouses of husbands with high-income growth during the 1980s and 1990s

[2]More considerable effects have been found with respect to the intensive margin of spousal labor supply. For example, Bredtmann, Otten, and Rulff (2018) find that working wives of newly unemployed husbands are more likely to switch from part-time to full-time work.

decreased their participation in the labor market, due to an income effect. Ellieroth (2023) argues that employed spouses can remain employed longer during business cycle downturns due to the higher risk of unemployment for the primary worker.

Furthermore, our paper contributes to the literature that relies on structural models to understand the supply of family labor and the design of fiscal programs. Our model differentiates itself from existing models by incorporating a rich set of ingredients: an extensive and intensive margin of labor supply for both workers in the household, a life cycle with endogenous human capital accumulation, and various types of income shocks. For comparison, Blundell, Pistaferri, and Saporta-Eksten (2016) estimates the degree of consumption insurance and the labor supply response of working spouses in a model without a participation margin.[3] Mankart and Oikonomou (2017) and Birinci (2024) employ a dual labor search model, but do not consider the role of the life cycle or correlated income shocks, elements that we find important to replicate our empirical findings.

Finally, our model environment and the characterization of the transfer system is close to Guner, Kaygusuz, and Ventura (2020) who analyze whether child-related transfers should be universally allocated and if they should be tied to mother's work. The key difference is that we analyze the properties of the transfer system in an economy that suffers an unexpected and transitory income shock (e.g., the government sending out checks during a labor market recession). Hence, the proposed transfer system is evaluated around temporary deviations from the steady state, which requires the full solution of the transition path.

The paper is organized as follows. Section 2 derives an analytic formula for the elasticity of the spousal labor supply to primary income in a static environment. Section 3 provides the empirical analysis. Section 4 sets up the quantitative model and calibrates it to match the salient features of the Norwegian data. Section 5 analyzes various policy experiments based on the quantitative model. Section 6 is the conclusion.

2 The Spousal Labor Supply in a Static Model

We analytically derive the elasticity of the spousal labor supply to primary income in a simple static model. This illustrates the key factors determining the response of the spousal labor supply to primary income shocks. We develop a fully specified quantitative model in Section 4.

Consider a household making decisions about consumption, c, the labor supply of the

[3] Wu and Krueger (2021) uses a model that includes a participation decision for the spouse to evaluate the approach of Blundell, Pistaferri, and Saporta-Eksten (2016) but do not separately analyze the model predictions for AWE. Our paper estimates extensive and intensive margin responses from the data and compares these to a model that includes both margins.

primary worker and his/her spouse, h_p and h_s. We assume a unitary model of household labor supply where consumption is fully shared among household members.

Household preferences are given by:

$$U = \frac{c^{1-\sigma}}{1-\sigma} - \frac{h_p^{1+\frac{1}{\gamma_p}}}{1+\frac{1}{\gamma_p}} - \frac{h_s^{1+\frac{1}{\gamma_s}}}{1+\frac{1}{\gamma_s}}$$

where σ is the coefficient of relative risk aversion and γ is the Frisch elasticity of labor supply. We allow for different Frisch elasticity for the primary worker and the spouse. In our full dynamic quantitative model, these differences arise naturally through differences in reservation wages. Household's total income consists of primary worker's earnings (wx_ph_p), spouse's earnings (wx_sh_s), and non-labor income (n) where w is the wage rate for the efficiency units of labor and x_p and x_s is the productivity of the primary worker and the spouse, respectively. The household's budget constraint is:

$$c = wx_ph_p + wx_sh_s + n.$$

We assume that primary and spouse productivity are correlated through the function $x_s = f(x_ph_p)$.[4] The first-order conditions for labor supply are:

$$\frac{1}{\gamma_i}\ln h_i = -\sigma \ln\left[wx_ph_p + wx_sh_s + n\right] + \ln x_i, \text{ with } i = \{p, s\}.$$

The total differentiation of the first-order condition for the spousal labor supply $i = s$ with respect to (h_s, x_s) gives the Marshallian labor supply elasticity for the spouse:

$$\frac{dh_s}{dx_s}\frac{x_s}{h_s} = \frac{1-\sigma S_s}{1/\gamma_s + \sigma S_s}$$

where $S_s = \frac{wx_sh_s}{wx_ph_p+wx_sh_s+n}$ denotes the spousal earnings share in household's income (Keane, 2011).[5] The share of primary earnings S_p can be defined similarly. The Marshallian elasticity is determined by the relative size of the substitution effects and the income effects. With a zero income effect ($\sigma = 0$), the Marshallian elasticity is identical to the Frisch elasticity γ_s (which captures the substitution effect). The strength of the income effect depends on the relative risk aversion and the income shares of the spouse. When σ is larger (the marginal utility of consumption decreases rapidly as consumption increases) or when the income share

[4]We assume that x_s is a function of x_ph_p (instead of x_p) because it is analytically convenient to derive an elasticity with respect to primary income. In the full dynamic model, we allow for a correlation that occurs between the productivity of spouse, x_s, and the productivity of primary, x_p.

[5]Detailed exposition of the analytical derivations in this section is presented in Appendix A.

(S_s) is larger, the income effect is also larger: that is, we have a smaller Marshallian elasticity of the labor supply.

Next, we derive the cross-elasticity of spousal labor supply with respect to primary labor income. A total differentiation of the first-order condition for spousal labor supply with respect to $(h_s, x_p h_p)$ gives the following:

$$\frac{dh_s}{d[x_p h_p]}\frac{[x_p h_p]}{h_s} = \underbrace{\frac{-\sigma S_p}{\frac{1}{\gamma_s}+\sigma S_s}}_{\text{income effect}} + \underbrace{\frac{dx_s}{d[x_p h_p]}\frac{x_p h_p}{x_s}}_{\text{correlation elasticity}} \times \underbrace{\frac{1-\sigma S_s}{\frac{1}{\gamma_s}+\sigma S_s}}_{\text{Marshallian elast.}} . \tag{1}$$

The formula highlights why estimates of the spousal response are typically small. Suppose that there is zero correlation between spousal productivity and primary income, then the second term disappears. The first term (income effect) is negative: a decline in primary income induces an increase in spousal labor supply. The size of this term depends on σ, S_p, S_s, and γ_s: combination of income effects and Frisch elasticity. As long as the Marshallian elasticity of spousal labor supply and the correlation between spousal productivity and primary income are positive, the second term is positive and so it weakens the response of the spousal labor supply.

In our view, this issue characterizes the majority of empirical studies that analyze AWE and has not been adequately addressed. In our empirical analysis of Section 3 we provide an instrumental variable designed to isolate primary labor income shifts orthogonal to spouse's productivity. This allows us to estimate the effect of primary income on the spousal labor supply that is unambiguously negative.

When the correlation is zero, the cross-elasticity of spousal labor supply may be small or large, depending on the strength of the income effect. The income effect depends on (i) the primary worker's income share, (ii) the spousal income share, and (iii) the curvature of the utility function. For example, a household with a small non-labor income share (e.g., little financial assets) and a highly productive primary worker is likely to exhibit a large cross-elasticity for the spouse. Therefore, we expect a large heterogeneity in the cross-elasticity of spousal labor supply, which we also examine in our empirical analysis below.

3 Empirical Analysis

3.1 Data

The Norwegian Registry is a comprehensive set of data with detailed information on employment, labor income, and household financial assets. Our empirical analysis is mainly based on five data sets: (1) Income and Wealth Registry Data provides detailed informa-

tion on income, transfers, and assets; (2) Central Population Register contains individual demographic information (e.g., gender, date of birth, marital status, number of children); (3) National Educational Database has the history and the latest education record for each resident; (4) Employer-Employee Register provides annual information on workers' labor market status (full- and part-time employment, employer ID, beginning and ending dates of job, total payments from each employer, industry, occupation, etc.); (5) Firm Accounts that report companies' profits and balance sheets, and can be linked to workers through the employer ID number.

The Income and Wealth Registry is based on tax records where most information is third-party reported by employers, banks, brokers, insurance companies, and any other financial intermediaries. In addition, there is information from social security registers. Therefore, earned income includes cash salary, capital income, entrepreneurial income, unemployment benefits, taxable benefits, sickness/maternity benefits, and pensions. Since households in Norway are subject to a wealth tax, the data also include detailed information on households' assets.[6]

Our data allows us to address several challenges that characterize empirical studies of spousal labor supply. Many existing estimates of AWE rely on job displacements, especially during economic downturns, periods when labor market opportunities are equally depressed for both spouses. In addition, much of the literature is based on survey data–which often have a limited sample size–and hence, little ability to study the heterogeneity in AWE (e.g., Cullen and Gruber, 2000; Casella, 2022; Birinci, 2024). In contrast, our administrative data overcome these limitations. First, as we discuss below, with the linked employee-employer registry, we can isolate fluctuations to primary income that are orthogonal to the spousal productivity. Second, the richness and scale of the data allows us to analyze the AWE across multiple dimensions: age, wealth, education status, family size, etc.

We start with all individuals in Norway during 2015-2019.[7] We focus on the working stage of the life cycle and thus keep individuals aged 25-60. At the outset, we have 12.7 million observations, with approximately 2.5 million individuals per year. We further refine the sample using the following criteria. First, we keep married households with spouses also aged 25-60. Second, we drop households where the primary worker is self-employed or works in the public sector. Third, since our instrument relies on idiosyncratic employer performance (i.e., uncorrelated with spousal productivity), we drop households where both members are currently working or have worked in the same company. After our restrictions, we have a

[6]Traded financial securities are reported at market value. The value of shares in private companies is reported by individuals as well as private companies to the tax authority. The tax authority will then combine the information from the companies' reports with that from individual households and adjust if necessary.

[7]The Employer-Employee Register underwent major changes in 2015 that significantly improved the data quality. Starting in 2015 it has full coverage of all workers and monthly reporting.

sample of 3.4 million observations, about 680,000 individuals or 340,000 households per year.

The primary worker is defined as the household member with the highest lifetime labor income. We classify someone as employed if they are matched to an employer in the Employer-Employee Register. This is similar to conditioning a non-zero salary, non-zero workdays, or if a member is matched with at least one firm. For members that are matched with multiple employers in a year, we use the employer (job) which pays the most or is of the longest duration, in that order.

Table 1: Summary Statistics

Variable	Mean	SD	Percentile 25^{th}	50^{th}	75^{th}
Primary Worker					
Employment	0.93	0.26	1	1	1
Labor Income (in $)	63,676	162,755	41,637	57,123	78,333
Hours	1,768	215	1,796	1,950	1,950
College	0.37	0.48	0	0	1
Age	45.1	9	39	46	52
Secondary Worker (Spouse)					
Employment	0.71	0.45	0	1	1
Labor Income (in $)	39,758	23,117	23,201	37,993	49,617
Hours	1,615	391	1,138	1,772	1,950
College	0.44	0.50	0	0	1
Age	43.6	9	37	44	51

Notes: Labor market and demographic characteristics for primary worker and spouse. Statistics are averaged over 2015–2019, 1,723,131 household-year observations. The annual labor income and hours are conditional on working. The exchange rate is 1 USD = 10 NOK in 2015 prices.

Table 1 reports the basic summary statistics. The employment rates in the labor market are high in Norway. In a typical year, on average, 93 percent of primary workers and 71 percent of spouses work. 55 percent of households are dual-working households, 35 percent are a household where only the primary earner is working, 5 percent are households with no worker, and 1 percent of households has only the spouse working. Norwegian primary workers earn around 64,000 per year (in U.S. dollars), and those who work dedicate 1,768 hours to the labor market. Norwegian spouses earn around 40,000 (in U.S. dollars) and, conditional on participating in the labor market, work 1,615 hours.[8] The average age and college education

[8]For easy comparison, we convert Norwegian krone to US dollars using the exchanger rate of 10 krone per

attainments are similar between primary workers and spouses.

Since consumption and labor supply responses are more sensitive to the amount of financial assets relative to housing assets, we focus on the liquid component of household wealth (Kaplan and Violante, 2014). The financial accounts in our data include bank deposits, bonds, financial securities, mutual funds, stocks and shares, and other financial assets. On average, assets are 1.7 times the average household income. The share of households with wealth less than three times average monthly earnings is 10 percent.

Finally, on average, primary workers contribute 50 percent of household income, spouses contribute 24 percent, and capital income adds another 8 percent. The rest comes from the government, which plays an important role in the income of Norwegian households. One component of government transfers is unemployment insurance. For permanent layoffs, it lasts up to two years and replaces, on average, 62.5 percent of the gross income in the last occupation. Furthermore, while employment protection laws make worker firings difficult, it is relatively easy to get workers on sick benefits or disability programs. As a result, in Norway there is a low unemployment rate, but high fractions of workers on sickness or disability benefits. In addition, sick benefits are paid for up to one year and compensate 100 percent of earnings. Although disability programs have complicated rules, we estimate their average compensation to 66 percent of previous earnings. Overall, all these government transfer programs combined (but net of taxes) contribute, on average, 18 percent of household income.

3.2 Econometric Framework

Let the *true* (log-linear) model of spousal labor supply and household consumption be given by:[9]

$$h_{s,i,t} = \beta_0 + \beta_c c_{i,t} + \beta_\omega \omega_{s,i,t} + u^h_{s,i,t} \tag{2}$$

$$c_{i,t} = \eta_0 + \eta_y y^P_{i,t} + u^c_{i,t}, \tag{3}$$

where $h_{s,i,t}$ is the labor supply of the spouse in the household i at time t which can be either an extensive margin (participation decision) or an intensive margin (log hours worked). The log of household consumption is $c_{i,t}$ which depends on the persistent component of household labor income, $y^P_{i,t}$ (more discussion on this assumption is given below).[10] Finally, $\omega_{s,i,t}$ denotes the

USD, the approximate average for the last 10 years.

[9]We allow for individual fixed effects in both labor supply and consumption but suppressed them here to save notation. The actual regression also includes controls for various household characteristics such as age, education, number of children, etc. See below (Section 3.3) for the complete list of control variables for the characteristics of the households.

[10]Although consumption depends on the persistent components of non-labor income (such as capital gains and entitlements), we abstract from those for simplicity here.

