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The inversion of married women's labour supply and wage: Evidence from Thailand

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This study investigates the labour supply behaviour of married Thai women with reference to their own and their spouse's wages. Controlling for spousal education and number of children, the main findings indicate an inverse relationship between married women's labour supply and wages, contrary to the evidence from developed countries. The estimated own wage elasticity ranges from −1.70 to −2.40 and the cross elasticity ranges from −0.16 to −0.17, indicating that the impact of own wage on labour supplied is much larger than spouse's wage. The results from disaggregation classified according to different socioeconomic backgrounds also show negative elasticities between own and spouses' wage across all subgroups, except for those with university degrees and higher income.

Introduction

The study of the labour supply of married women has been an active field of research in labour economics since 1960. Traditionally, married women are treated as the secondary earner in the family, moving between market work, leisure, and home production (Mincer 1962). Thailand has been one of the few developing countries that has had a historically high rate of female participation since 1990 (World Bank 2018). The Labour Force Survey (LFS) of Thailand, 1985–2016, reveals that married women's participation rate (approximately 65 per cent) has been stable. However, although women's real wage rate has more than doubled and the gender wage gap has decreased (Figure 1), their average working hours have fallen nearly 16 per cent (Figure 2).[1] This trend raises a question concerning the labour supply behaviour of married women and suggests that Thailand is an intriguing case study.

Married women play a relatively strong economic role in Thai families and have become more and more responsible for supporting their families as a result of marital

[1] The trend is consistent with previous studies (e.g. Nakavachara 2010; Paweenawat and McNown 2018). For example, Nakavachara (2010) found that the average working hours for females was 50.2 and 50 for males in 1985 and dropped to 48.8 for females and to 49.5 for males in 2005.

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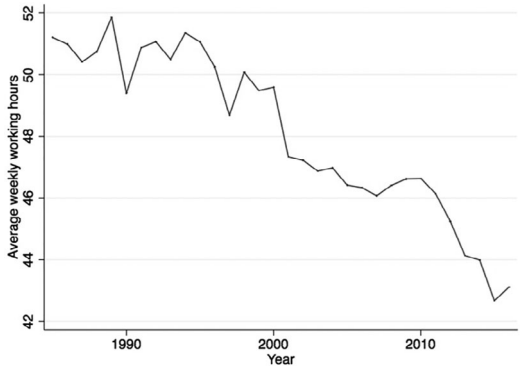
Figure 1
Average real wage rate trends for married women and men (1985–2016)

Source: Authors' calculations

Figure 2
Average weekly working hours trends for married women (1985–2016)



Source: Authors' calculation

disruption and the unreliability of their spouses (Richter and Havanon 1994). The earnings gap between men and women in Thailand has shrunk substantially since 1985 owing to the promotion of female education (Cameron et al. 2001; Nakavachara 2010). Married women working hours are comparable to married men, although single women work less hours than single men as a group (Lekfuangfu 2017). Furthermore, the country experienced rapid fertility decline in the late 20th century as a result of significant improvement in education levels (Berrington and Pattaro 2014). However, although there are significant changes among married Thai women because of rapid modernisation accompanied by social change, few studies have examined their labour supply behaviour.

The main purpose of this paper is to analyse the family context in which women's labour supply decisions are made, focusing on the connection between own and spouses' wages and female labour supply. More specifically, this study investigates the impact of the changes in wages and the labour supply of married women in Thailand, taking the effects of children and spouses into consideration. Utilising LFS data from 1985 to 2016, this paper estimates the static labour supply model for married women using different controlling variables, including number of children and own and spouses' education levels following Blau and Kahn (2007). Furthermore, we allow husbands' wages to have an effect on the labour supply of married women as suggested by Ashenfelter and Heckman (1974).

In addition to filling a gap in the literature on the married female labour supply in Thailand, our study contributes to the existing literature by proposing a new technique to correct for sample selection; it uses wage imputation for the unpaid workers by constructing wage regression for the group that has the most similar characteristics to this group, and using the predicted wage value for them (Juhn 1992; Juhn and Murphy 1997; Blau and Kahn 2007). Moreover, the empirical analysis uses the instrumental variable (IV) approach, in the form of a series of dummy variables indicating the wage decile for both own and spousal wages, following Juhn and Murphy (1997) and Blau and Kahn (2007) to alleviate endogeneity problems, as the wages of husbands and wives are correlated with unobserved individual heterogeneity for work, such as motivation or taste; thus they suffer from measurement error. Furthermore, the study extends the existing research on married female labour supply in Thailand by studying the behaviour of subgroups classified by socioeconomic background.

Our main result shows that in contrast to developed countries, there is an inverse relationship between married women's labour supply and their wages across all specifications. The own wage elasticity of married women's labour supply ranges from −1.70 to −2.40 and the cross elasticity ranges from −0.16 to −0.17. We provide suggestive evidence on the domination of the income effect for married women in Thailand by considering the subsistence constraint at lower levels of development: this is further demonstrated in the disaggregation analysis where only married women with university degrees and a high income show the domination of the substitution effect. The robustness checks, including the estimation of the marriage sample correction, different time periods, and the group data approach, leads to the same conclusion.

