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Lusi Liao and Sasiwimon Warunsiri Paweenawat

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Lusi Liao

School of Economics
University of the Thai Chamber of Commerce, Thailand

Sasiwimon Warunsiri Paweenawat

School of Economics
University of the Thai Chamber of Commerce, Thailand

Correspondence address:

Sasiwimon Warunsiri Paweenawat, School of Economics, University of the Thai Chamber of Commerce, 126/1 Vibhavadee-Rangsit Rd., Dindaeng, Bangkok, 10400, Thailand.
Tel.: +66-2-697-6653; Fax: +66-2-277-4359
Email-address: sasiwimon_war@utcc.ac.th; sasiwimon.warunsiri@gmail.com

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Abstract

This study investigates the labour supply behaviour of married Thai women with reference to their own and their spouse's wages. By utilising data of the national Labour Force Survey in Thailand from 1985 to 2016, the wage imputation technique and the instrumental variables approach are applied to correct sample selection and to alleviate endogeneity, common issues that cause bias in estimating female labour supply. By 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 results found in most developed countries. The estimated own wage elasticity ranges from -1.70 to -2.40 and 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 socio-economic backgrounds also show the negative elasticities between own and spouses' wage across all subgroups, except for those with university degrees and higher income.

Keywords: Labour Supply, Married Women, Thailand, IV-estimators

JEL Classification: J12; J22; C26

1. INTRODUCTION

Traditionally, married women are treated as the secondary earner in the family, alternating among market work, leisure, and home production (Mincer 1962). The study of labour supply among married women has been an active field of research in labour economics since 1960. The changes in their behaviours may drive the changes in female labour supply overall (Killingsworth and Heckman 1986, Blau and Kahn 2007). Thailand has been one of the few developing countries that has 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%) is stable over time (Figure 1). However, although their real wage rate has more than doubled (Figure 2), their average working hours have dropped nearly 16% (Figure 3). This trend raises a question concerning the labour supply behaviour of married women and suggests that Thailand is an intriguing case study.

[Figure 1]

[Figure 2]

[Figure 3]

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 disruption and the unreliability of their spouses (Richter and Havanon 1994). The earning gap between men and women in Thailand has shrunk substantially from 1985 to recent years owing to the promotion of female education in the country (Cameron et al. 2001, Nakavachara 2010). Their working hours are comparable to married men, although single women work less hours than single men as a group (Lekfuangfu 2017). Furthermore, the country has experienced rapid fertility decline

in the late 20th century (Jones 2011) 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 married women group by emphasising the family context in which their labour supply decisions are made, focusing on the connection between own and spouses' wages and the 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. By utilising data of the LFS 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 also 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 that does not consider the effect of children and husbands, 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, our empirical analysis uses the instrumental variable (IV), which is 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 problems, as the wages of both husbands and wives are correlated with unobserved individual

heterogeneity for work, such as motivation or taste; thus they suffer from measurement error. Furthermore, this study extends the existing studies on married female labour supply in Thailand by covering a 30-year period (1985–2016) that presents the long-term trend and estimating behaviours of subgroups classified by socio-economic 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 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 has been 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 check, including the estimation of the marriage sample correction, different time periods, and the group data approach, has led to the same conclusion.

The paper is organised as follows: the next section reviews studies of the female labour supply. Section 3 presents the data and variables used for the estimation. Section 4 describes the basic instrumental variable approach estimation procedure. Section 5 shows the estimation results followed by the elasticity disaggregation. Section 6 is the robustness check and Section 7 concludes with recommendations for further research.

2. LITERATURE REVIEW

A large number of studies have estimated the married female labour supply and provides a great variation in the elasticity that derives 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 elasticity and negative spousal wage elasticity using different estimation methods (see survey by Blundell and MaCurdy 1999 for the US and Europe, Devereux 2004, Blau and Kahn 2007, Kaya 2014 for the US, Merz 2008 for Germany, Dostie and Kromann 2012 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 existing between the 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 the female labour supply and wage rates in rural India using the Heckman selection model. Licona (2000) studies the 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.

The econometric difficulties in the estimation of female labour supply behaviour have attracted studies that propose various methodologies to reduce the problems. 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, Devereaux 2007). Further, the wage 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 Khan 2007).

Second, the endogeneity of wages to labour supply has been caused by the measurement error and omitted variables. Measurement error occurs when data on hours of work do not accurately reflect the hours that the individual has actually worked (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 also 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 endogenous problems in the cross-sectional data. There are several different kinds of variables used as the instrument for wages. Using the interaction between education and other variables, like age, or gender and year, make it hard to justify the exclusion restrictions (Mroz 1987, Blundell et al. 1998, Gomez and Vazquez 2010, Dostie and Kromann 2012). 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, the 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 concerning 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 among the female labour supply is around -0.22 to -0.25 using the LFS from 1985 to 2004. Their aggregated data do not suit the married women sample as they do not take the effect of individual spouses and children into consideration.