(log) productivity of the spouse.[11] Here, β_c represents the income elasticity and β_ω represents the substitution elasticity of the labor supply. Residual factors in the supply of spousal labor and household consumption (which are assumed to be i.i.d. and uncorrelated) are denoted by $u^h_{s,i,t}$ and $u^c_{i,t}$, respectively.

Let us assume that both primary and spousal's log income consists of persistent and transitory components:

$$y_{p,i,t} = y^P_{p,i,t} + y^T_{p,i,t} \text{ and } y_{s,i,t} = y^P_{s,i,t} + y^T_{s,i,t}. \tag{4}$$

The transitory components ($y^T_{p,i,t}$ and $y^T_{s,i,t}$) are assumed to be i.i.d. and uncorrelated with the persistent components. However, persistent components may be correlated between members.

As is well understood, consumption responds more strongly to persistent labor income shocks relative to transitory labor income shocks (Blundell, Pistaferri, and Preston, 2008; Kaplan and Violante, 2010). For this reason, we have modeled consumption in equation (3) as only a function of the persistent component of household labor income, $y^P_{i,t}$.[12] The log of persistent component of household labor income can be approximated by the weighted sum of the logs of each member's persistent labor earnings:

$$y^P_{i,t} = \alpha y^P_{p,i,t} + (1-\alpha) y^P_{s,i,t}, \tag{5}$$

where α gives the share of the persistent component of the primary worker's labor income with respect to the persistent income of the household. Using equations (2), (3), and (5) produces the following:

$$h_{s,i,t} = \bar{\beta}_0 + \beta_c \eta_y \alpha y^P_{p,i,t} + \beta_c \eta_y (1-\alpha) y^P_{s,i,t} + \beta_\omega \omega_{s,i,t} + \beta_c u^c_{i,t} + u^h_{s,i,t}, \tag{6}$$

where $\bar{\beta}_0 = \beta_0 + \beta_c \eta_0$.

The typical regression in empirical studies of spousal labor supply uses some form of the following specification:

$$h_{s,i,t} = \alpha + \beta y_{p,i,t} + e_{s,i,t}. \tag{7}$$

Note that the regressor is the total income of the primary worker (instead of the persistent

[11] Spousal productivity is only observed for working spouses (through wages).

[12] Blundell, Pistaferri, and Preston (2008) find that transitory shocks are nearly perfectly insurable. Using a relative standard Aiyagari (1994) model, Kaplan and Violante (2010) find a higher pass-through of transitory shocks when households are borrowing constrained but still substantially less than the pass-through of persistent shocks.

component). For comparison, we rewrite equation (6) as follows:

$$h_{s,i,t} = \bar{\beta}_0 + \beta_c \eta_y \alpha y_{p,i,t} \underbrace{-\beta_c \eta_y \alpha y^T_{p,i,t}}_{\text{attenuation bias}} + \underbrace{\beta_\omega \omega_{s,i,t} + \beta_c \eta_y (1-\alpha) y^P_{s,i,t}}_{\text{endogeneity bias}} + \beta_c u^c_{i,t} + u^h_{s,i,t}. \tag{8}$$

Comparing equations (7) and (8) highlights the identification challenges in estimating the cross-elasticity of spousal labor.

First, the regressor in equation (7), $y_{p,i,t} = y^P_{p,i,t} + y^T_{p,i,t}$, contains persistent and transitory components of income, while only the persistent component, $y^P_{p,i,t}$, affects consumption. Thus, using the observed income (instead of persistent one) biases the estimates β toward zero (attenuation bias).

The second issue is endogeneity. The productivity of the spouse ($\omega_{i,s,t}$), and the persistent component of the spousal income ($y^P_{s,i,t}$), are plausibly correlated with the regressor ($y_{p,i,t}$). This violates the orthogonality condition and the OLS estimate of β would be biased.

The direction of the bias depends on the relative strengths of the substitution and income effect of the spousal labor supply (that is, the magnitude of the Marshallian elasticity of the labor supply, as we illustrate in Section 2). To begin with, it is natural to assume that the productivity (or income) of married couples is positively correlated. Thus, the first term is likely to bias β toward zero ($corr(y_{p,i,t}, \omega_{i,s,t}) > 0$ and $\beta_\omega > 0$ so estimated β becomes less negative) and the second term is likely to bias β away from zero ($corr(y_{p,i,t}, y^P_{s,i,t}) > 0$ and $\beta_c < 0$ so estimated β becomes more negative). The elasticity of the spousal labor supply with respect to the own wage is often estimated to be high and even close to 1: $\beta_\omega = 1$ (e.g., Chang and Kim, 2006).[13] Thus, the bias of the first term is not negligible. In contrast, we believe that the bias due to the second term is limited because the value of $\beta_c \eta_y (1-\alpha)$ is close to zero.[14] Thus, the bias arising from the first term is more substantial and drives the OLS estimate toward zero.

With an instrumental variable that is orthogonal to the transitory component of primary income and to the persistent component of spousal income (and productivity), we can obtain a consistent estimate of cross-elasticity ($\hat{\beta} = \beta_c \eta_y \alpha$). To overcome these identification challenges, we use information from the employer of the primary worker, namely the sales revenue of the firm where the primary worker is employed ($\Pi_{p,i,t}$).[15] This is a valid instrument because (i)

[13] Erosa, Fuster, and Kambourov (2016) reports an elasticity of the labor supply of 0.5 for an intensive margin.

[14] For example, the typical value of consumption elasticity in labor supply is $\beta_c = -1$ and that of income elasticity in consumption is $\eta_y = 0.65$ (Blundell, Pistaferri, and Preston, 2008). The average share of spousal income in our sample is 0.24. These values imply $\beta_c \eta_y (1-\alpha) = -0.14$.

[15] According to Guiso, Pistaferri, and Schivardi (2005), sales revenue is preferred to profits for two reasons. First, sales revenue is the variable that is directly subject to stochastic fluctuations. Second, firms have discretionary power over the reporting of profits in balance sheets, which makes profits a less reliable objective.

the performance of the primary worker's firm is likely orthogonal to the spousal productivity and income ($\mathbb{E}(\Pi_{p,i,t} \mid \omega_{s,i,t}) = 0$ and $\mathbb{E}(\Pi_{p,i,t} \mid y^P_{s,i,t}) = 0$) and (ii) it is significantly correlated with the primary worker's earnings ($corr(\Pi_{p,i,t}, y_{p,i,t}) \neq 0$). At the same time, the component of worker's earnings that is associated with firm's sales revenue is highly persistent (close to a random walk), so that it helps to eliminate the attenuation bias.

The exogeneity assumption can be violated if (i) low-ability workers systematically sort into low-productivity firms (see, for example, Bonhomme et al., 2023) and (ii) low-ability workers also sort in the marriage market, which is very natural. In such a case, primary workers employed in firms that perform worse than the average may be more likely to be married with spouses who have lower than average labor market opportunities. However, this issue is addressed as we estimate in first differences to eliminate the fixed effect (see below for more details). As long as the sorting in the labor market occurs mostly based on fixed effects of workers and firms, it does not pose a concern for our identification assumption.

We close the discussion with one caveat. The spousal wage can be used as a proxy for productivity $\omega_{s,i,t}$, in the regression of (8). But wages are observed only when the spouse worked, and our primary interest is estimating the added worker effect (participation decision).

3.3 Two Stage Regression

Consider equation (7) in first differences:

$$\Delta h_{s,i,t} = \beta \Delta y_{p,i,t} + X'_{i,t}\delta + \upsilon_{s,i,t} \tag{9}$$

where $X_{i,t}$ controls for household characteristics, which include the number and age of children, the lagged financial assets of the household (in log), the age and education of the primary worker and the spouse, dummy variables indicating that the primary worker or the spouse is sick or on parental leave, and finally, dummy variables for time and industry. We only include primary workers who record positive earnings every year in the regression. Although we only consider households where the primary worker participates in the labor market every year, it does not exclude the possibility of a temporary job displacement within a year, which will show up as a significant reduction in the observed primary income $y_{p,i,t}$.

The OLS estimate for the elasticity of spousal employment with respect to primary income (β) is close to zero: -0.00 (0.01) where the number in parentheses represents the standard error. This is not surprising given that the literature has not found strong evidence on the added worker effect (e.g., Doepke and Tertilt, 2016). We also estimate (9) using spouse's earnings as a dependent variable. Again, the OLS estimate is also close to zero: 0.017 (0.005).

As discussed in Section 3.2, the OLS estimate of β is likely to be biased toward zero for

two reasons. First, the correlation between primary income and spousal productivity. Second, there is an attenuation bias because the regressor (measured income) contains persistent and transitory components, whereas consumption responds only to persistent income.[16]

We use the firm-side information of the primary worker as an instrumental variable to resolve the issues with the OLS estimation. Our instrument is the firm's sales revenue, where the primary worker is employed. As explained in the previous Section 3.2, the instrument is valid if (i) changes in the performance of the primary worker's firm are orthogonal to changes in spousal productivity, and (ii) changes in the performance of the primary worker's firm pass-through to the primary worker's earnings. This last condition may not be satisfied if workers' earnings are set based on aggregate conditions only, such as collective bargaining agreements. In fact, collective bargaining-based wage setting is common in Norway. However, collective bargaining only sets a wage *norm*, where there is room for wage adjustments based on worker or firm-related idiosyncratic factors (Fagereng, Guiso, and Pistaferri, 2018). We scale the firm's sales revenue (gross revenue minus operating costs) by the size of the firm's gross assets and denote the (log) sales revenue-to-assets ratio by $\Pi_{p,i,t}$.[17] In the robustness Section 3.5 we show that using value added instead of sales revenues leads to similar results. The first stage regression is as follows:

$$\Delta y_{p,i,t} = \phi \Delta \Pi_{p,i,t} + X'_{i,t}\zeta + \xi_{p,i,t} \tag{10}$$

where ϕ reflects the pass-through coefficient of the firm's revenue growth to the worker's income growth.

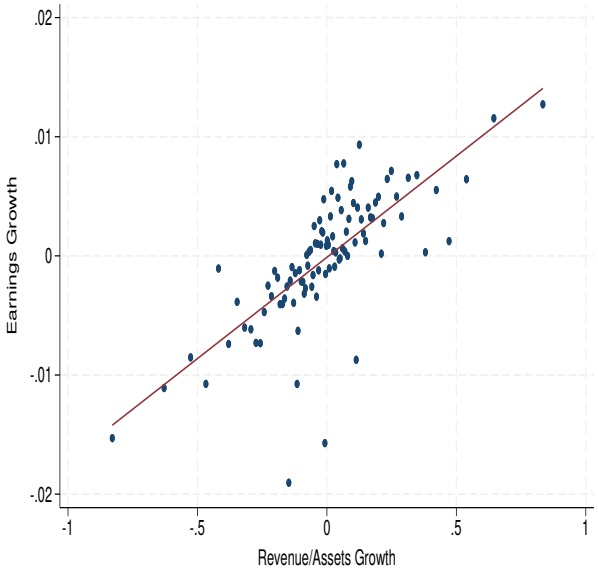
Table 2 shows the estimated pass through of sales revenue-to-assets to worker's earnings, the first-stage regression. The left panel of Table 2 is the scatter plot between the growth rate of primary worker earnings ($y-$ axis) and the growth rate of firm sales revenue scaled by assets ($x-$axis). It clearly shows that primary income is highly correlated with sales revenue-to-assets. The right panel provides some estimates of the first-stage regression (10).[18] The estimated pass-through coefficient $\widehat{\phi} = 0.0135$ with a t-statistic equal to 13. Hence, our instrument is powerful with a F-statistic well beyond what the literature considers an acceptable threshold. Since we also control for industry and time fixed effects in the regression, the pass-through arises purely from idiosyncratic fluctuations in firm sales, not sectoral or

[16] In addition, when households anticipate the changes in primary income, they may have already responded by adjusting spousal labor supply and consumption. In fact, a recent literature suggests that a substantial portion of the residual variation in earnings is predictable and reflects individual choices rather than risk (e.g., Primiceri and van Rens, 2009, Guvenen and Smith, 2014). To the extent that income changes are anticipated, the estimated response would be muted.

[17] For small firms, the growth rates of sales revenue are highly volatile and often generate extreme values. We scale sales revenue by assets to effectively eliminate outliers.

[18] The regression also includes other controls such as time and industry dummies, etc.

Table 2: The First Stage: Pass-through of Sales Revenue onto Worker's Earnings



Dependent Variable: Primary Earnings ($\Delta y_{p,i,t}$)		
	Coefficient	S.E.
Sales Revenue ($\Delta\Pi_{p,i,t}$)	0.0135	0.0008
Log Household Assets $_{t-1}$	−0.011	0.0003
Number of Children	0.005	0.0003
Primary, Age	−0.003	0.0001
Secondary School	−0.017	0.0008
College	−0.002	0.0010
Sick Leave	−0.042	0.0008
Parental Leave	−0.078	0.0022

Note: The figure shows a bin-scatter plot between the growth of primary earnings and the growth of firm's sales revenue (scaled by assets). The table reports the first-stage regression estimates of (10) for selected control variables. The regression also includes the year and industry dummies.

aggregate shocks.

The estimated pass-through is small, implying that firm-related risk is a small share of overall household risk. But that alone is not a problem for our identification. The instrument is still sufficient to capture an uninsurable component of primary worker's earnings that is plausibly orthogonal to the spousal labor supply decision.[19]

The second stage regression replaces $\Delta y_{p,i,t}$ in equation (9) with $\widehat{\Delta y}_{p,i,t}$ from (10). Table 3 shows the estimated spousal response of employment and (log) labor earnings. Earnings are conditional on working (that is, changes in the intensive margin only, which also explains why the number of observations decreases).[20]

The instrumental variable regression generates a sizable response of the spousal labor supply and earnings that is in line with our theory: the spouse increases the labor supply in response to a decrease in primary income. According to our estimate, in response to a 10 percent decline in primary income, the spousal employment rate increases by 1.5 percentage points and the spousal earnings by 4.2 percent. Both estimates are statistically significant.

[19] Guiso, Pistaferri, and Schivardi (2005) emphasize the importance between permanent and transitory shocks in firm-level shocks. When we separate the firms into those facing persistently negative or positive sales growth for the entire sample period of 2015-2019, the pass-through increases modestly to 2 percent. Another explanation is that focusing on workers who remain employed in the firm (as we do) can substantially underestimate the transmission of firm shocks to worker wages (e.g. Friedrich et al., 2024).