The paper is organised as follows: the next section reviews studies of female labour supply. Section 3 presents the data and variables used in the estimations. Section 4 describes the basic instrumental variable approach. Section 5 shows the estimation results followed by the elasticity disaggregation. Section 6 describes the robustness checks, while Section 7 concludes.

Literature review

Many studies have estimated married female labour supply functions, which provide considerable variation in the elasticities that derive from using different approaches. The survey by Killingsworth and Heckman (1986) records that the estimates of uncompensated wage elasticities for wives can vary considerably under different sample and estimation procedures, ranging from −0.89 to 15.24.

For developed countries, most studies of married women's labour supply have reported positive own wage elasticities and negative spousal wage elasticities using different estimation methods (see survey by Blundell and MaCurdy 1999 for the USA and Europe, Devereux 2004, Blau and Kahn 2007, Kaya 2014 for the USA, Merz 2008 for Germany, Dostie and Kromann 2013 for Canada, and Cai 2018 for Australia). Goldin (1990) mentioned that this positive relationship indicates the domination of the substitution effect of own wages on married women's labour supply.

While the common expectation that substitution effects dominate the income effect found in developed countries, several studies in developing countries show a different picture. Various studies related to developing countries have found an inverse relationship between female labour supply and their own wage. Dessing (2002) presents an empirical analysis for low-income women in rural Philippines and reports wage elasticity estimates ranging from −0.16 to −0.46. Dasgupta and Goldar (2006) find a significant inverse relationship in female labour supply and wage rates in rural India using the Heckman selection model. Licona (2000) studies female labour supply for Mexico and finds that most people in low-income families, especially women, devote more time to the labour market when wages decline. Besides, adults in developing countries have higher working hours than those in developed countries for both men and women, and along both extensive and intensive margins (Bick et al. 2018).

As there is substantial heterogeneity in the response of labour supply, the econometric difficulties in the estimation of female labour supply behaviour have attracted studies that propose various methodologies to reduce the problems (e.g. Erosa et al. 2016; Attanassio et al. 2018). First, we only observe the wage offers for those who have reported them. In Thailand's case, unpaid family workers account for the largest percentage of work status for married women—thus we cannot observe their wages. As such, our sample is not randomly selected, and this is endogenous to the behaviour of their interests. The method most often applied in the literature is the Heckman selection model (1979). In addition, by using the synthetic cohort approach for repeated cross-sectional data with large observations in each cohort, sample bias will be small (Verbeek and Nijman 1992; Devereux 2007). Furthermore, the wages of those

with similar characteristics who work very little should be a close proxy for the unobserved wage offers to unpaid workers (Juhn et al. 1991; Juhn 1992; Juhn and Murphy 1997; Blau and Kahn 2007).

Second, the endogeneity of wages to labour supply has been caused by the measurement error and omitted variables. Measurement error occurs when working hours reported do not represent the actual working hours (Killingsworth and Heckman 1986). The nature of surveys producing data on usual work hours will create measurement errors that are correlated with the wage rate and bias the elasticities (Barrett and Hamermesh 2016). Similarly, the endogeneity problem also arises with the factors omitted in the estimation. The unobserved characteristics of both wives and husbands are likely to be correlated to the wages of each other (Devereux 2004), such as taste in work or the individual's motivation, which influences the wage rate and correlates with working hours. Therefore, a simple OLS estimation will be biased and inconsistent.

Using the IV approach is the most common way to deal with endogeneity problems in cross-sectional data. There are several different kinds of variables used as the instrument for wages. Using the interaction between education and other variables, such as age, gender, and year, makes it hard to justify the exclusion restrictions (Mroz 1987; Blundell et al. 1998; Gómez and Vázquez 2010; Dostie and Kromann 2013). Several studies use group averages as the instrument for wages (Angrist 1991; Devereux 2004), but the sample size needs to be large enough to obtain a small biased result owing to group estimation. Blau and Kahn (2007) apply a series of dummy variables indicating the wage decile for both own and spouse's wage to estimate the wage. These dummy variables should be highly associated with wage, but not correlated with the unobserved heterogeneity. Moreover, use of deciles can correct some degree of measurement error in wages (Baker and Benjamin 1997; Juhn and Murphy 1997; Blau et al. 2003).

Few previous studies are concerned with the married female labour supply in Thailand. Schultz (1990), using the *Socio-economic Survey of Thailand* for women aged 24–54, estimates a married women's hours of work equation with respect to the husbands' wage by the maximum likelihood approach. The study obtains the women's wage coefficient (−10.3) and husband's wage coefficient (−1.07) without sample correction, and (−7.16) and (−3.57), respectively, with the sample correction, following Heckman (1979). Paweenawat and McNown (2018) analyse the labour supply behaviour of Thai women using the synthetic cohort approach and report that the elasticity of estimated hours worked by females is −0.22 to −0.25 using the LFS for the period 1985 to 2004.

Aemkulwat (2014) estimates the labour supply of married females in the informal sector in Thailand using the LFS for 2008. It applies the simultaneous system of the labour supply equation and wage equation, including a selection of correction variables, following Hay (1980), and estimates the equations by three-stage least squares. It reports that the own wage elasticity for female unpaid family workers was 0.93 and there was a negative cross-wage elasticity for female own-account workers. However, the result is limited to only one year for workers in the informal sector, and no control for spousal education is applied despite this having been found to play an important role in affecting wives' working hours (Hersch and Stratton 1994; Pencavel 1998; Farré and Vella 2007; Bredemeier and Juessen 2010; Papps 2010; Schwartz 2010). More recently, using LFS 2016, Tumsarp and Pholphirul (2020) suggest that married women have higher probability to join in the labour market and work longer hours than unmarried women in Thailand.