The most recent estimates for married females in Thailand is Aemkulwat (2014) who used LFS for 2008 to analyse the informal sector. This approach 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 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 (Hersh and Stratton 1994, Pencavel 1998, Farré and Vella 2007, Schwartz 2010, Bredemeier and Juessen 2010, Papps 2010).

Our paper is the first that we are aware of to estimate the married women group in Thailand by taking into account both the effect of spouses and children, and using an updated dataset spanning over three decades, the longest period examined compared to other existing studies. The 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 further insights into comprehensively understanding the behaviour of this group over time, and the behaviour of different socio-economic groups in the country.

3. DATA

The data used in this study are from the Thailand LFS collected by the National Statistical Office of Thailand from 1985 to 2016. The third quarter of each survey year is employed as most Thai agricultural workers move to work in the cities during the dry season, and return in the rainy season (Sussangkarn and Chalamwong 1996, Lekfuangfu 2017, Paweenawat and McNown 2018).

Our sample includes the sample age of married females between 25 to 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[1] following the suggestions of Borjas (1980) and Welch (1997). Wages are deflated by the Thailand Consumer Price Index.[2]

To account for the features 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 get this information for married women. The education variable is classified into primary, secondary, and university level.

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

Table 1 presents descriptive data for our main explanatory variables. The average age for the married female sample with a total of 136,948 observations is 39 and the average weekly working hours for the sample is 44. 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 for the 55.7%, while those with secondary and university education are lower at 27.5% and 16%, respectively. Comparatively, their spouses have higher educational attainment with 34.3% having achieved secondary and 17.8% university level education.

[Table 1]

In addition, during the last 31 years, the demographic characteristics of the sample have changed in several ways (Figure 4). Population ageing shows the significant effect of decomposition with the oldest group changing from 24% to 44% over time. The overall education level has increased for married women while the primary level education group has decreased from around 86% to 54%; the secondary level group has increased from 10% to over 30%, and the university level group has increased from only 2% to over 12%. Married women tend to have fewer children in Thailand. The percentage of women with no children has more than doubled, while those with more than one child have declined from 68% to 32%. These aggregate changes affect the labour supply behaviour of married women over time, which may distort the underlying relationship of labour supply and wages, and require appropriate controls.

[Figure 4]

4. 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.

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

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.

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 Khan's (2007) suggestion to include spouses' wages in the equation separately in order to present the family bargaining model.

The estimation of equation (1) has 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 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.

[Table 2]

In addition, to address the issue of selection bias that might result from this imputation technique (John 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 2012). First, we estimate the inverse Mills ratio (λ_i)[3] to add as an extra regressor for the wage and hours equation for sample correction following Heckman's two-step model (Heckman 1979). A reduced form probit is as follows:

$$P_i = \beta_0 + \beta_1 X_i + \varepsilon_i \qquad (2)$$

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

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 reduced form probit is estimated at the first stage and the inverse Mills' ratio is calculated. At the second stage, a selection-corrected regression is then estimated by including the inverse Mills' ratio from the first stage in the estimation.

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

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

$$lnW_i = \alpha_0 + \alpha_1 X_i + \epsilon_i \qquad (3)$$

where X_i is a vector of control variables that affects the wage, including three education-level dummy variables, number of children, regional 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 endogenous problems, we employ the instrumental variable (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.[4] 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).[5]

[4] We have tested the endogeneity of wage and tested whether these dummies are an appropriate IV for wage, overidentification, and weak instruments.

[5] 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.

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

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, four regional categories, age, and age squared, and 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 the 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 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.

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

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

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

5. RESULTS

5.1 OVERALL

The OLS estimation results of 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 cross elasticity ranges from -0.16 to -0.17 (Table 4).

[Table 3]

[Table 4]

Compared with the IV results, OLS 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 OLS 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 reached by Schultz (1990) using the Socio-economic Survey of Thailand in 1980–1981 for married women and Paweenawat and McNown (2018) using 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).

Under the assumption that leisure is a normal good, the choices between market work and leisure indicate a positive substitution effect and negative income effect on the response of supply of working hours to the changes in wage rate (Mincer 1962). Khan (1995) estimates labour supply function in different groups with different economic status and asset ownership. That study indicates that the labour supply decision of the subsistence group is guided by their need to achieve the minimum level of consumption. Although Thailand showed remarkable progress in social and economic development from 1985 to 2016 and has moved from being a low-income country to an upper-income country (World Bank 2018), the labour supply behaviour of married women still stagnates at a low development level.