[20] Appendix B provides detailed estimates for the entire set of controls.

Table 3: Spousal Response to Primary Income: 2SLS

Dependent Variable ($\Delta h_{s,i,t}$):	Employment	Earnings
Primary Earnings ($\widehat{\Delta y}_{p,i,t}$)	−0.15***	−0.42***
	(0.04)	(0.16)
Log Household Assets $_{t-1}$	−0.005***	−0.013***
	(0.001)	(0.001)
Number of Children	0.002***	0.007***
	(0.000)	(0.000)
Primary, Age	0.00	0.001**
	(0.00)	(0.000)
Sick Leave	−0.011***	−0.023***
	(0.002)	(0.005)
Parental Leave	0.057***	0.143***
	(0.004)	(0.014)
Spouse, Age	−0.002***	−0.008***
	(0.00)	(0.000)
Sick Leave	−0.055***	−0.147***
	(0.001)	(0.002)
Parental Leave	−0.087***	−0.301***
	(0.002)	(0.006)
Observations	865,066	701,119

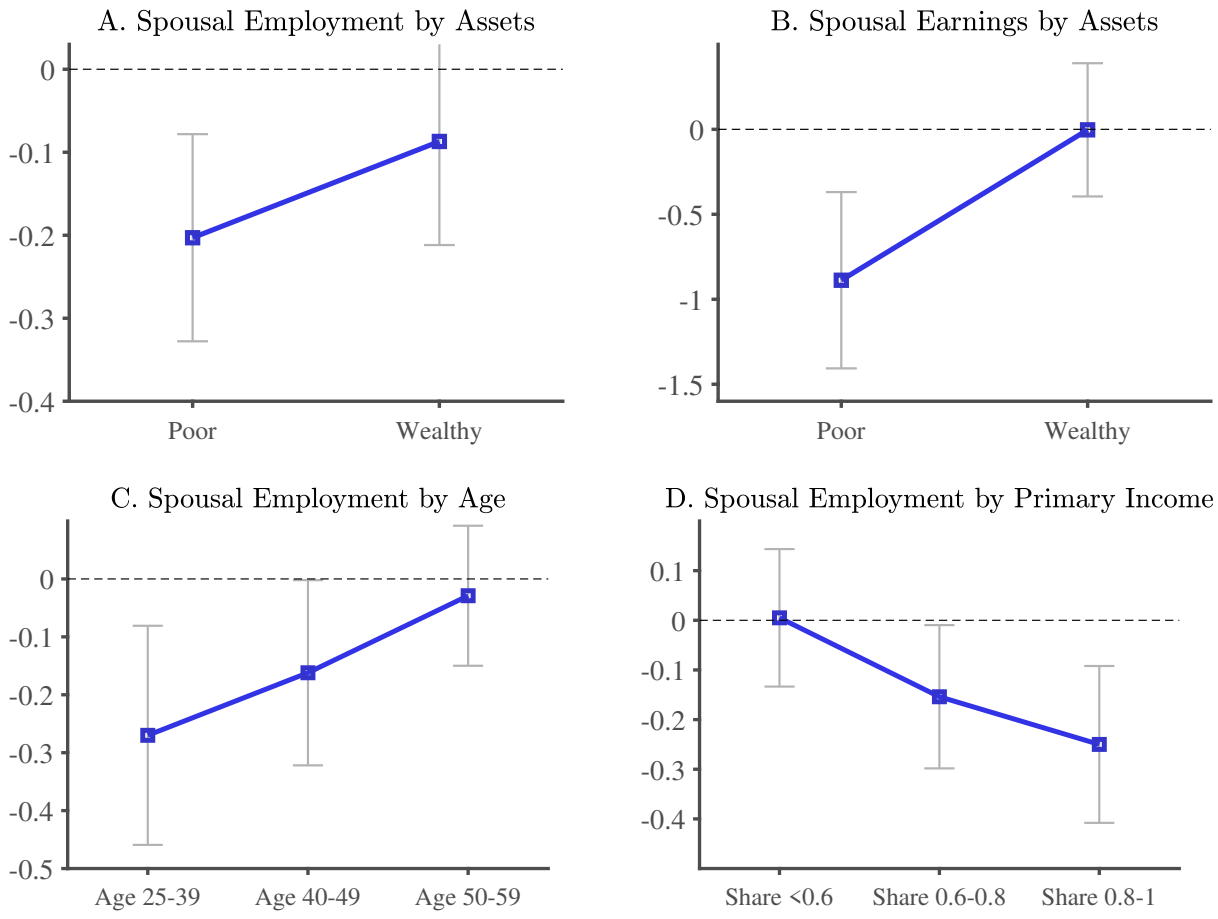
Notes: The instrumental variable is the sales revenue (scaled by assets) of the firm that employs the primary earner. The regression also includes education, year, and industry dummies. The numbers in parentheses are standard errors.

Our results are notably higher than the typical estimates in the literature that find a weak or non-existent spousal labor supply response.

We also find a wealth effect on labor supply: wealthy households exhibit weaker spousal labor supply. Sick leaves (both primary and spouse) also weaken the response, indicating that spouses stay home to take care of a partner in need. Parental leave of the primary worker strengthens the spousal response, indicating the sharing of childcare between partners.[21]

[21] One third of the parental-leave benefit period (a total of 46 weeks) is reserved for fathers in Norway.

Figure 1: Heterogeneity in Spousal Labor Supply Response



Notes: The figures exhibit 2SLS estimates ($\hat{\beta}$) and 95% confidence intervals for the spousal employment and earnings in response to a 1 percent primary income shock.

3.4 Heterogeneity in Spousal Labor Supply Responses

We take advantage of our rich data and examine the spousal response at a more disaggregate level.[22] According to our economic theory, the response of the spousal labor supply is stronger for households that do not have sufficient means to protect against income fluctuations. To examine this, we classify households into two groups based on their financial assets: "poor" households whose financial assets (as of the beginning of the year) are less than the average earnings of 6 months in Norway and "wealthy" more than the average earnings of 6 months. Panel A of Figure 1 shows the estimated employment response of the spouse in each group. The response is consistent with our theory. Poor households show a stronger response, twice as large as wealthy households. The difference between the two groups is even

[22]See Appendix B for detailed estimates of spousal employment and earnings.

more evident in the response to the earnings (panel B). When primary income decreases by 10 percent, poor households increase their earnings by 8.8 percent, twice as much as the average, while the spousal earnings of wealthy households hardly change.

Panel C shows the employment responses of the spouse by age. Young households (whose primary workers are 25-39 years old) show a response twice as large as the average of the entire population (consistent with a previous study by Bacher, Grübener, and Nord, 2025), while the old households (whose primary workers are 50-59 years old) do not show a statistically significant response. Finally, Panel D shows the employment responses by the primary income share. When primary income is the dominant source of household income (larger than 80% of total income), the response is almost twice as large as the average, consistent with our formula (1) in Section 2.

3.5 Robustness Analysis

We discuss a series of robustness analyses briefly here and provide detailed statistics in Appendix B.

Alternative Instruments We consider alternative instrumental variables: (i) the value added of the firms and (ii) both sales revenue and value added. Our results are robust to these alternative measures of firm performance. Specifically, the elasticity of spousal employment with respect to primary income is -0.20 when we use value added as an instrument and -0.16 when we use both measures, both of which are slightly greater than our benchmark case of -0.15. The earnings elasticity is -0.39 and -0.41, respectively, similar to our benchmark case of -0.42.

Firm Size Our identification requires that an individual worker has no significant impact on firm performance. However, if the firm is very small, it is possible that the productivity of an individual worker, potentially correlated with that of the spouse, may affect the firm's performance. To avoid this possibility, we exclude small companies (those with less than 20 employees). The elasticity of spousal employment to primary income then becomes -0.23 and that of earnings -0.84. Both estimates are slightly larger than the benchmark estimates. As an experiment, when we isolate the sample to small firms only (those with less than 20 workers), the estimated elasticity of the spousal employment decreases to -0.099 (with standard error of 0.046). Since they represent a small fraction of our sample, they have limited impact on the overall estimation results (see Table A-2). We also tried other cut-off points by keeping only firms with more than 5 and more than 10 employees. The higher the cut-off, the larger the estimated response is (-0.18 and -0.23, respectively).

Regional Recessions Our identification scheme isolates changes in primary earnings that are orthogonal to the productivity of the spouse. In our benchmark specification, we include time and industry dummies to eliminate the events that potentially affect both members (such as aggregate business cycles or industry-wide events if both members work in the same industry). In Norway, there was a big recession caused by oil price shocks (in 2015 and 2016) that influenced the regions that rely heavily on oil industries. To avoid the influence of this event on our estimates, we exclude workers who live in Stavanger, the region most hit by the oil price shock. The response to spousal employment becomes -0.17, slightly larger than our benchmark estimate.

Households with Small Children We have shown that young households (who on average have limited resources to self-insure against income shocks) exhibit a stronger response of spousal labor supply. One might also expect that young households with small children are less able to adjust labor, constrained by child care (e.g., Casella, 2022). We do find that young households (under 39 years old) with small children (under 6 years old) exhibit a much smaller earnings elasticity than those without small children (-0.58 vs. -1.34). However, young households with small children do not necessarily show a smaller elasticity in terms of spousal employment: they are -0.33 and -0.20, respectively, with and without small children, but the difference is not statistically significant (see Table A-2).

Unemployment Spell We separately consider households whose primary workers experienced an unemployment spell during the year and those without such experience. We do not find a statistically significant difference in the spousal response between the two groups. The elasticity of spousal employment is -0.13 and -0.15, respectively, for with and without the unemployment spell of primary workers.

4 Quantitative Analysis

We built a quantitative model with heterogeneous households and calibrate it to match key features of life-cycle profiles of labor supply and earnings in Norway. We use the model for two main purposes. First, we examine whether the model can reproduce the estimated response of the cross elasticity we documented in Section 3. Second, we use the model to evaluate government policies that take into account the households' joint labor supply decisions.

4.1 Economic Environment

Demographics We consider a small open economy populated by a continuum of households with a total measure of one. Households are born single or married and retain their status throughout the life cycle (Guner, Kaygusuz, and Ventura, 2023). Married households, which comprise a fraction π_m of the population, consist of two potential earners: a primary worker and a spouse indexed by $i = \{p, s\}$. Similarly to the data, primary workers have higher lifetime labor income (due to higher productivity) than spouses. We assume that married individuals are of the same age (indexed by j), which is broadly consistent with the data, where primary workers are on average one year older than their spouses. Each individual enters the labor market at age $j = 1$ and lives until age J. An exogenous mandatory retirement age, j_R, is imposed, although participation is endogenous: workers can choose to retire earlier. Starting from age j_R, households receive social security benefits from the government. Finally, we assume that there is an age-dependent probability (s_j) that the household survives.

Preferences Each household maximizes lifetime utility by choosing consumption, c_j, and labor supply of the primary worker and the spouse, h_p and h_s:

$$U = \mathbf{E}\Big[\sum_{j=1}^{J} \beta^{j-1} \mathbf{\Pi}_{k=1}^{j} s_k \ \Big\{\frac{c_j^{1-\sigma}}{1-\sigma} - \psi_p \frac{h_{p,j}^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}} - \psi_s \frac{h_{s,j}^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}}\Big\}\Big] \tag{11}$$

where β is the discount factor, σ the coefficient of relative risk aversion, and γ the Frisch elasticity of labor supply. We assume that disutility from working is different between the primary worker and the spouse (ψ_p and ψ_s).

The first assumption we make is that of a unitary model of the household. This is a standard assumption, but it also has implications that are often rejected (e.g., Lise and Seitz, 2011). However, the sharing rules between the partners identified in collective models of household labor supply turn out to be roughly equal (e.g., Gayle and Shephard, 2019). Our second assumption is that of an additive separable utility function. Wu and Krueger (2021) show that the elasticity of spousal earnings to permanent primary shocks diminishes only slightly in a model of non-separable preferences relative to a model with separable preferences.

Number of Children The number of children in each married household is exogenous and varies based on the parents' age (Borella, De Nardi, and Yang, 2023). Dual-income households incur (child care) expenses $\zeta_5 n_5(j)$ where $n_5(j)$ denotes the number of children under age 5. In contrast, single-earner married households and married households without any earners do not face these costs.

Productivity The log productivity (wage) of the worker i at age j consists of five components: a permanent fixed effect (skill), α_i, human capital (accumulated over time through labor market experience), $\theta_{i,j}$, a persistent and *partially* correlated among spouses productivity shock, $x_{i,j}$, a persistent productivity shock that is not correlated between spouses, $z_{i,j}$, and an i.i.d. shock, $\varepsilon_{i,j}$:

$$\ln w_{i,j} = \ln \alpha_i + \ln \theta_{i,j} + \ln x_{i,j} + \ln z_{i,j} + \ln \varepsilon_{i,j}.$$

The uncorrelated component $z_{i,j}$ serves as an instrument to obtain orthogonal wages, similar to the firm component of the earnings used in the empirical analysis.

At the beginning of the life cycle, each household draws a permanent skill type from a normal distribution: $\ln \alpha \sim N(0, \sigma_\alpha^2)$. We assume complete positive assortative matching, so the fixed effect is common between spouses. In addition, we allow for the accumulation of human capital through the labor market experience, an important feature when evaluating the effect of fiscal policy on female labor supply (Blundell, Costa Dias, et al., 2016). Specifically, human capital $\theta_{i,j}$ increases with experience in the labor market $l_{i,j}$. The exact functional form of $\theta(l)$ is described when we calibrate the model.