Our paper is the first that we are aware of to study married women in Thailand by taking into account both the effect of spouses and children. A new estimation technique, an imputation technique, is proposed to analyse the labour supply behaviour of married Thai women to resolve the sample selection bias; and a new series of instruments are applied to reduce bias from endogeneity. Finally, our study provides insights into understanding the behaviour of different socioeconomic groups.

Table 1
Explanatory variables for married female sample, 1985–2016

	(1)	(2) 1985–2016	(3)	(4)	(5)
	Mean	Min	Max	1985–1989 Mean	2012–2016 Mean
Age	41	25	60	39	44
Weekly working hours	47	0	98	51	44
Number of children	1.3	0	12	1.9	1.1
Weekly log wage	7.51	1.83	11.88	7.08	7.73
Weekly log spouse wage	7.66	2.52	12.32	7.37	7.81
Own education:					
Primary level	68%	0	1	84%	58%
Secondary level	22%	0	1	11%	29%
University level	9%	0	1	3%	11%
Spouse education:					
Primary level	63%	0	1	78%	57%
Secondary level	26%	0	1	16%	32%
University level	11%	0	1	6%	11%
Observation	136,948			8323	37,528

Note: The explanatory variables also include age squared, and 5 regional categories.

Data

The data used in this study are from the Thailand LFS collected by the National Statistical Office of Thailand from 1985 to 2016. Data from the third quarter of each survey year is employed as workers in agricultural sector go to work in urban area due to seasonal change (Sussangkarn and Chalamwong 1996; Lekfuangfu 2017; Paweenawat and McNown 2018).

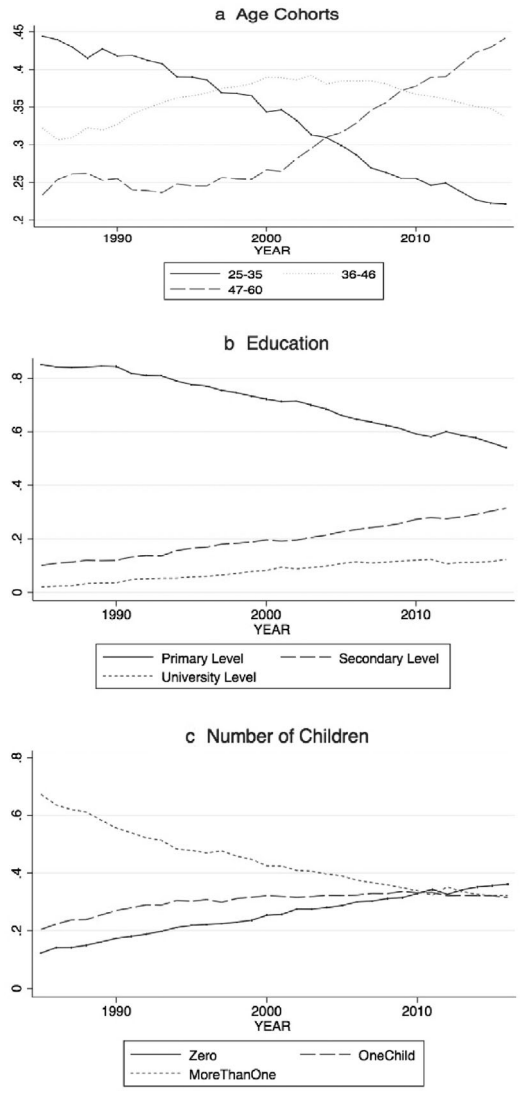
Our sample includes married females between 25 and 60 years old in order to abstract this group from issues concerning school enrolment and retirement. The measure of the labour supply is weekly working hours, obtained directly from the survey. To avoid the possible division bias from using the hourly wage, we obtain the weekly wages by calculating the monthly wage rate divided by 4.3[2] following the suggestions of Borjas (1980) and Welch (1997). Wages are deflated by the Thailand Consumer Price Index.[3]

To account for the characteristics of the married female group, we include the number of children and spouses' income and education. These variables do not come directly from the survey. Instead, we use the household number and family relations that have been reported in the survey to obtain this information for married women. The education variable is classified into primary, secondary, and university level.

Table 1 presents descriptive data for our main explanatory variables. The average age for the married female sample from a total of 136,948 observations is 41 and the average weekly working hours for the sample is 47. Compared to their wives, spouses receive a higher wage. The dummy variables for education indicate that the ratio of married women with primary education accounts sits at 68 per cent, while those with secondary and university education are lower at 22 and 9 per cent, respectively. Spouses have higher educational attainment with 26 per cent having achieved secondary schooling and 11 per cent

[2] The survey reports the wage or salary on a monthly basis.
[3] The CPI indexes (2015 is the base year) are from the Bureau of Trade and Economic Indices, Ministry of Commerce, Thailand.