Similarly, the inverse relationship with spouses' wages indicates that women decrease their labour supply when spouses' wages rise, which corresponds with Mincer's (1962) suggestion that the labour supply of women in the family 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 wage of household members, including spouses' wages. 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.

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 estimation and should be correlated with unmeasured factors such as taste in work (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 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 in order to cover the higher cost 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 the number of children (comparing models 1 and 3 to models 2 and 4) has increased slightly in absolute value.

On the one hand, given that fertility decisions depend on women's preferences, the tendency to have children allows women to place a higher value in the labour market. Blau and Kahn (2007) conclude that if and when wages decrease, women tend to shift their time from household to market work and this affects their fertility decisions. Compared with the results for 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.

5.2 DISAGGREGATION

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

A. Disaggregation by Education Levels

In Thailand, policies to promote female education have increased the percentage of female workers who obtain a higher level of education (Nakavachara 2010). To check how elasticity changes across the education groups, we disaggregate education attainments into three main

levels. We found 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). However, despite the positive relationship between education and wage rate, as income rises the substitution effect will increase and the income effect will decrease, which 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 as Poonsab (2008) suggests that level of education has a positive effect on payments for workers in Thailand.

[Table 5]

B. Disaggregation by Age

Goldin (2006) suggests that younger cohorts in the US are less responsive both to own wage and spousal wage changes. To check this issue in Thailand, we disaggregate the labour function by 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 as the younger generation tends to invest more in education and career development, and places careers ahead of or equal to marriage, the absolute magnitude of elasticity declines considerably for the group.

[Table 6]

C. 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 disaggregate 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 should spend more time on household work than those without them, if wages increase they should decrease 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.

[Table 7]

D. Disaggregation by Income Levels

As we explain earlier, the inverse relationship between married women's labour supply and wages is due to the domination of income effect. With a higher income, the income effect should then have less effect and the substitution effect should be higher. To check the different income effects for different levels of income, we disaggregate the labour supply function into two income groups. As reported by National Statistical Office of Thailand (2018), the average monthly income in Thailand is around 13,750 baht per month.[6] We use this as the baseline to decompose the sample into a lower-income group and a higher-income group.

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

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 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.

[Table 8]

E. 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 wages 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 are similar for urban and rural women using hours worked-wage equations for women of all ages.

[Table 9]

F. Disaggregation by Sector

Agriculture is one of the most important sectors in the economy in Thailand, with a high proportion of the labour force working in this area, although it constitutes a decreasing share of the GDP as other sectors like manufacturing begin to play an increasing role in the economy (World Bank 2018). Poonsab (2008) finds that women in Thailand who work in agriculture earn less than those in non-agricultural sectors. We disaggregate 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 and are less responsive to wage changes to fulfil their subsistence needs.

[Table 10]

6. ROBUSTNESS CHECK

A. Check for Marriage Proneness and Correct for Marriage Selection

As our estimation focuses on the married women group, it is possible that those who choose to get married may incur self-selection bias. For example, if there is a smaller percentage of women who choose to get married over time, they will be more marriage-prone compared to the total population of women. If this is associated with motivation or taste 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 Khan 2007). To do this, we acquired more observations but could not control for family effect. The results shown in Table 11, which do not show much difference compared with the basic estimation, indicate that marriage selection does not cause much of a problem with endogeneity.

[Table 11]

B. Check for Changes in Elasticity over Time

As the structure of the labour force in Thailand has changed dramatically over three decades, we analyse the trend of 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 decrease during 2005 to 2016. This pattern is consistent with Goldin (1990), who studies the changes in married women's wage and income elasticities from 1900 to 1970 in the US. Initially, the income effect dominates during the low level of development. 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 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 career orientation.

In Thailand, the resulting pattern for elasticity 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 10-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 have 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 decrease in elasticity (Goldin 1990, Bradbury and Katz 2008).

[Table 12]

C. Group Data Estimation

As our data have a long-time survey record, which is quite advantageous for analysing developing countries, we take this advantage to use the group data constructed from our repeated cross section data. Using group data estimation can relax the exclusion restriction needed for our IV. Deaton (1985) points out that using cohorts to estimate a linear model for repeated cross sections can yield consistent results, and Angrist (1991) shows that grouped data can serve as an instrumental variable procedure where a set of cohort dummy variables is used as instruments. Furthermore, Devereux (2004) also indicates 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, three education groups for both own and spouse's age, and thirteen birth cohorts; these will potentially yield 351 cells (= 3 x 3 x 3 x 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. However, compared with the basic estimation, own wage elasticity becomes smaller in this case. This result is consistent with Devereux's (2004) use of group data, which provides much smaller own wage elasticity under WLS compared with the IV approach, and Paweenawat and McNown's (2018) application of the synthetic cohort approach, which reports a relatively smaller own wage elasticity.