The productivity shock x follows a jointly log-normal AR(1) process:

$$\ln x_{i,j} = \rho_x \ln x_{i,j-1} + \nu_{i,j}, \qquad \text{with} \quad \begin{bmatrix} \nu_p \\ \nu_s \end{bmatrix} \sim N\Big(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_\nu^2 & \sigma_{ps} \\ \sigma_{ps} & \sigma_\nu^2 \end{bmatrix} \Big) \tag{12}$$

where ρ_x represents persistence and ν_p and ν_s, innovations to the primary worker and spouse, respectively. Innovations have variance σ_ν^2 and covariance σ_{ps}. Hence, these shocks are potentially correlated between the primary worker and the spouse. The transition matrix for this autoregressive process is denoted by $\Gamma_{x,x'}$ where $x = \{x_p, x_s\}$. The initial value of x is drawn from a log-normal distribution with zero mean and variance $\sigma_{x(1)}^2$. The uncorrelated productivity shock z also follows a log-normal AR(1) process:

$$\ln z_{i,j} = \rho_z \ln z_{i,j-1} + \eta_{i,j}, \;\; \text{with} \;\; \eta \sim N(0, \sigma_\eta^2). \tag{13}$$

This persistent shock is orthogonal between the primary and spouse. The transition matrix for this autoregressive process is denoted by $\Gamma_{z,z'}$, where $z = \{z_p, z_s\}$. Finally, we assume that idiosyncratic productivity shocks ε are independently distributed between time *and* family members with variance σ_ε^2. The probability distribution of these transitory shocks is denoted by $\pi(\varepsilon)$.

Household Labor Supply Households make decisions in both the intensive and extensive margin of labor supply. Let e stand for an employment status that can take two values: E, employment, and N, non-employment. We assume that moving from status N to E requires a one-time utility cost ξ that reflects the costs associated with finding and moving to a new job from non-employment. We assume that these costs may be different for p and s. The cost of entering the labor market serves two purposes. First, it helps match the average levels of employment rates for the primary worker and the spouse. Second, it influences the frequency of transitions between E and N. Without this cost, the model would predict too frequent transitions between labor market states.

In a model where the productivity shock is the main driver of employment decisions, it is mainly wealthy and/or low-productivity workers who are not employed, while the employment rate is weakly correlated with productivity or wealth in the data (Mustre-del Rio, 2015). We introduce an exogenous separation probability λ to weaken this correlation.

Private and Public Insurance We assume that the capital market is incomplete (Aiyagari, 1994). The households insure themselves against income risk by accumulating a risk-free asset a that pays a rate of return r (precautionary motive). They also save for retirement (lifecycle motive). There is an exogenous borrowing constraint, $\underline{a}$: $a' \geq \underline{a}$.

The government plays two roles in the model. First, it taxes household income using a tax function $-T + \tau Y$, where T represents lump-sum transfers, τ proportional tax rate, and Y household income. Note that our tax function is not realistic: in Norway the tax system is progressive and poses a much larger tax rate for top incomes. When families can file joint taxes, like in the U.S., newly working spouses can face the disincentive of higher marginal tax rates associated with the primary worker's income (see, for example, Holter, Krueger, and Stepanchuk, 2023). But in Norway tax filing is only based on individual income, so there is less impact of the degree of tax progressivity on the spousal decision to join the workforce.

In addition, the government runs a social security system. When the household retires from the labor market at age j_R, it receives a social security benefit b. For simplicity, we assume that all workers receive the same social security benefit, regardless of their history of earnings. The government spends tax revenue to pay (i) lump sum transfers, (ii) social security benefits, and (iii) government spending G (which does not enter into the household's utility). Thus, the government budget constraint is as follows:

$$\mu_w \tau Y = \mu_w T + (1 - \mu_w) b + G \tag{14}$$

where μ_w is the share of the working-age population. The tax parameter τ is adjusted to

balance the budget.[23]

State Variables Our model is computationally demanding and includes 13 state variables: five individual state variables (human capital stock, three productivity shocks, and previous employment status) for the primary worker and the spouse, and three household state variables (age, skill, and assets). We denote the state of a household with age j and permanent productivity α by:

$$\boldsymbol{k} = (a, x_p, x_s, z_p, z_s, l_p, l_s, \varepsilon_p, \varepsilon_s, e_{p,j-1}, e_{s,j-1}; j, \alpha)$$

where a denotes asset holdings, x_p, x_s are the individual persistent and correlated productivity levels, z_p, z_s are the individual persistent and uncorrelated productivity levels, l_p, l_s are the accumulated human capital stocks, $\varepsilon_p, \varepsilon_s$ are i.i.d. shocks, and $e_{p,j-1}$, $e_{s,j-1}$ denote the previous employment status for the primary worker and spouse, respectively.

Value Functions We present value functions for three types of households: a dual-earner household (EE), a household where only the primary worker is working (EN), and a retired household. The other sets of value functions are reported in Appendix C. To save space, we write the value functions as if there is no exogenous separation.

Dual Earner Household:

$$V^{EE}_{j,\alpha}(\boldsymbol{k}) = \max_{c,a',h_p,h_s} \left\{ \frac{c_j^{1-\sigma}}{1-\sigma} - \psi_p \frac{h_{p,j}^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}} - \psi_s \frac{h_{s,j}^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}} - \sum_{i=\{p,s\}} \xi_i \mathbb{1}_{\{e_{i,j-1}=N\}} \right.$$
$$\left. + \beta s_{j+1} \sum_{x'_p} \sum_{x'_s} \sum_{z'_p} \sum_{z'_s} \sum_{\varepsilon'_p} \sum_{\varepsilon'_s} \pi(\varepsilon'_p)\pi(\varepsilon'_s)\Gamma_{z'|z}\Gamma_{x'|x} \max\Big\{ V^{EE}_{j+1,\alpha}(\boldsymbol{k}'), V^{EN}_{j+1,\alpha}(\boldsymbol{k}'), V^{NE}_{j+1,\alpha}(\boldsymbol{k}'), V^{NN}_{j+1,\alpha}(\boldsymbol{k}') \Big\} \right\}$$

$$\begin{aligned}
\textbf{s.t.} \quad & c + a' = (1-\tau)(y_p + y_s) - \zeta_5 n_5(j) + T + (1+r)a \\
& a' \geq \underline{a} \\
& y_p = \alpha x_p z_p \theta_{p,j} \varepsilon_p h_p \\
& y_s = \alpha x_s z_s \theta_{s,j} \varepsilon_s h_s \\
& \boldsymbol{k'} = (a', x'_p, x'_s, z'_p, z'_s, l_p + 1, l_s + 1, \varepsilon'_p, \varepsilon'_s, E, E)
\end{aligned}$$

[23]Based on our estimates, labor income taxes are not sufficient to fund both transfers, social security benefits, and government spending. Thus, we interpret G more broadly to reflect also annual receipts from the Norwegian oil fund that amount to around 20 percent of the government budget.

Single Earner Household (Primary Worker):

$$V^{EN}_{j,\alpha}(\boldsymbol{k}) = \max_{c,a',h_p} \left\{ \frac{c_j^{1-\sigma}}{1-\sigma} - \psi_p \frac{h_{p,j}^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}} - \xi_p \mathbb{1}_{\{e_{p,j-1}=N\}} \right.$$

$$\left. + \beta s_{j+1} \sum_{x'_p} \sum_{x'_s} \sum_{z'_p} \sum_{z'_s} \sum_{\varepsilon'_p} \sum_{\varepsilon'_s} \pi(\varepsilon'_p)\pi(\varepsilon'_s)\Gamma_{z'|z}\Gamma_{x'|x} \max\Big\{ V^{EE}_{j+1,\alpha}(\boldsymbol{k'}), V^{EN}_{j+1,\alpha}(\boldsymbol{k'}), V^{NE}_{j+1,\alpha}(\boldsymbol{k'}), V^{NN}_{j+1,\alpha}(\boldsymbol{k'}) \Big\} \right\}$$

$$\begin{aligned} \textbf{s.t.} \quad & c + a' = (1-\tau)y_p + T + (1+r)a \\ & a' \geq \underline{a} \\ & y_p = \alpha x_p z_p \theta_{p,j} \varepsilon_p h_p \\ & \boldsymbol{k'} = (a', x'_p, x'_s, z'_p, z'_s, l_p + 1, l_s, \varepsilon'_p, \varepsilon'_s, E, N) \end{aligned}$$

Retired Household:

$$V^R_j(a) = \max_{c,a'} \left\{ \frac{c_j^{1-\sigma}}{1-\sigma} + \beta s_{j+1} V^R_{j+1}(a') \right\} \tag{15}$$

$$\begin{aligned} \textbf{s.t.} \quad & c + a' = b + (1+r)a \\ & a' \geq \underline{a}. \end{aligned}$$

4.2 Calibration

Externally Set Parameters The model period is one year. Married households are 78 percent of the population. Households are born and enter the labor market at $j = 1$ and live for 80 periods, $J = 80$. This life cycle corresponds to ages 21 to 100. All household members retire exogenously at $j_R = 45$ (age 65) when they start receiving the social security benefit b. The survival probability $\{s_j\}$ and the number of children per married household under the age of 5 is from Statistics Norway (depicted in Figure A-1 in the Appendix). We set ζ_5 (child care cost) based on an annual cost of daycare expenses equal to \$2,500. The risk aversion σ is set to 2 and the Frisch elasticity of labor supply (in the intensive margin) γ is 0.5, parameters common in the literature.

Our model does not have multiple assets, so we use a single interest rate that captures the overall financial rates of return. According to estimates from Klovland (2004), the annual rate of return in Norway is 1.4 percent for risk-free assets and 4.5 percent for stocks, respectively. In addition, Chang et al. (2022) document an average share of risky assets equal to 57 percent in Norwegian portfolios. Based on this evidence, we set the average rate of return $r = 3$ percent. We set the borrowing limit $\underline{a}$ to match the average debt-to-income ratio in the data.

Table 4: Internally Fitted Parameters

Description	Variable	Value	Target Moments
Asset Market	β	0.985	Average asset-to-income
	$\underline{a}$	-0.05	Average credit card debt-to-income
Labor Market	ξ_p	18.1	Average employment, primary
	ξ_s^0	13.8	Life-cycle employment, spouse
	ξ_s^1	0.24	Life-cycle employment, spouse
	ψ_p	12.9	Average hours, primary
	ψ_s	9.0	Average hours, spouse
	λ	2.0%	Average $N \to E$
Income Process	σ_α^2	0.019	College wage premium
	χ_0^s	0.75	Gender wage premium
	χ_1	0.17	Wage growth (25-60)
	$\sigma_{x(1)}^2$	0.10	Variance of log-earnings (30-40)
	ρ_x	0.98	Rise in variance of log-earnings (30-55)
	σ_ν^2	0.006	Variance of log-earnings (45-55)
	σ_{ps}	0.30	Correlation in productivity
	ρ_z	0.99	Persistence of earnings (instrumented)
	σ_η^2	0.007	Variance of earnings ($''$)
Government	T	0.13	Transfers-to-income ratio

The proportional tax rate, $\tau = 0.32$, is set to match the average tax liability of household income in the data. The social security benefit is set so that it matches an average replacement rate equal to 55 percent in the Norwegian social security system.

Finally, the only externally set productivity parameter is the variance of the i.i.d. shocks that we set to $\sigma_\varepsilon^2 = 0.04$ based on estimates of Blundell, Pistaferri, and Saporta-Eksten (2016).

Internally Fitted Parameters Table 4 shows the internally fitted parameters. Each group of parameters is jointly calibrated to fit a set of moments. However, to make the calibration more transparent, we associate each parameter with the statistic that is most informative about its value. Specifically, we calibrate the discount factor β to match the asset-to-income ratio. We also give each household an initial endowment of assets to match the assets-to-income ratio at age 25. The disutility of work, ψ_i, is set so that, on average, primary earners work around 34 percent of their time and spouses 28 percent of their time. The utility cost of moving from non-employment to employment, ξ_i, is chosen to match the employment rates.

To better fit the data on the spousal employment rate, we assume that for the spouse this cost is age-dependent: $\xi_{s,j} = \xi_0^s + \xi_1^s\ j$. The exogenous separation rate λ is selected by targeting the average transition rate from employment to non-employment.

The variance of permanent productivity σ_α^2 is calibrated to match an average college premium of 1.3. We assume that human capital evolves with the experience of the labor market according to $\log \theta_{i,j}(l) = \log \chi_0^i + \chi_1^i \log(1 + \frac{1}{q}(l-1))$ where q represents the probability that human capital increases to the next level. There are three levels of labor market experience $l = \{1, 2, 3\}$ and thus the probability of accumulating experience is $q = \frac{1}{15}$ $(= 3 \times \frac{1}{45})$. At the beginning of the life cycle, all workers start with the same level of experience ($l = 1$). We normalize $\chi_0^p = 1$ and set $\chi_0^s = 0.75$ to reflect an average wage discount for female workers in the data equal to 25 percent. The slope parameter is chosen to match the average lifetime growth in earnings for the primary worker and the spouse (both equal to around 50 percent between ages 25 and 50). To replicate this, we set $\chi_1 = 0.17$.[24]

For the correlated productivity shocks, we set $\rho_x = 0.98$ and $\sigma_\nu^2 = 0.006$ to replicate an increasing variance of log earnings throughout the life cycle of around 12 percentage points. We set the dispersion in initial productivity to match the level of cross-sectional variance in log income at younger ages. In addition, conditional on education levels, the estimated correlation between primary and spousal hourly wages is 0.2 (in our data). We set the covariance σ_{ps} to match this correlation.

For uncorrelated productivity shocks, $\ln z_{i,j}$, we match the stochastic process of earnings fluctuations predicted by our instrument in the data. Specifically, we choose $\rho_z = 0.99$ and $\sigma_\eta = 0.007$ so that the predicted component of the primary earnings, which is obtained by regressing $\ln y_{p,i,t}$ on $\ln z_{p,i,t}$, matches the persistence and volatility of the instrumented primary earnings in the data. It turns out that the fraction of primary income variability due to z in our model (0.16) is close to its counterpart (fraction of primary income volatility due to firm sales revenue) in the data (0.19). Finally, the size of the lump sum transfers, T, is set to match the average share of government transfers in household income in the data (18 percent).