Figure 3
Married women cohorts for age, educational attainment, and number of children (%)



Source: Authors' calculations

university level education. More people have obtained secondary and university level education over time. Comparing columns 4 and 5, working hours have decreased from 51 to 44, while married women's wages and spouses' wage have increased. Meanwhile, the number of children has declined.

During the past 31 years the demographic characteristics of the sample have changed in several ways (Figure 3). Population ageing shows the most significant effect with the oldest group changing from 24 to 44 per cent. The overall education level has increased for married women while the primary level group has declined from 86 to 54 per cent; the secondary level group has increased from 10 to over 30 per cent, and the university level group has increased from only 2 per cent to over 12 per cent. In Figure 3 (panel C), married women are seen to have fewer children as the percentage of women with no children has more than doubled, while those with more than one child have declined from 68 per cent to 32 per cent. These changes affect the labour supply behaviour of married women, which may distort the underlying relationship of labour supply and wages and require appropriate controls.

Methodology

This study applied the classical model for estimating the labour supply behaviour of married women suggested by Mincer (1962), presented as the following specification.

$$H_i = a_0 + a_1 lnW_i + a_2 lnW_i^S + a_3' X_i + u_i \quad (1)$$

where H_i is the weekly hours of work for individual i, W_i is the own real weekly wage rate, W_i^S is the spouse's real weekly wage rate, X_i is a vector of control variables, and u_i is the disturbance term. We assume that working hours are always observed, in which those who do not work have zero working hours.

To take the substitution or complementary effect of husbands and wives' leisure into consideration, we follow Ashenfelter and Heckman (1974), allowing the spouse's wage to have an effect on the wives' labour supply; and then take into account Blau and Kahn's (2007) suggestion to include spouses' wages in the equation separately in order to present the family bargaining model.

Table 2
Means for unpaid workers and those working less than 25 hours (married women 25–60)

	(1)	(2)	(2)–(1)
	Unpaid workers	Less Than 25 Hours	Difference
Age	42.3696	42.9978	0.6282
Primary level	0.7658	0.7696	0.0039
Secondary level	0.1917	0.2348	0.0431
University level	0.0382	0.0490	0.0108
Spouse primary level	0.6362	0.6584	0.0223
Spouse secondary level	0.2241	0.2029	−0.0212
Spouse university level	0.0498	0.0424	−0.0074
No children	0.2658	0.2639	−0.0019
Number of children = 1	0.3102	0.3168	0.0066
Number of children = 2	0.2809	0.2809	0.0000
Number of children = 3	0.1004	0.0960	−0.0044
Number of children more than 3	0.0428	0.0425	−0.0003
Total children age under 18	1.3633	1.3554	−0.0079

Source: Authors' calculations.

The estimation of Equation (1) poses several econometric difficulties. First, as we do not observe the wages of those who do not work or have missing wages, such as unpaid family workers, a sample selection bias is incurred. Inspired by Juhn (1992), Juhn and Murphy (1997), and Blau and Kahn (2007), we impute the wage for those with missing wages by constructing a wage regression for the group that has similar characteristics to unpaid workers and using their predicted wage value.

Note that the group that works for less than 25 hours per week has the most similar features to this group. Table 2 shows that the two samples are reasonably similar compared to the other variables, indicating that the short-hour group will be an appropriate base for the imputation concerning unpaid workers.

In addition, to address the issue of selection bias that might result from this imputation technique (Juhn and Murphy 1997), we also include the inverse Mill's ratio in the estimation as a correction term following the Heckman two-step method (Heim 2007; Dostie and Kromann 2013). First, we estimate the inverse Mills ratio (λ_i)[4] to add as an extra regressor for the wage and hours equation for sample correction following Heckman's two-step model (Heckman 1979). The reduced form probit is as follows:

$$P_i = \beta_0 + \beta_1 X_i + \varepsilon_i \tag{2}$$

$$P_i = \begin{cases} 1 \; if \; P_i > 0 \\ 0 \; \text{otherwise} \end{cases}$$

where $P_i = 1$ denotes the individual i participating in the labour market; X_i are the variables that affect the participation decisions, including own education and spouse's education, number of children, regional dummies, age, and age squared. In particular, the regression of the reduced form probit is estimated at the first stage and the inverse Mills' ratio is then calculated. At the second stage, a selection-corrected regression is estimated by including the inverse Mills' ratio from the first stage in the estimation.

In the second step, we impute the missing wage based on the group that works for fewer than 25 hours per week using the wage regression of the form:

$$lnW_i = \alpha_0 + \alpha_1 X_i + \epsilon_i \tag{3}$$

where X_i is a vector of control variables that affects the wage, including three education-level dummy variables, number of children, regional

[4] Following Heckman (1979), the inverse Mill's ratio, $\lambda_i = \frac{\phi(Z_i)}{\Phi(-Z_i)}$

dummy variables, age, and age squared, and where ϵ_i is the error term. The predicted values are obtained for the regression. The imputed wage is equal to the actual wage unless the individuals have a missing wage.