[Table 13]

7. CONCLUSIONS

This paper investigated married women's labour supply behaviour using LFS in Thailand from 1985 to 2016. Our main finding indicates the 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 the measurement error and omitted variables, we find a negative relationship between married women's labour supply and their real wages, which is robust using different estimation techniques and indicates a dominant income effect.

The significant effect of husbands and number of children for married women's labour supply has been found in our study. The estimated own wage elasticity ranges from -1.70 to -2.40 and cross elasticity ranges from -0.16 to -0.17, which indicates that married women in Thailand intend to decrease their working hours when their own and spouses' wage 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.

For example, 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 perceive their employment as a long-term career and acquire greater labour force attachment (Goldin 2006). Further promotion of education attainment by the government 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 decrease in elasticity. For further development, the promotion of education is necessary.

Finally, our results indicate that the labour supply of married women with children responds more to the 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 their children, thus the implementation of social and economic policies related to childcare, whether 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 overall.

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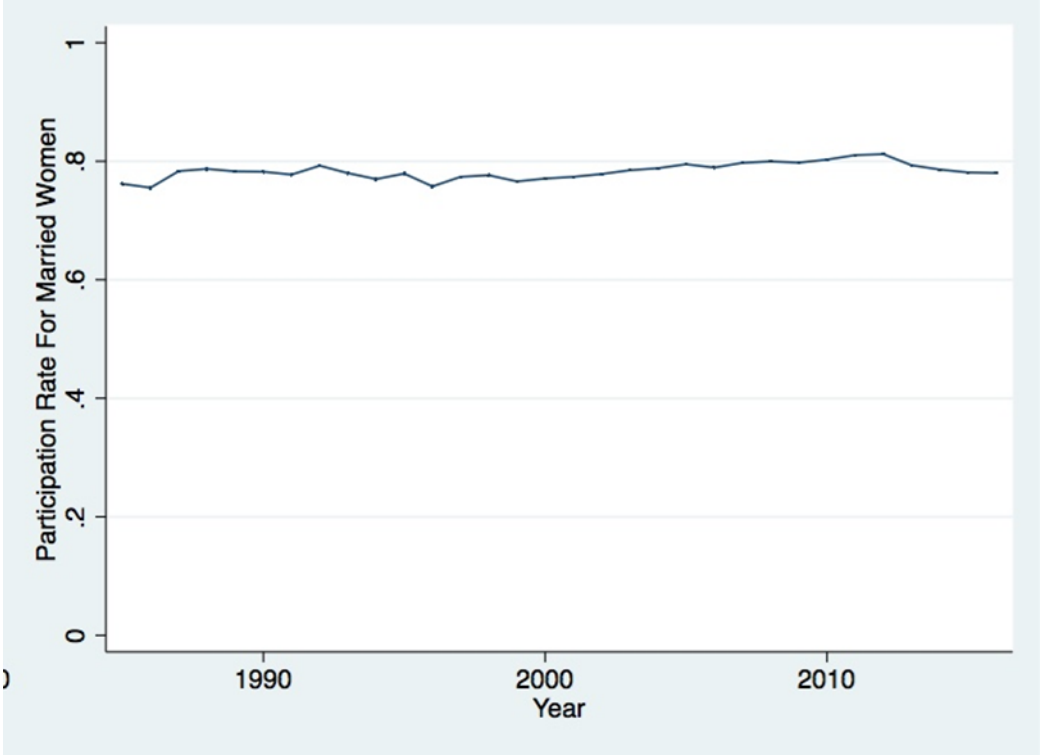
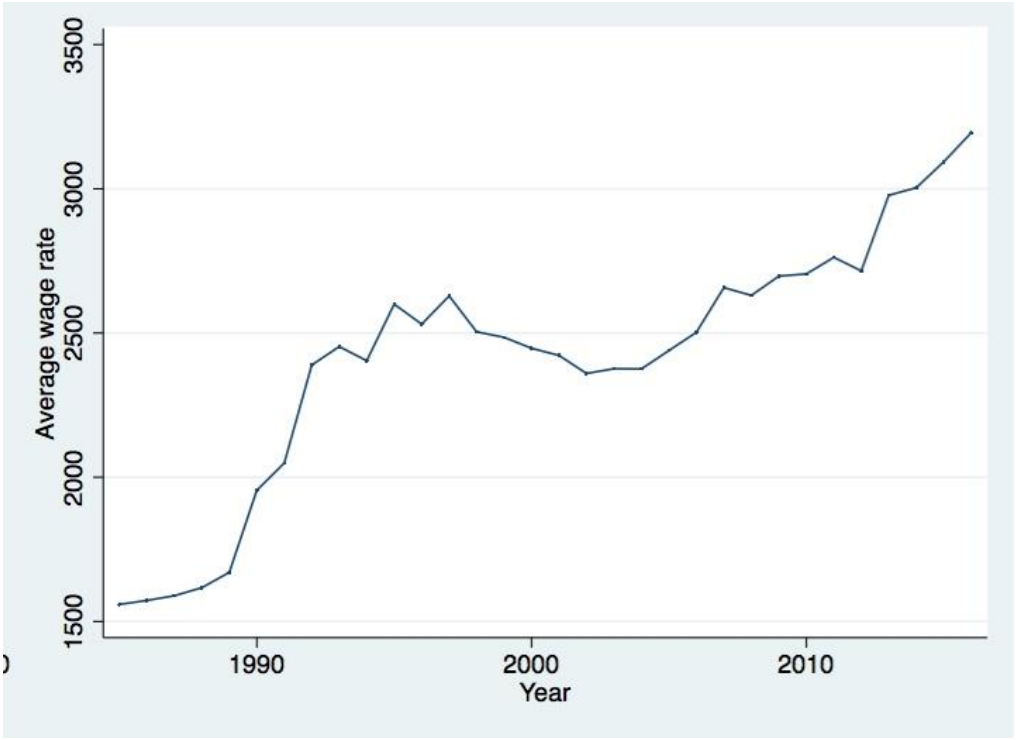
Figure 1: Average participation rates for married women (1985-2016) (%)