4.3 Model Fit

Table 5 summarizes key statistics from the model and the data. The model reproduces the data well in terms of the asset-to-income ratio, debt-to-income ratio, average employment rates, hours worked, entry rates to employment. The model is less successful in matching the share of dual earners (55 percent in the data vs. 60 percent in the model) and single-earner

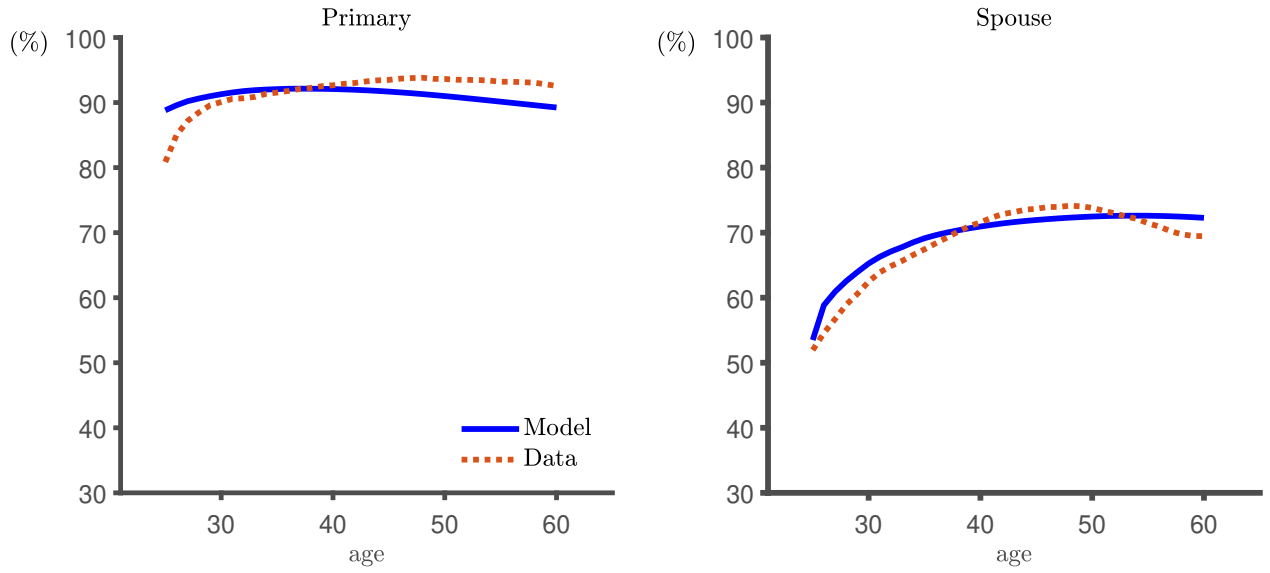
[24]Both estimates of the gender-wage gap and the life cycle growth of earnings in the Norwegian data are broadly comparable to estimates for the U.S. labor market (see, for example, Heathcote, Storesletten, and Violante, 2010 and Guvenen et al., 2021).

Table 5: Comparison between Model and Data

Statistic	Model	Data	Statistic	Model	Data
Assets / Income	1.78	1.81	Income share, p	0.46	0.50
Employment, p	0.91	0.91	Income share, s	0.29	0.24
Employment, s	0.68	0.68	T / Y	0.18	0.18
Hours of work, p	0.35	0.34	Share of dual earners	0.60	0.55
Hours of work, s	0.27	0.28	Share of single earners	0.28	0.35
$N \to E$ rate, p	2.0%	2.9%	Debt / Income	0.05	0.05
$N \to E$ rate, s	2.8%	3.2%	Wage growth w_{50}/w_{25}, p	56%	55%
Wage gap w_s/w_p	0.75	0.75	Wage growth w_{50}/w_{25}, s	55%	50%

Notes: The statistics of primary workers and their spouses are denoted by p and s, respectively.

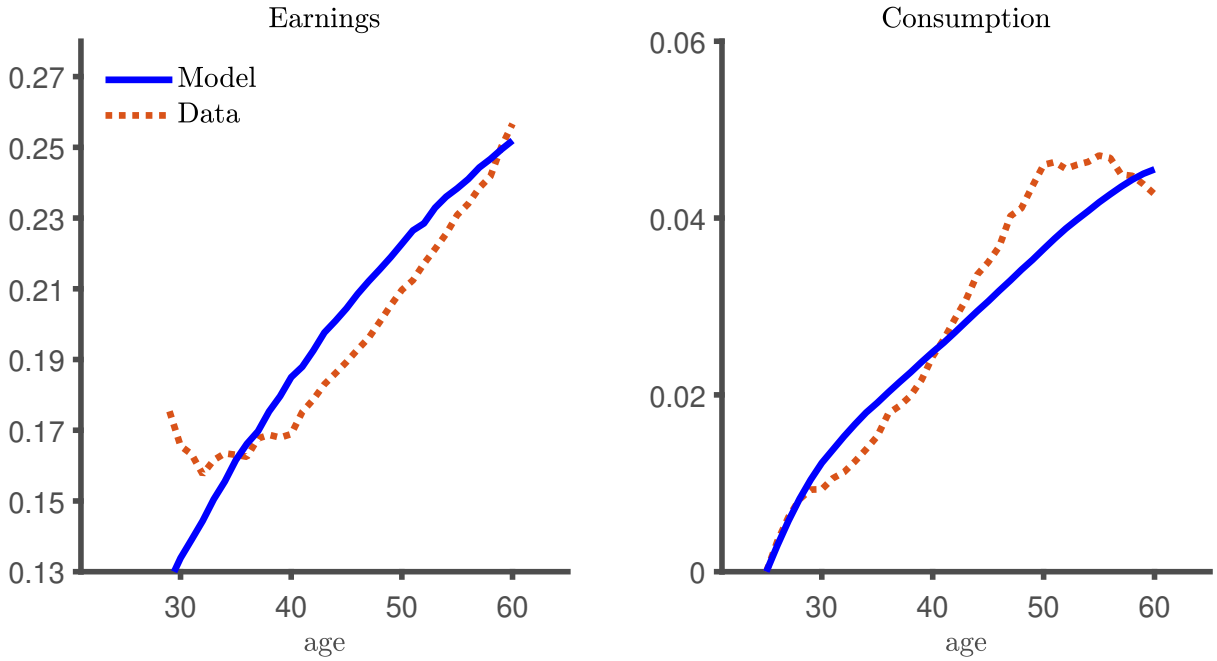
Figure 2: Life Cycle Profiles of Employment Rates: Model vs. Data



households (35 percent in the data versus 28 percent in the model).

Figure 2 shows the life cycle profiles of employment rates for primary workers and spouses. In the data, the life cycle employment profile of spouses features a gentle hump shape. The model can generate a similar shape thanks to the interaction of various factors: the entry cost of participation, age-dependent child care costs, initial dispersion in productivity, gradual accumulation of human capital through labor market experience, exogenous separation prob-

Figure 3: Life Cycle Profiles of Variance of Earnings and Consumption



Notes: The variance of cross-sectional log earnings (left) and log consumption (right). The variance of log consumption in the data is from Fagereng, Holm, and Natvik (2021) and is available in terms of the differences from age of 25.

ability, and the wealth effect from the accumulated assets. The entry cost to the labor market is high for younger spouses. In addition, the cost of child care is higher for younger households and decreases after their peak at the age of 30. As a result, low-productivity households delay their entry into the labor market and wait for a favorable productivity shock. At the same time, to build both human and financial capital, workers are strongly attached to the labor market in the middle part of the life cycle. Toward the end of the life cycle, employment rates begin to stabilize. Closer to retirement, workers exit as they have accumulated enough financial wealth.

Figure 3 shows the profile of the variance of cross-sectional log earnings (left) and log consumption (right). In the data, because of the widely scattered hours of work among young households, the variance of earnings is very large for young workers, which is hard to replicate in a standard model. As they settle on the jobs, the dispersion starts to decrease. The dispersion starts to increase as persistent productivity shocks accumulate over time. Although the model cannot match the large dispersion of earnings in the early stage of the life cycle, it matches the data closely after the age of 35. The variance of log consumption increases by around 4 percentage points between ages 25 and 60. Although we did not target to match this profile, the model is able to reproduce the life-cycle increase in the dispersion of consumption

fairly well.

Table 6: Spousal Labor Supply Response: Data vs. Model

		Data	Model
Employment	OLS	−0.00	−0.01
	IV	−0.15	−0.13
Earnings	OLS	0.017	−0.06
	IV	−0.42	−0.27

4.4 Cross-Elasticity of Labor Supply

We examine whether our model can replicate the estimated elasticity of the spousal labor supply to a change in primary income. We perform both OLS and IV estimation using panel data generated from the model simulation. For the OLS estimation, we use the same specification as in the empirical analysis:

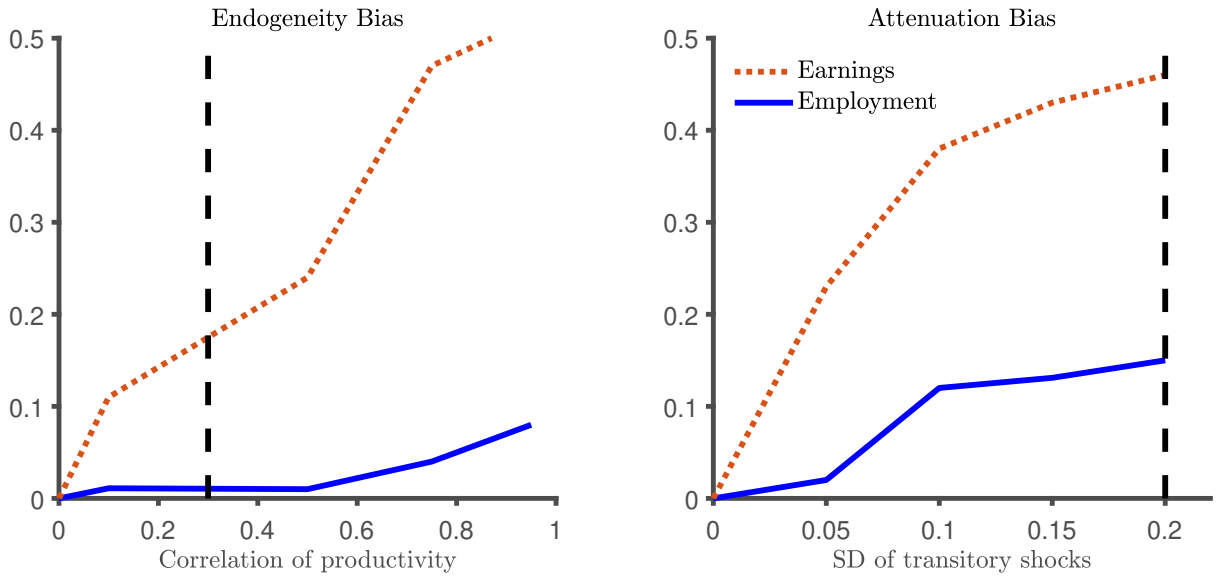
$$\Delta h_{s,i,t} = \beta \Delta y_{p,i,t} + X'_{i,t}\delta + v_{s,i,t}$$

where $h_{s,i,t}$ is the outcome variable (employment or log earnings), $y_{p,i,t}$ is the log of primary income, and $X_{i,t}$ is a set of controls, specifically, permanent productivity, age, and asset holdings of the household. Since $\Delta y_{p,i,t}$, contains a mixture of shocks–transitory and persistent (correlated and uncorrelated between spouses)–as in the data, the OLS estimate suffers from the same bias (due to attenuation and endogeneity). For IV estimation, we use persistent uncorrelated productivity $z_{p,i,t}$ as our instrument. In the second stage, we estimate the above equation by replacing $\Delta y_{p,i,t}$ with $\widehat{\Delta y}_{p,i,t}$, the predicted values from the first stage regression of $\Delta y_{p,i,t}$ on $\Delta \ln z_{p,i,t}$.

Table 6 compares the OLS and IV estimates between the model and the data. Similarly to the data, the OLS estimate produces a close to zero estimate for the spousal response to primary income. When we use the instrument, the estimate of $\widehat{\beta}$ for the employment response from the model-generated data is −0.13, broadly comparable to the IV estimates from the empirical analysis. Finally, the model is less successful in producing the large earnings elasticity conditional on participation in the data (−0.27 in the model versus −0.42 in the data).

Quantifying Two Biases The OLS estimate diverges from the IV estimate for two reasons: (i) endogeneity due to correlated productivity between the primary worker and the spouse,

Figure 4: Two Biases in OLS estimate of β



Notes: The endogeneity bias (left) is computed by shutting down the transitory shocks ($\sigma_\varepsilon = 0$). The attenuation bias (right) is computed by shutting down the covariance ($\sigma_{ps} = 0$). The vertical line represents the benchmark case.

and (ii) attenuation bias due to a transitory component in income. To isolate the marginal contribution of each bias, we simulate the model while shutting down one of the two channels. Figure 4 shows the magnitude of each bias for various values of the covariance of productivity (σ_{ps}) and variance of transitory shocks (σ_ε). The endogeneity bias (left) is computed by shutting down the transitory shocks ($\sigma_\varepsilon = 0$). The attenuation bias (right) is computed by shutting down the covariance ($\sigma_{ps} = 0$). The vertical line represents the benchmark case values. We report estimates for employment and earnings. For employment (blue line), most of the bias stems from attenuation under our benchmark calibration, whereas for earnings (dashed red), one-third of the bias stems from endogeneity, and two-thirds from attenuation.

Heterogeneity in Spousal Response Table 7 reports the estimates of the spousal employment response by household assets and age using instrumental variable regression. The model clearly shows that the effects are stronger among less wealthy and younger households who have limited ability to insure themselves, consistent with empirical findings. A stronger effect for younger households are partially explained by these households having fewer financial assets. But at the same time, there is a time-horizon effect. In younger single-earner households that experience a decline in primary income, the spouse is more willing to pay the one-time entry cost and move into employment, given that the working horizon is longer. At the same

Table 7: Heterogeneity in Spousal Employment Response: Model vs. Data

	Model	Data
Wealth		
$<$ 6 month's earnings	-0.15	-0.20
$\geq$ 6 month's earnings	-0.11	-0.08
Age		
$25-39$	-0.22	-0.27
$40-49$	-0.10	-0.16
$50-59$	-0.03	-0.02

Notes: The response are based on the IV estimates from the model and data.

time, the longer horizon of human capital accumulation also encourages the participation of spouses relative to older households.