Next, to solve the endogeneity problem, we employ the IV approach. Both own wage and spouse's wage are considered as endogenous variables in the model. Following Juhn and Murphy (1997) and Blau and Kahn (2007), we take a series of dummy variables indicating the wage decile for both own and spouse wage as excluded instruments.[5] Although these dummy variables are not related to the unobserved heterogeneity, they are highly associated with the wage. In addition, the deciles can correct some degree of the measurement error in wages (Baker and Benjamin 1997; Juhn and Murphy 1997; Blau et al. 2003).

Thus, in the third step, we estimate the selection-corrected labour supply regression with an instrumental approach (2SLS).[6]

$$H_i = a_0 + a_1 lnW_{Im} + a_2 lnW_S + a_3{}' X_i + u_i \qquad (4)$$

Equation (4) is estimated on women's observed positive hours of work, where the log imputed wage lnW_{Im} and lnW_S are the endogenous variables, and we control for own education and spouse education, number of children, five regional categories, age, and age squared, and the inverse Mill's ratio from the first stage.

There are both advantages and disadvantages for controlling education and number of children in the estimation. First, schooling can be viewed as an indicator of work preferences and permanent income. The wage coefficient controlling for education level can be interpreted as an intertemporal substitution effect (Blundell and MaCurdy 1999). Without controlling for schooling, the wage variable can present the change in wages that also increases lifetime income (Blau and Kahn 2007).

For the number of children, on the one hand, wives' preference for family size can affect their labour supply decisions. On the other hand, the labour supply of married women may also affect their decision to have children. The changes in wages might impact their time allocation to the market, inducing them to have more or fewer children (Rosenzweig and Wolpin 1980; Angrist and Evans 1998). Therefore, we apply four specifications of the equation (with and without controlling for education and number of children).

Using the estimates from the third step, we follow Heim (2007) to compute wage elasticities, which are calculated in the following formulae.

$$\varepsilon^{own} = \frac{\hat{a_1}}{\bar{H}} \qquad (5)$$

$$\varepsilon^{spouse} = \frac{\hat{a_2}}{\bar{H}} \qquad (6)$$

where $\hat{a_1}$ and $\hat{a_2}$ are the estimated coefficients on the own wage and spouse wage from the last step; $\bar{H}$ denotes the mean working hours.

Results

Overall

The OLS estimation results of the labour supply equation for the four specifications show that own log wage coefficients range from −5.81 to −7.55 and spouse log wage coefficients from −1.16 to −1.64, with own wage elasticity −0.97 to −1.27, and spouse wage elasticity −0.20 to −0.29 (see Table 3). The IV estimation is then applied and the results show significant negative log wage coefficients −10.10 to −14.35, and spouse coefficients −0.92 to −0.96. Own wage elasticity ranges from −1.70 to −2.40 and the cross elasticity ranges from −0.16 to −0.17 (Table 4).

[5] We have tested the endogeneity of wages and tested whether these dummies are an appropriate IV for wage, over-identification, and weak instruments.

[6] A selected wage regression with the reduced form is
$lnW_i = \beta_0 + \beta_1 Z_i + \gamma_i$
where Z_i includes the instruments-dummies for wage decline and other controlling variables, including inverse Mill's ratio from the first stage.

Table 3
OLS estimations for labour supply of married women, 1985–2016

	OLS			
	Model 1	Model 2	Model 3	Model 4
Own log wage	−7.551***	−7.482***	−6.210***	−5.807***
	(0.106)	(0.108)	(0.172)	(0.185)
Spouse log wage	−1.623***	−1.636***	−1.157***	−1.162***
	(0.0655)	(0.0656)	(0.0688)	(0.0688)
Number of children		−0.0981***		−0.190***
		(0.0307)		(0.0324)
Control for own and spouse education	No	No	Yes	Yes
Control for number of children	No	Yes	No	Yes
Observations	136,948	136,948	136,948	136,948
Computed elasticities (at means)				
Own log wage	−1.262	−1.273	−1.038	−0.971
Spouse log wage	−0.279	−0.286	−0.199	−0.200

Note: Robust standard errors in parentheses.
***$p < 0.01$,
** $p < 0.05$,
* $p < 0.1$.

Table 4
Instrumental variable labour supply estimations for married women, 1985–2016

	IV			
	Model 1	Model 2	Model 3	Model 4
Own log wage	−10.10***	−10.15***	−13.73***	−14.35***
	(0.146)	(0.15)	(0.28)	(0.302)
Spouse log wage	−0.973***	−0.959***	−0.931***	−0.924***
	(0.0856)	(0.086)	(0.0862)	(0.0863)
Number of children		0.0667**		0.381***
		(0.031)		(0.036)
Inverse Mill's ratio	−18.33***	−18.45***	−23.60***	−24.75***
	(0.218)	(0.229)	(0.403)	(0.448)
Control for own and spouse education	No	No	Yes	Yes
Control for number of children	No	Yes	No	Yes
Observations	136,948	136,948	136,948	136,948
COMPUTED elasticities (at means)				
Own log wage	−1.724	−1.697	−2.295	−2.399
Spouse log wage	−0.171	−0.165	−0.160	−0.159

Robust standard errors in parentheses.
***$p < 0.01$,
**$p < 0.05$,
* $p < 0.1$.
Own wage is equal to actual wage unless individual's wage is missing. The regressors include age, age squared, three education categories, number of children, and five regional categories.