4.5 Consumption Elasticity

Blundell, Pistaferri, and Saporta-Eksten (2016) measure the degree of insurance against income shocks by (one minus) the pass-through of income shocks to household consumption. We also estimate the pass-through in our model by running the same regression as follows. In fact, this specification is almost identical to the consumption function presented in (3) except that we further distinguish between persistent and transitory productivity:

$$\Delta c_{i,t} = \eta_0 + \eta_x \Delta x_{j,i,t} + \eta_\varepsilon \Delta \varepsilon_{j,i,t} + \nu_{i,t} \tag{16}$$

where $c_{i,t}$ is household consumption, $x_{j,i,t}$ and $\varepsilon_{j,i,t}$ are persistent and transitory productivity of worker $j = \{p, s\}$, respectively. For the primary worker, we obtain the pass through of $\widehat{\eta_x} = 0.30$, i.e., 30 percent of permanent income shocks pass through to consumption and $\widehat{\eta_\varepsilon} = 0.01$, i.e., transitory shocks are nearly perfectly insured. For spouses, we obtain the pass through of $\widehat{\eta_x} = 0.22$, i.e., 22 percent of permanent income shocks pass through to consumption and again a nearly zero coefficient for transitory shocks. Our estimates are close to Blundell, Pistaferri, and Saporta-Eksten (2016) who using data from the U.S. estimate that 35 percent of primary permanent shocks pass through consumption and 19 percent of spouse permanent shocks pass through consumption.

5 Transfer Policy against Income Shock

What is an effective government transfer policy when a part of the economy suffers an income loss? We use our structural model to study various fiscal policies to mitigate a negative productivity shock. More specifically, we analyze temporary government subsidies that aim to support consumption and employment.[25]

5.1 A Negative Productivity Shock to Primary Workers

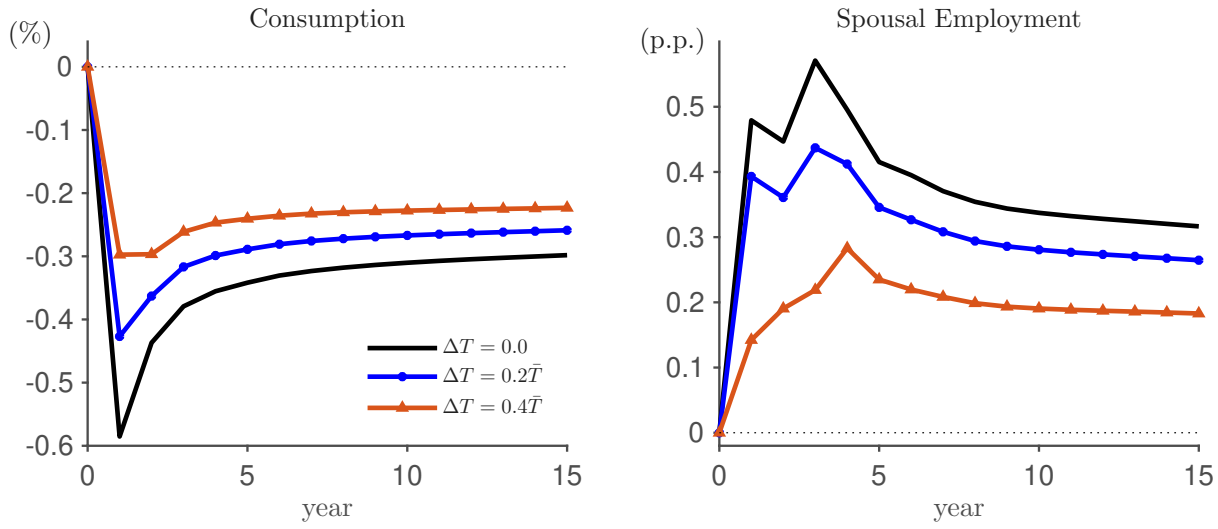
Suppose that the productivity of the primary worker unexpectedly decreases by 20 percent for a fraction (5 percent) of households in the economy. We assume that this productivity shock is autocorrelated with a persistence of 0.3: the negative productivity shock essentially fades out after four years. Once this event unfolds, households have perfect foresight of how the shock evolves over time. Spousal productivity is not affected by this shock. This scenario corresponds to a negative shock in an industry where the dominant workforce is male workers (e.g., industries such as construction or manufacturing). In response to this adversity, the government can provide an additional transfer amount ΔT to these households for one year: temporary relief program. The extra expenditure is financed by adjusting the labor income tax τ.

Figure 5 shows the impulse responses of consumption and spousal employment of households affected by the negative productivity shock. Without government intervention ($\Delta T = 0$, the black line), consumption decreases by around 0.6 percent (relative to the steady state) in the first year. Households self-insure against the shock by (i) drawing down their financial assets and (ii) increasing spousal labor supply. The spousal employment rate increases about 0.5 percentage points (relative to steady state) in the first year. The increase in spousal employment occurs over several years due to entry costs and the stochastic nature of market productivity. Not all spouses enter the labor market immediately. Some may want to wait for a more favorable productivity draw.

The figure also shows the effect of the additional lump sum transfer (in the first year) with two different sizes: $\Delta T = 0.2\bar{T}$ and $\Delta T = 0.4\bar{T}$ where $\bar{T}$ is the transfer amount in the steady state. Since the lump sum transfer in the steady state is 18 percent of total GDP, these additional transfers amount to 3.6 percent and 7.2 percent of the average income, respectively. Clearly, a one-time increase in government transfer mitigates the decline in consumption. At the same time, it partially mutes the increase in spousal employment. This happens for two reasons. First, the additional government transfer reduces the households' willingness to self-

[25] Although economists use social welfare to evaluate policies, policymakers often adopt consumption and employment as a goal because they are much easier to measure and communicate with.

Figure 5: Response to a Decline in Primary Worker's Productivity



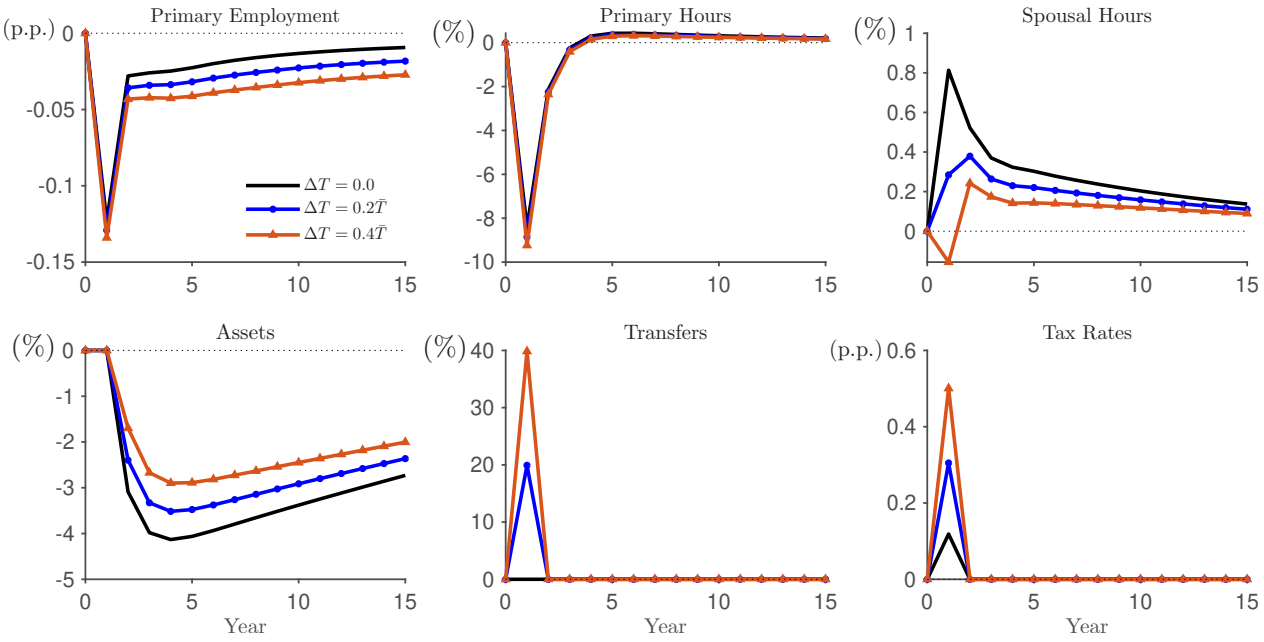
Notes: Consumption (left) is expressed in terms of percentage change from the steady state. Spousal employment (right) is expressed in terms of percentage point difference relative to the steady state.

insure through the labor supply of spouses: public insurance partially crowds out private insurance (Cullen and Gruber, 2000; Birinci, 2024). Second, an increased transfer amount implies a higher income tax rate, which further reduces the incentive to work. With a generous additional transfer ($\Delta T = 0.4\bar{T}$), consumption decreases by around 0.3 percent (compared to 0.6 percent when there is no additional subsidy) and spousal employment increases by 0.15 percentage points in the first year (as opposed to 0.5 percentage points without additional subsidy).[26]

Figure 6 shows the impulse response of primary employment, the hours of work (conditional on working) for primary and spouse, household assets, transfers and tax rates. The employment of primary workers (who suffer from this negative productivity shock) declines by 0.13 percentage points in the first year and then returns to the steady state over time. Although primary worker employment falls only slightly (because they are strongly attached to the market), working hours decrease significantly by 8.4 percent. Households reduce their

[26]The reason why the spousal employment shows a wiggling shape–spousal employment decreases temporarily in year 2 before it reaches its peak in year 3–is because of a large drop in primary employment (which causes a strong substitution between primary and secondary workers in the market). There is a sudden, large drop in primary employment in the first year–requiring a big push of spousal participation. Although primary workers who left the market return to work gradually, most of the return occurs in the second year as the productivity shock is short-lived (see Figure 6). Despite the reshuffling of labor supply between primary and secondary workers within the household (who suffer from a negative productivity shock to a primary worker), total (primary plus spousal) employment of these households shows a smooth movement over time. When a generous additional subsidy ($\Delta T = 0.4\bar{T}$) mitigates a big push in spousal employment in the first year, this wiggly shape disappears.

Figure 6: Impulse Responses of Impacted Households



Notes: All variables are relative to their steady state values.

assets and increase spousal labor to smooth consumption. Household assets gradually decrease and then recover over time. Spousal hours (conditional on working) increase by 0.8 percent in the first year. The labor-income tax rate has to increase by 0.1 percentage points in the first year to make up for the reduced tax revenue. Since the increase in tax rate is small, it has relatively little impact on the rest of the economy.

Table 8 reports the response (first year) of earnings and hours (both with extensive and intensive margins) of households that suffer a negative productivity shock. Without government intervention, primary earnings and hours decrease by 8.6 and 8.5 percent, respectively. Spousal earnings and hours increase by 1.1 and 1.6 percent, respectively. Although additional government subsidies support consumption, they reduce the incentive to work. Under $\Delta T = 0.2\bar{T}$, the increase in spousal earnings and hours is reduced by about half (0.6 and 0.9 percent, respectively). With a generous transfer, $\Delta T = 0.4\bar{T}$, spousal earnings and hours respond very little (-0.01 and 0.06 percent, respectively).

Finally, Table 9 reports the responses of two types of skill group (high and low value of α).[27] Although both groups receive the same degree of productivity shocks, the employment responses are somewhat different. The primary employment of the high-skilled decreases by only 0.01 percentage points, while that of the low-skilled decreases by 0.11 percentage points.

[27]The average wage ratio of high-skill vs. low-skill is 1.3.

Table 8: Earnings and Hours of the Impacted Households

	ΔT=0	$\Delta T = 0.2\bar{T}$	$\Delta T = 0.4\bar{T}$
Earnings, p	−8.61	−8.97	−9.29
Hours, p	−8.53	−8.98	−9.37
Earnings, s	+1.10	+0.60	−0.01
Hours, s	+1.60	+0.91	+0.06

Note: All variables are expressed in percentage change from the steady state.

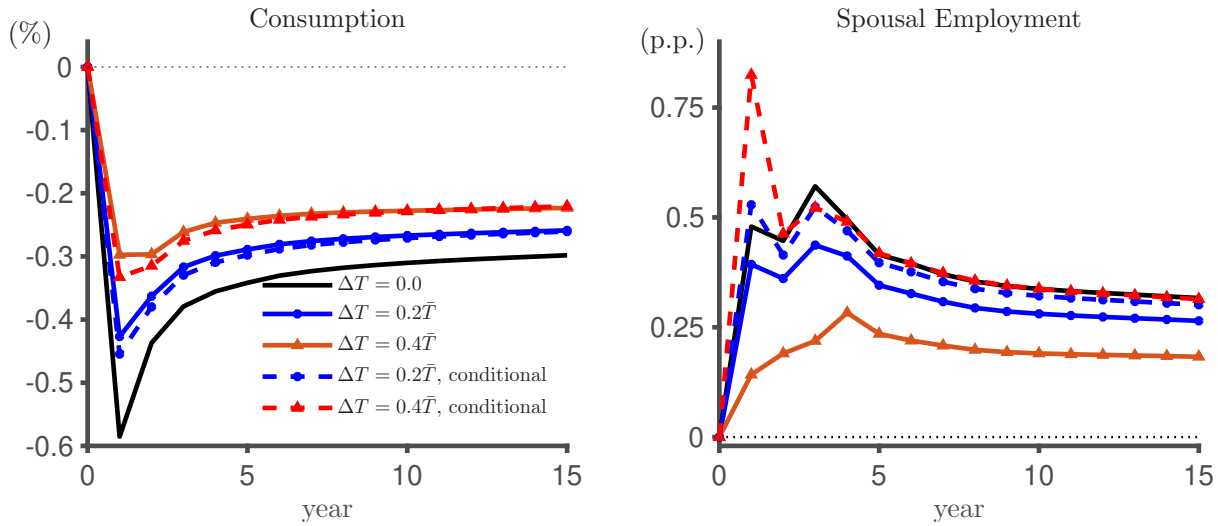
Table 9: Household Response: High- vs. Low-Skilled

	ΔT=0	$\Delta T = 0.2\bar{T}$	$\Delta T = 0.4\bar{T}$
High-skilled			
Employment, p	−0.01	−0.01	−0.01
Earnings, p	−8.50	−8.85	−9.16
Employment, s	+0.27	+0.21	+0.12
Earnings, s	+1.29	+0.73	+0.14
Consumption	−0.61	−0.45	−0.33
Low-skilled			
Employment, p	−0.11	−0.11	−0.11
Earnings, p	−8.70	−9.06	−9.39
Employment, s	+0.20	+0.17	+0.01
Earnings, s	+0.98	+0.52	−0.11
Consumption	−0.54	−0.39	−0.25

Note: All variables are expressed in percentage change from steady state value. Employment is expressed in terms of percentage points.

High-skilled primary workers, who have a strong comparative advantage in the market, hardly leave the market, while their earnings decrease significantly by 8.5 percent due to reduced productivity and hours. High-skilled spouses increase their participation in the labor market (by 0.27 percentage points) to compensate for the primary income loss. The increase in employment of low-skilled spouses is smaller than that of high-skilled spouses. This is because low-skilled spouses have less opportunity in the market–note that we assume a perfectly assortative matching. The employment rate of high-skilled spouses increases by 0.27 percentage points, while that of low-skilled spouses increases by 0.20 percentage points. This difference is more pronounced when the government provides an additional subsidy. With generous transfers ($\Delta T = 0.4\bar{T}$), the spousal employment of low-skilled increases by only 0.01 percentage points, while that of high-skilled increases by 0.12 percentage points.

Figure 7: Effects of Conditional Program



Notes: Under the conditional transfer program (dashed lines), the amount of payment is tied to the employment status.

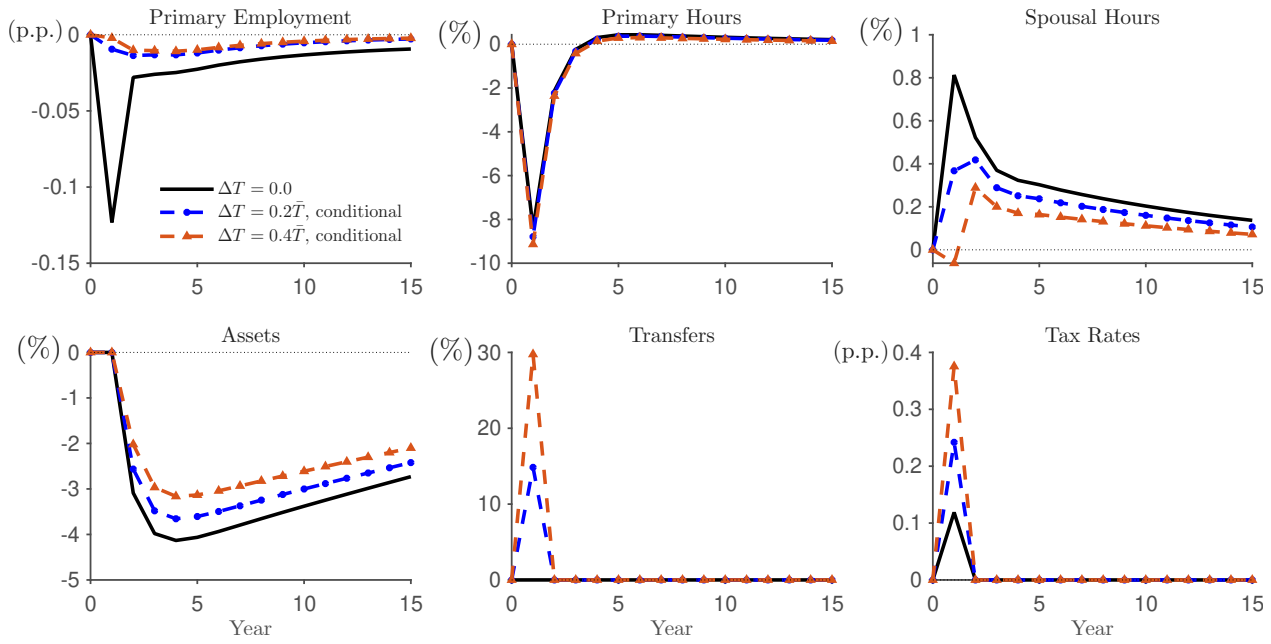
5.2 Re-Designing Fiscal Assistance Programs

An effective fiscal assistance program must support consumption and employment at a minimal cost. We have just shown that the additional transfer supports the consumption of households, but at the expense of employment. We consider an alternative policy, which makes eligibility for additional transfer conditional on employment. First, we make the transfer conditional on being employed. Second, we double the transfer when both members work. That is, if one member is working, the household receives $\Delta T = 0.1\bar{T}$ and if both members are working, the household receives $\Delta T = 0.2\bar{T}$. We also consider a more generous case in which a single-earner household receives $\Delta T = 0.2\bar{T}$ and a dual-earner household receives $\Delta T = 0.4\bar{T}$.

Figure 7 shows the impulse responses of the conditional transfer program (dashed lines). Conditional transfer generates a much larger increase in spousal employment while mitigating the consumption loss almost as much as unconditional ones. When the transfer is given regardless of employment status, the increased spousal employment is significantly dampened as the additional transfer becomes more generous: public insurance crowds out private insurance. However, when the additional transfer is tied to employment, the spousal employment increases even more as the additional transfer becomes more generous, because it also means an extra incentive to work.

Figure 8 shows that the conditional policy is also very effective in maintaining the employ-

Figure 8: Impulse Responses: Conditional Transfer Program



Notes: All variables are relative to their steady state values.

ment of primary workers: primary employment barely changes, while hours of work still fall as much as in the unconditional policy. Since the transfer is conditional, the program is also cost-effective. The required tax rate under the conditional programs is about three-quarters of the unconditional one.

Table 10 reports the welfare of households in units equivalent to steady-state consumption. When the government does not intervene ($\Delta T = 0$), households that suffer a negative productivity shock experience a welfare loss equal to 0.3 percent of the steady-state consumption. With government aid program, the welfare of impacted households improves, but at the expense of non-impacted households who face a slightly higher income tax rate. The additional aid does improve ex ante average welfare slightly.

Under the conditional transfer program, there are two opposing effects. On the one hand, households who suffered the negative shock prefer unconditional transfer to conditional ones: they receive the full amount regardless of employment. On the other hand, non-impacted households prefer conditional transfers because they face a smaller increase in income tax rate. Specifically, under the unconditional transfer policy, the tax rate increases by 0.31 and 0.50 percentage points for $\Delta T = 0.2\bar{T}$ and $\Delta T = 0.4\bar{T}$, respectively. Under the conditional program the tax rate increases by 0.24 and 0.38 percentage points, respectively. Overall, the conditional transfer program provides the average welfare almost the same as that of

Table 10: Welfare of Households

	ΔT=0	$\Delta T = 0.2\bar{T}$	$\Delta T = 0.4\bar{T}$
	Transfer for All Impacted		
Impacted	−0.30%	−0.20%	−0.10%
Non-impacted	−0.002%	−0.007%	−0.017%
Average	−0.018%	−0.017%	−0.016%
	Conditional Transfer Program		
Impacted	−0.30%	−0.23%	−0.17%
Non-impacted	−0.002%	−0.005%	−0.009%
Average	−0.018%	−0.017%	−0.017%

Note: Welfare is expressed in terms of steady state consumption.

unconditional ones, while effectively preserving employment.

6 Conclusion

This paper examines the role of the spousal labor supply as an insurance mechanism against income fluctuations of the primary worker in the household. Using administrative data from Norway, we identify income shocks to primary workers that are unanticipated, persistent, and uncorrelated with the spousal's productivity, which help to precisely estimate the response of spousal labor supply. Our findings highlight a significant added worker effect, particularly for households with limited options for self-insurance (that is, young and poor households who have relatively limited financial resources). We develop a structural dual-earner model calibrated to match the salient features of the Norwegian labor market and the welfare system. We show that our model successfully replicates the spousal response that we estimated from the data. We then use this model to design a temporary relief program (transfers) that support consumption and, at the same time, preserve the employment of households who suffer from negative productivity shocks to the primary worker. We show that making the additional transfer conditional on working is effective in preserving employment while achieving almost the same average welfare as the unconditional policy.

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Appendix: For Online Publication

A Static Model of Household Labor Supply

We derive an analytical formula for the labor supply in a static environment. Assume that there is a household with the following additively separable preferences:

$$U = \frac{c^{1-\sigma}}{1-\sigma} - \frac{h_p^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}} - \frac{h_s^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}}$$

where c is household consumption, h_p and h_s are the hours worked for the primary worker and the spouse, respectively. The household consumption is equal to the primary worker's earnings, the spouse's earnings and non-labor income n.

$$c = wx_p h_p + wx_s h_s + n$$

It is convenient to define the labor share of primary/secondary income:

$$S_i = \frac{wx_i h_i}{wx_p h_p + wx_s h_s + n} \quad \text{with } i = \{p, s\}.$$

The first-order condition for the supply of spousal labor is:

$$\frac{1}{\gamma} \ln h_s = -\sigma \ln \left[wx_p h_p + wx_s h_s + n \right] + \ln x_s + \ln w.$$

By total differentiation of the first-order condition with respect to h_s and x_s we obtain the following:

$$\frac{1}{\gamma}\frac{1}{h_s} dh_s = -\sigma \frac{wx_s}{wx_p h_p + wx_s h_s + n} dh_s - \sigma \frac{wh_s}{wx_p h_p + wx_s h_s + n} dx_s + \frac{1}{x_s} dx_s$$

After some algebra, we have:

$$\frac{dh_s}{dx_s}\frac{x_s}{h_s}\left[\frac{1}{\gamma} + \sigma \underbrace{\frac{wx_s h_s}{wx_p h_p + wx_s h_s + n}}_{S_s} \right] = -\sigma \underbrace{\frac{wx_s h_s}{wx_p h_p + wx_s h_s + n}}_{S_s} + 1.$$

This leads to the Marshallian labor supply elasticity:

$$\frac{dh_s}{dx_s}\frac{x_s}{h_s} = \frac{1 - \sigma S_s}{1/\gamma + \sigma S_s}.$$

To obtain the cross-elasticity of the spousal labor supply with respect to primary income, we take the total differentiation of the first-order condition with respect to h_s and $x_p h_p$:

$$\frac{1}{\gamma}\frac{1}{h_s}dh_s = -\sigma\frac{wx_s}{wx_p h_p + wx_s h_s + n}dh_s - \sigma\frac{w}{wx_p h_p + wx_s h_s + n}d[x_p h_p]$$

After some algebra, we have

$$\frac{1}{\gamma}\frac{dh_s}{d[x_p h_p]}\frac{[x_p h_p]}{h_s} = -\sigma\underbrace{\frac{wx_s h_s}{wx_p h_p + wx_s h_s + n}}_{S_s}\frac{dh_s}{d[x_p h_p]}\frac{[x_p h_p]}{h_s} - \sigma\underbrace{\frac{[wx_p h_p]}{wx_p h_p + wx_s h_s + n}}_{S_p}$$

and

$$\frac{dh_s}{d[x_p h_p]}\frac{[x_p h_p]}{h_s}\left[\frac{1}{\gamma} + \sigma S_s\right] = -\sigma S_p.$$

The cross-elasticity of the spousal labor supply with respect to primary income is:

$$\frac{dh_s}{d[x_p h_p]}\frac{[x_p h_p]}{h_s} = \frac{-\sigma S_p}{\frac{1}{\gamma} + \sigma S_s}.$$

Now consider a case where the primary income $wx_p h_p$ is correlated with the productivity of the spouse. Specifically, we assume that $x_s = f(x_p h_p)$. The first-order condition of spousal labor remains the same. However, the total differentiation of the first order condition with respect to h_s and $x_p h_p$ gives the following expression.

$$\begin{aligned}\frac{1}{\gamma}\frac{1}{h_s}dh_s = &-\sigma\frac{wx_s}{wx_p h_p + wx_s h_s + n}dh_s - \sigma\frac{w}{wx_p h_p + wx_s h_s + n}d[x_p h_p] \\ &-\sigma\frac{wh_s}{x_p h_p + x_s h_s + N}f' d[x_p h_p] + \frac{1}{x_s}f' d[x_p h_p]\end{aligned}$$

With some algebra, we have

$$\frac{dh_s}{d[x_p h_p]}\frac{[x_p h_p]}{h_s}\left[\frac{1}{\gamma} + \sigma S_s\right] = -\sigma S_p - \sigma\frac{wh_s x_s}{wx_p h_p + wx_s h_s + n}f'\frac{[x_p h_p]}{x_s} + \frac{x_p h_p}{x_s}f'$$

or equivalently,

$$\frac{dh_s}{d[x_p h_p]}\frac{[x_p h_p]}{h_s}\left[\frac{1}{\gamma} + \sigma S_s\right] = -\sigma S_p + [1 - \sigma S_s]\frac{x_p h_p}{x_s}f'.$$

Note that $\frac{x_p h_p}{x_s}f'$ is the elasticity of spousal productivity with respect to primary income, which we denoted $\varepsilon_{x_s, x_p h_p}$. We now obtain the formula in the main text for the cross-elasticity:

$$\frac{dh_s}{d[x_p h_p]}\frac{[x_p h_p]}{h_s} = \underbrace{\frac{-\sigma S_p}{\frac{1}{\gamma} + \sigma S_s}}_{\text{income elasticity}} + \varepsilon_{x_s, x_p h_p} \times \underbrace{\frac{1 - \sigma S_s}{\frac{1}{\gamma} + \sigma S_s}}_{\text{Marshallian elast.}}.$$

B Additional Information from Empirical Analysis

We present more information about our empirical analysis. Table A-1 shows the full estimated coefficients from our OLS and IV regressions for the two outcome variables of the spousal labor supply: (i) employment and (ii) earnings. Table A-2 shows the estimated coefficients for different groups and for each robustness analysis.

C Value Functions and Calibration

In the text, we present the value functions for three types of households: a dual-earner household ($e = EE$), a household where only the primary worker is working ($e = EN$), and a retiree ($e = NN$). Here, we present the dynamic program for a household where only the spouse is working ($e = NE$), and without an earner ($e = NN$). To save space, we express the value functions as if there is no exogenous separation.