Compared with the IV results, the OLS estimation yields smaller coefficients in absolute value and the IV estimates of own wage elasticities of labour supply exceed OLS estimates in absolute value, which indicates unobserved individual heterogeneity is

negatively correlated with own wage and the OLS regression has a downward bias due to its effect.

Using the married women sample, Schultz (1980) obtains the OLS estimates for uncompensated wage elasticities, ranging from 0.16 to 0.65, which are less than other studies using IV or sample correction models, such as Heckman (1980) (1.47–14.79), or Dooley (1982) (4.28–15.24). Without correction for endogeneity, there is a downward bias using OLS for the labour supply equation (Senesky 2003).

For the wage coefficients under IV estimation, similar negative results were reached by Schultz (1990) using the Socio-economic Survey of Thailand in 1980–1981 for married women and Paweenawat and McNown (2018) using the LFS from 1985 to 2004 for the female group in Thailand. This inverse relationship has also been found in other developing countries (Dessing (2002) for Philippines, Dasgupta and Goldar (2006) for India, and Licona (2000) for Mexico). During this time, Thailand has undergone rapid economic development and experienced a large increase in income per capita (World Bank 2020), accompanying the increase in female education and decline of the gender wage gap (Paweenawat and Liao 2019). The industrial structure of Thailand has changed dramatically, where the agriculture sector has declined and manufacturing and the service sector have increased, accounting for the reduction of income inequality. As suggested by Rendall (2013), the structural change in Thailand has benefitted women by having a more flexible labour market and better chance to match their abilities to occupational skills. The dominant income effect accounts for the negative relationship between wages and working hours (Dessing 2002). When wages increase, married women tend to spend more time on household chores and childcare and work fewer hours.

When assume that leisure is a normal good, the choices between being labour and leisure suggest a positive substitution effect and negative income effect on the response of working hours to the changes in wage rate (Mincer 1962). Khan (1995) estimated the labour supply function for different groups with different economic status and asset ownership that the labour supply decision of the subsistence group is driven by minimum requirement on consumption. Even though Thailand has made success in the development from 1985 to 2016 and has shifted from a low-income country to an upper-income country (World Bank 2018), the labour supply behaviour of married women stagnates at a low development level.

Similarly, the inverse relationship with spouses' wages indicates that women reduce their labour supply when spouses' wages rise, which corresponds with Mincer's (1962) suggestion that the labour supply of women in the household is negatively affected by changes in husbands' wages. Poapongsakorn (1979) suggested that in Thailand's case, married women are more responsive to their own wages than to the wages of household members, including spouses. The estimated income elasticities for wives range from −1.29 to −1.52, while other member's income elasticities range from −0.27 to −0.31 (Poapongsakorn 1979).

The rise of the absolute value of wage coefficients when we control for education suggests that schooling has a significant effect on women's labour supply and should be correlated with unmeasured factors such as work preference (Blau and Kahn 2007). Evidence of the importance of education also appears in previous studies in Thailand: Cameron et al. (2001) find that Thailand shows a very strong relationship between education and women's labour supply.

The number of children also has a significant impact on married women's labour supply. The significant positive coefficient for number of children under the IV estimation indicates that married women tend to work more when they have more children to cover the higher costs generated by more family members; this is in contrast to the negative relationship found in developed countries (Lacovou 2001). The wage coefficients for women's labour supply when we control for

Table 5
Disaggregation results using Model 4 (computed elasticities)

	Own log wage	Spouse log wage
A. By education levels		
Primary level	−0.761	−0.117
Secondary level	−2.993	−0.236
University level	0.810	−0.142
B. By age		
Age 25–35	−1.615	−0.142
Age 36–46	−2.938	−0.139
Age 47–60	−3.147	−0.145
C. By number of children		
No children	−2.134	−0.206
With children	−2.519	−0.134
D. By income level		
Low income	−1.917	−0.171
High income	0.129	−0.183
E. By place of residence		
Urban	−2.247	−0.176
Rural	−2.749	−0.105
F. By sectors		
Agriculture	−0.779	−0.339
Non-agriculture	−2.459	−0.265

the number of children (comparing models 1 and 3 to models 2 and 4) increase slightly in absolute value.

Given that fertility decisions depend on women's preferences, the tendency to have children allows women to place a higher value on the labour market. Blau and Kahn (2007) conclude that when wages decline, women tend to shift their time from household to market work and this affects their fertility decisions. Compared with the results for the spouse's wage coefficient, the changes are relatively small. The movement of own and spouses' wage elasticities is the same as the movement of own and spouse's wage coefficients.

The changes in women's own wage elasticity may not be because of the changes in the estimated coefficients, but the changes in means of the variables that have been used for calculating the wage elasticity. Thus, to probe the effect of movement in the means of those variables, we estimate the elasticity as the means of all variables across the years (Heim 2007). Our results indicate the changes in elasticity should be due to the changes in the coefficients.

Disaggregation

To further check the basic estimation results across several dimensions, we separate the wage responsiveness by subgroups using the complete specification, which controls for both number of children and education (model 4). The results are presented in Table 5, which show negative own and spouses' wage elasticities across all subgroups during 1985 to 2016, except for the group with university degrees and high incomes.

Disaggregation by education levels. Policies to promote female education in Thailand have increased the percentage of female workers who obtain a higher level of education (Nakavachara 2010). To check how the elasticity coefficient changes across education groups, we disaggregated educational attainment into three main levels. We find that secondary level attainment has the highest responsiveness to both own and cross-wage elasticities (−2.99 and −0.24), and university level has a positive value for own wage elasticity (0.81 and −0.14). These results are consistent with Paweenawat and McNown (2018). The positive relationship between education and the wage rate—as income rises the substitution effect increases and the income effect declines, results in a positive value for those who obtain university level qualifications. This is consistent with the positive elasticity result for the high-income group obtained by Poonsab (2008).

Disaggregation by age. Goldin (2006) suggests that younger cohorts in the USA are less responsive both to own wage and spousal wage changes. To check this issue in Thailand, we disaggregated the labour function into three age groups. Results for each age group show that the younger group has the least absolute value in both own and

cross-wage elasticities (−1.62 and −0.14) and that value grows as women get older (−2.94 and −0.14; −3.15 and −0.15). The younger cohorts tend to show less responsive labour functions than the older cohort. Goldin (2006) concluded that younger people spend more time and money on education and career development, and prefer career advancement over marriage, the absolute magnitude of elasticity declines considerably for the group.

Disaggregation by number of children. As the number of children also affects women's labour force behaviour, we wanted to see how women's labour supply relationship changes according to this factor. We disaggregated women into two groups: without children and with children. The results indicate that women with children are more responsive to their own wages (−2.52 and −0.13; −2.13 and −0.21). As women with children likely spend more time on household work than those without them, if wages increase they should reduce their market work more than those without, which then yields a higher elasticity in absolute value. With lower family costs, women without children respond more to changes in their spouses' wage.

Disaggregation by income level. As explained earlier, the inverse relationship between married women's labour supply and wages is due to the domination of the income effect. With a higher income, the income effect should have less effect and the substitution effect should be higher. To check the income effect for different levels of income, we disaggregated the labour supply function into two income groups. As reported by the National Statistical Office of Thailand (2018), the average monthly income in Thailand is around 13,750 baht per month.[7] We use this income as the baseline to decompose the sample into a lower-income group and a higher-income group.

Comparing the income level subgroups, the lower-income group responds negatively to wage changes (own wage elasticity −1.92, and spousal wage elasticity −0.17), indicating a dominant income effect. Surprisingly, for the high-income group, the results for the own wage coefficient are not statistically significant (own wage elasticity 0.13), while the spousal wage is significant (spouse's wage elasticity −0.18), possibly indicating the stronger effects of assortative mating. This suggests that the labour supply of this group is not affected much by changes in their wage but is significantly affected by their spouses' wage.

Disaggregation by place of residence. Place of residence affects the responsiveness of labour supply to wages as well. We check the responses for married women living in urban areas and rural areas. The results show that the urban workers respond less to own wage changes and more to spousal wage changes (−2.25 and −0.18; −2.75 and −0.11), suggesting that higher incomes for urban workers and better working environments may be the causes. As income is higher for women in urban areas than in rural areas, the substitution effect should be higher in urban areas and women should tend to stay with the job longer. This result contradicts Paweenawat and McNown (2018), who explained that estimated elasticities do not vary across living areas.

Disaggregation by sector. Agriculture is one of the most important sectors in the Thai economy, with a high proportion of the labour force working in this sector, although it constitutes a declining share of total GDP as other sectors such as manufacturing are playing an increasing role (World Bank 2018). Poonsab (2008) finds that women in Thailand who work in agriculture earn less than those in non-agricultural sectors. We disaggregated married women into those working in agricultural and non-agricultural sectors. The results suggest that women in the agricultural sector are less responsive to own wage changes (−0.78 and −0.34; −2.46 and −0.27). Given lower wages and education levels in the agricultural sector, women have fewer choices

[7] To be consistent with the 2015 base year CPI, income is also from 2015. Monthly income has been divided by 4.3.

Table 6
Robustness check (computed elasticities)

	Own log wage	Spouse log wage
(A) Marriage selection correction		
Model 1	−1.925	—
Model 3	−1.816	–
(B) Changes in elasticity over time (Model 4)		
Year fixed effect (1985–2016)	−2.360	−0.154
1985–1994	−0.808	−0.106
1995–2004	−1.712	−0.121
2005–2016	−0.931	−0.067
(C) Pseudo-panel approach		
WLS	−0.611	−0.444

Note: In Panel (A) Marriage selection correction, we add the non-married group to the sample using Model 1 (no control for both education and number of children) and Model 3 (control for education but no control for number of children).

and are less responsive to wage changes to fulfil their subsistence needs.

Robustness check

Check for marriage proneness and correction for marriage selection

As our estimations focus on the married women group, it is possible that those who choose to marry may incur a self-selection bias. For example, if there is a smaller percentage of women who choose to get marry, they will be more marriage-prone compared to the total population of women. If this decision is associated with motivation or preference in work, our results will be biased. To solve this problem, we first checked the marriage rate over the 31-year period and found that the marriage rate in Thailand from 1985 to 2016 was relatively stable.

Furthermore, we added the non-married group to the sample without controlling for spouses' education and number of children (Blau and Kahn 2007). To do this, we acquired more observations but could not control for family effect. The results in Table 6 (panel A), which do not show much difference compared with the basic estimation, indicate that marriage selection does not cause much of a problem with endogeneity.