Single Earner Household (Spouse is Working):

$$V_{j,\alpha}^{NE}(\mathbf{k}) = \max_{c,a',h_s} \left\{ \frac{c_j^{1-\sigma}}{1-\sigma} - \psi_s \frac{h_{s,j}^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}} - \xi_s \mathbb{1}_{\left\{e_{s,j-1}=N\right\}} \right.$$

$$\left. + \beta s_{j+1} \sum_{x'_p} \sum_{x'_s} \sum_{z'_p} \sum_{z'_s} \sum_{\varepsilon'_p} \sum_{\varepsilon'_s} \pi(\varepsilon'_p)\pi(\varepsilon'_s)\Gamma_{x'|x}\Gamma_{z'|z} \max\left\{ V_{j+1,\alpha}^{EE}(\mathbf{k}'), V_{j+1,\alpha}^{EN}(\mathbf{k}'), V_{j+1,\alpha}^{NE}(\mathbf{k}'), V_{j+1,\alpha}^{NN}(\mathbf{k}') \right\} \right\}$$

$$\begin{aligned} \textbf{s.t.} \quad & c + a' = (1-\tau)y_s + T + (1+r)a \\ & a' \geq \underline{a} \\ & y_s = \alpha x_s \theta_{s,j} \varepsilon_s h_s \\ & \boldsymbol{k'} = (a', x'_p, x'_s, z'_p, z'_s, l_p, l_s + 1, \varepsilon'_p, \varepsilon'_s, N, E) \end{aligned}$$

Household with No Earners:

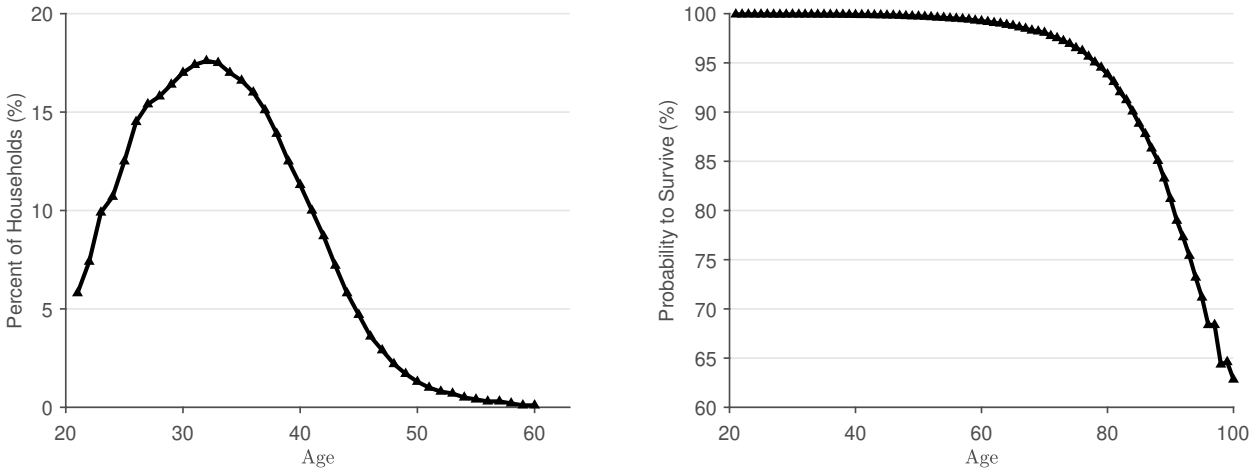
$$V_{j,\alpha}^{NN}(\mathbf{k}) = \max_{c,a'} \left\{ \frac{c_j^{1-\sigma}}{1-\sigma} \right.$$

$$\left. + \beta s_{j+1} \sum_{x'_p} \sum_{x'_s} \sum_{z'_p} \sum z'_s \sum_{\varepsilon'_p} \sum_{\varepsilon'_s} \pi(\varepsilon'_p)\pi(\varepsilon'_s)\Gamma_{x'|x} \max\left\{ V_{j+1,\alpha}^{EE}(\mathbf{k}'), V_{j+1,\alpha}^{EN}(\mathbf{k}'), V_{j+1,\alpha}^{NE}(\mathbf{k}'), V_{j+1,\alpha}^{NN}(\mathbf{k}') \right\} \right\}$$

$$\begin{aligned} \textbf{s.t.} \quad & c + a' = T + (1+r)a \\ & a' \geq \underline{a} \\ & \boldsymbol{k'} = (a', x'_p, x'_s, z'_p, z'_s, l_p, l_s, \varepsilon'_p, \varepsilon'_s, N, N) \end{aligned}$$

Our model includes age-dependent expenses for child care. To calibrate these expenses, we need the number of young children by age group. In the administrative data, we observe the age of the youngest child in each family. Based on this information, we calculate the share of households that have a child under the age of 5. Figure A-1 shows the share of married households that have a child under the age of 5. At its peak (at the age of 32), 17.6 percent of Norwegian households have a child under the age of 5. We also show the survival probability by age $\{s_j\}$.

Figure A-1: Households with a Child Under the Age of 5 and Survival Probability

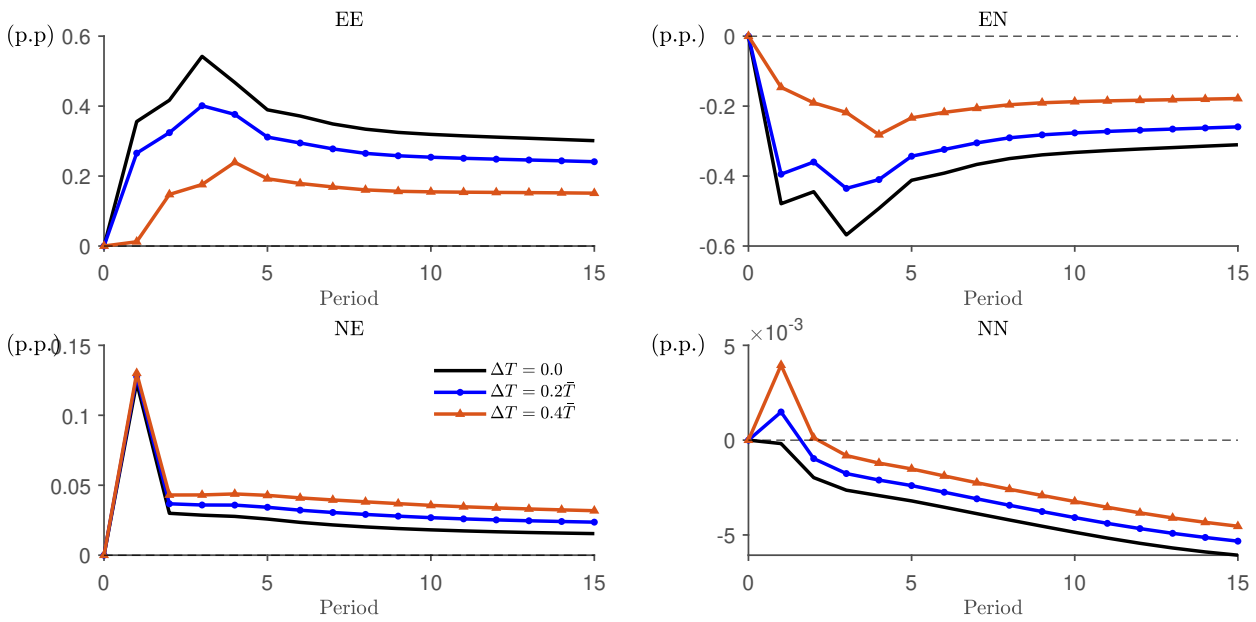


Notes: The left panel shows the share of households with a child less than age of 5. The right panel shows the survival probability by age.

D Policy Experiment: Additional Information

Figure A-2 shows the shares of employment status. The shares of EE and NE increase because more spouses participate in the labor market. Figure A-3 shows the shares of the types of employment in households. EE increases substantially under conditional policy.

Figure A-2: Shares of Households



Notes: All variables are relative to their steady state values. EE denotes the households with dual earner, EN those with only primary worker working, NE those with only spouse working, and NN those with no one working.

Figure A-3: Shares of Households: Conditional Transfer Program

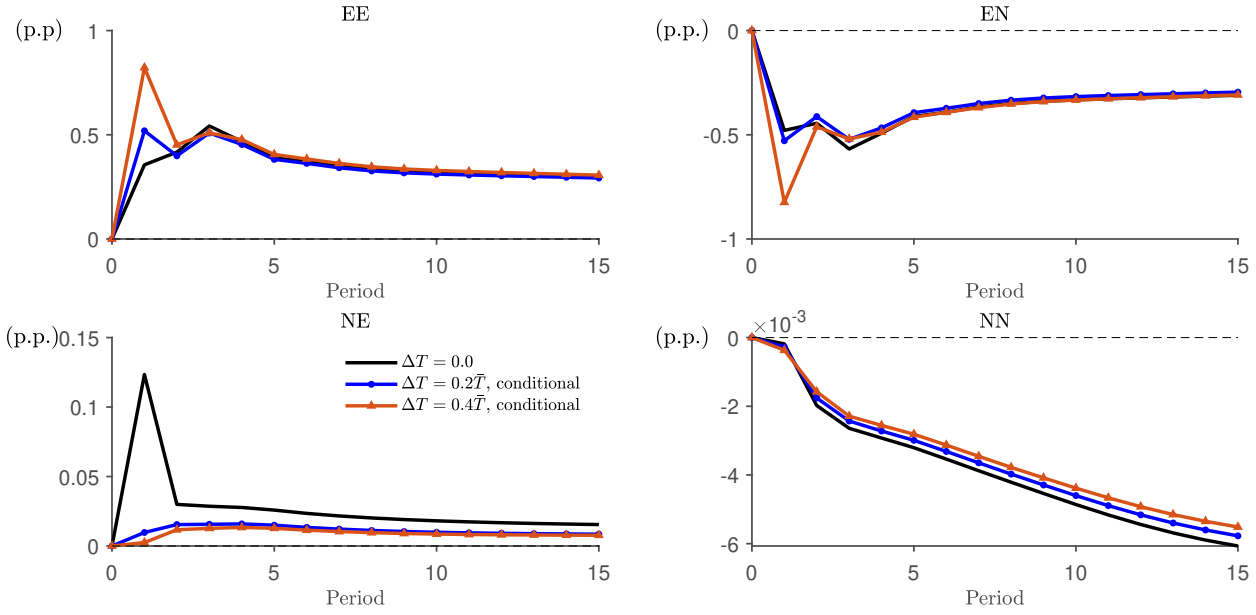


Table A-1: Spousal Labor Supply Responses: Regression of (9)

	Employment		Earnings	
	OLS	IV	OLS	IV
Primary Earnings ($\hat{\beta}$)	0.001	-0.150***	0.017***	-0.418***
	(0.001)	(0.046)	(0.005)	(0.162)
Age, Primary	0.001***	0.000	0.002***	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
College, Primary	-0.002***	-0.002***	-0.004***	-0.003
	(0.001)	(0.001)	(0.002)	(0.002)
Log Assets $_{t-1}$	-0.003***	-0.005***	-0.011***	-0.013***
	(0.000)	(0.001)	(0.001)	(0.001)
Age, Spouse	-0.002***	-0.002***	-0.008***	-0.008***
	(0.000)	(0.000)	(0.000)	(0.000)
College, Spouse	0.009***	0.007*	0.034***	0.031***
	(0.001)	(0.001)	(0.002)	(0.003)
Manufacturing	0.000	0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.003)	(0.003)
Electricity and Water	0.001	0.001	0.003	0.002
	(0.001)	(0.001)	(0.003)	(0.003)
Construction and Wholesale	0.001*	0.002***	0.002	0.003
	(0.001)	(0.001)	(0.002)	(0.003)
Transportation	-0.001	0.001	0.001	0.003
	(0.001)	(0.001)	(0.003)	(0.004)
Finance	0.001	0.002**	-0.001	0.001
	(0.001)	(0.001)	(0.003)	(0.003)
Prof., Scientific and Admin	0.000	0.003**	0.001	0.006*
	(0.001)	(0.001)	(0.003)	(0.004)
Public Sector	-0.003**	0.000	-0.015***	-0.011**
	(0.001)	(0.002)	(0.004)	(0.005)
Arts and Entertainment	0.001	0.003	-0.005	-0.003
	(0.003)	(0.003)	(0.008)	(0.008)
Year 2016	–	-0.014***	–	-0.062***
	–	(0.002)	–	(0.006)
Year 2017	0.006***	-0.003***	0.036***	-0.014***
	(0.001)	(0.001)	(0.002)	(0.002)
Year 2018	0.008***	-0.001	0.034***	-0.014***
	(0.001)	(0.001)	(0.002)	(0.002)
Year 2019	0.007***	–	0.046***	–
	(0.001)	–	(0.002)	–
Number of Children	0.001***	0.002***	0.007***	0.007***
	(0.000)	(0.000)	(0.001)	(0.001)
Sick Leave, Primary	-0.004***	-0.011***	-0.011***	-0.023***
	(0.001)	(0.002)	(0.002)	(0.005)
Parental Leave, Primary	0.069***	0.057***	0.176***	0.143***
	(0.002)	(0.004)	(0.006)	(0.014)
Sick Leave, Spouse	-0.054***	-0.055***	-0.147***	-0.147***
	(0.001)	(0.001)	(0.002)	(0.002)
Parental Leave, Spouse	-0.089***	-0.087***	-0.307***	-0.301***
	(0.002)	(0.002)	(0.005)	(0.006)
Observations	865,066	865,066	701,119	701,119

Table A-2: Spousal Responses ($\hat{\beta}$)

	Employment		Earnings	
Age				
25-39	-.270	(.097)	-.925	(.332)
40-49	-.162	(.082)	.119	(.261)
50-59	-.029	(.062)	. -.493	(.262)
Education				
Elementary school	-.152	(.067)	-.675	(.283)
High School	-.008	(.067)	-.028	(.215)
College	-.318	(.106)	-.689	(.353)
Assets				
Poor ($<$ 6 months)	-.203	(.064)	-.888	(.266)
Wealthy ($\geq$ 6 months)	-.087	(.064)	.003	(.201)
Primary Income Share				
$<$ 0.6	.005	(.071)	-.239	(.200)
0-6-0.8	-.154	(.074)	-.230	(.185)
0.8-1	-.250	(.081)	-1.77	(.816)
Young Households (age 25-39)				
With kids under age 6	-.332	(.142)	-.584	(.395)
No kids under age 6	-.209	(.134)	-1.34	(.584)
Unemployment Spell (Primary)				
Yes	-.134	(.075)	-.463	(.285)
No	-.155	(.053)	-.418	(.188)
Firm Size				
Less than 20 workers	-.099	(.046)	-.168	(.153)
More than 20	-.230	(.095)	-.842	(.358)
More than 10	-.227	(.082)	-.733	(.312)
More than 5	-.179	(.075)	-.623	(.291)
Region				
Without Stavanger	-.173	(.048)	-.498	(.067)