Check for changes in elasticity over time

To control for social trends that may result in changes in labour supply, we added a set of year fixed effects to the basic estimation. Comparing the results in Table 6 (panel B) to the basic results in Model 4 in Table 4, the negative effect is robust and the magnitude of both own and spouse wage elasticities declines (−2.36 vs. −2.40; −0.15 vs. −0.16). In addition, as the structure of the labour force in Thailand has changed dramatically over three decades, we analyse the trend in the wage-hour relationships by separating the data into three periods. Our results show significant negative coefficients of own wage and spouses' wages with an increase in the absolute value of own and spouses' wage elasticity for women in the first two periods, and a decline during 2005 to 2016. This pattern is consistent with Goldin (1990), who studied the changes in married women's wage and income elasticities from 1900 to 1970 in the USA. Initially, the income effect dominates. As technology improves and household costs decline, the elasticity of the female labour supply in absolute value increases from the 1930s to 1950s. Later, a decline in the own wage elasticity of married women occurs after 1950 and shows a declining responsiveness to husbands' income over the period because of the increase in the divorce rate and changes in career orientation.

In Thailand, the resulting elasticity pattern has been affected by many factors changing over the decades. The increase of elasticity in absolute value during the first two decades may be due to rapid development accompanied by technological improvement and decreased household costs, which allows women to respond more easily to wage changes. The National Statistical Office (2018) reports an increasing divorce rate over the most recent ten-year period that make women reluctant to change their working hours; this may be the reason for the decline in elasticity

in the third time period. In addition, the promotion of female education and gender equality has led to a shrinking gap in earnings and led women to care more about their own development; these factors may also account for the recent decline in the elasticity (Goldin 1990; Bradbury and Katz 2008).

Pseudo-panel approach

We take advantage of the long-term survey data to use the group data constructed from our repeated cross sectional data and implement a pseudo-panel approach that can relax the exclusion restriction needed for our IV. Deaton (1985) pointed out that using cohorts to estimate a linear model for repeated cross sections can yield consistent results; and Angrist (1991) showed that grouped data can serve as an IV procedure where a set of cohort dummy variables is used as instruments. Furthermore, Devereux (2004) indicated that weighted least squares (WLS) for group means is equivalent to 2SLS with individual-level data using group dummies as instruments.

To apply the group averages, we define three age groups and three education groups for both own and spouse's age, and 13 birth cohorts; these will potentially yield 351 cells ($= 3 \times 3 \times 3 \times 13$). We apply WLS accounting for the heteroscedasticity of different observations in each cohort. The weights are the square root of the number of sample sizes in each cohort (Pencavel 1998; Dargay 2007; Paweenawat and McNown 2018). We obtain a robust, significantly negative wage coefficient in Table 6 (panel C). However, compared with the basic estimation, the own wage elasticity declines. This result is consistent with Devereux's (2004) use of the pseudo-panel approach, which provides much smaller own-wage elasticities under WLS compared with the IV approach.

Conclusions

This paper investigated married women's labour supply behaviour in Thailand using LFS from 1985 to 2016. Our main finding indicates a negative relationship between married women's labour supply and their real wage. Using the wage imputation for unpaid workers to correct for the sample selection and the IV approach to solve for measurement error and omitted variables, we find a negative relationship between married women's labour supply and their real wages that is robust to different estimation techniques and indicates a dominant income effect.

The effect of husbands and number of children for married women's labour supply is significant. The estimated own wage elasticity ranges from −1.70 to −2.40 and the cross elasticity ranges from −0.16 to −0.17, which indicates that married women in Thailand tend to reduce their working hours when their own and spouses' wages increase.

According to the different disaggregations by educational attainment, age, number of children, income levels, industry, and areas of residence, the inverse relationship between labour supply and wage caused by the dominant income effect is robust, except for those with university level education and high incomes. These elasticities have positive implications for the labour policies affecting married women's labour supply.

Women's labour supply is affected differently as wages change. Those who obtain university degrees show positive own wage elasticity, suggesting that they are willing to work more if wages increase. With a higher level of education, women tend to stay longer period of employment and connect more to the labour market (Goldin 2006). According to Nakavachara (2010) and Paweenawat and Liao (2019), the increase in women's education is the main contributor to the recent decline of the gender wage gap in Thailand. Policies relating to promoting educational attainment will be necessary for a fundamental transformation in women's labour supply behaviour as the ratio of Thai women at each level of educational attainment has significantly changed over 31 years. Thus, the greater increase in the education level of married women during the most recent two decades may account for the decline in the elasticity.

Finally, our results on the impact of the number of children on women's labour supply indicate that the labour supply of married women with children responds more to changes in wages than in those without children, indicating that the latter group is less attached to the labour force. The supply of working hours by married women is constrained by the number of children. The limited provision of public childcare and high costs of private childcare in Thailand hampers women's socio-economic development and affects household formation (Liao and Paweenawat 2020). Thus, the implementation of social and economic policies related to childcare, either subsidies or tax credits offered by government, should be regarded as a tool to increase the level of attachment of married Thai women in the labour market, as this will eventually benefit the country as a whole.

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