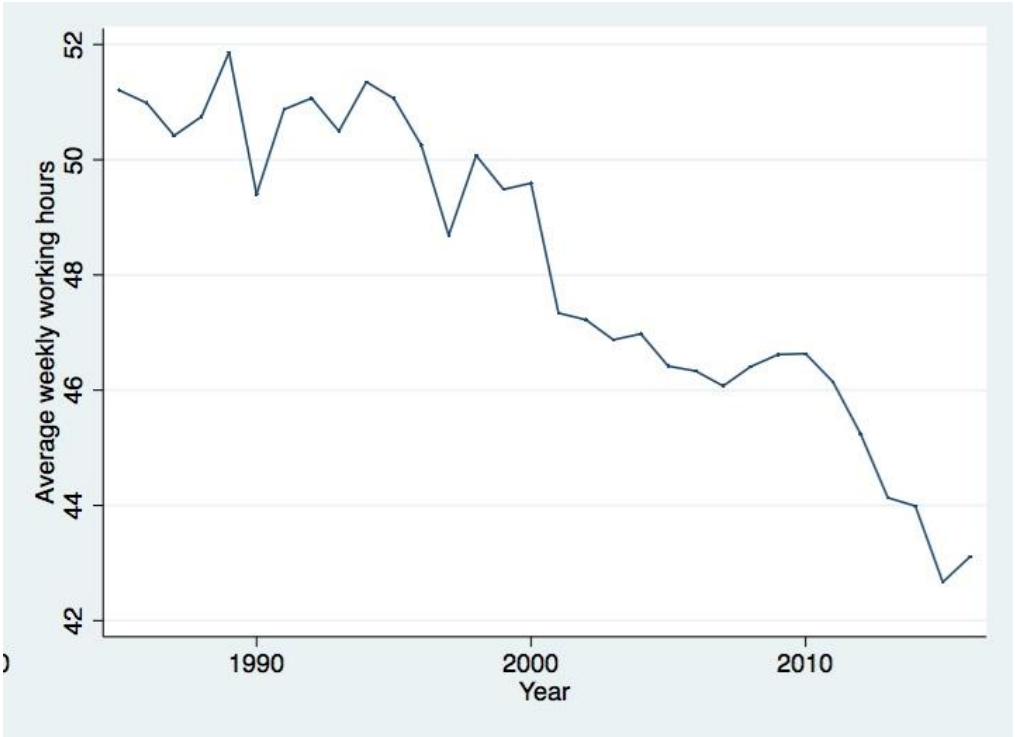
Source: Authors' calculation

Figure 2: Average real wage rate trends for married women (1985-2016)



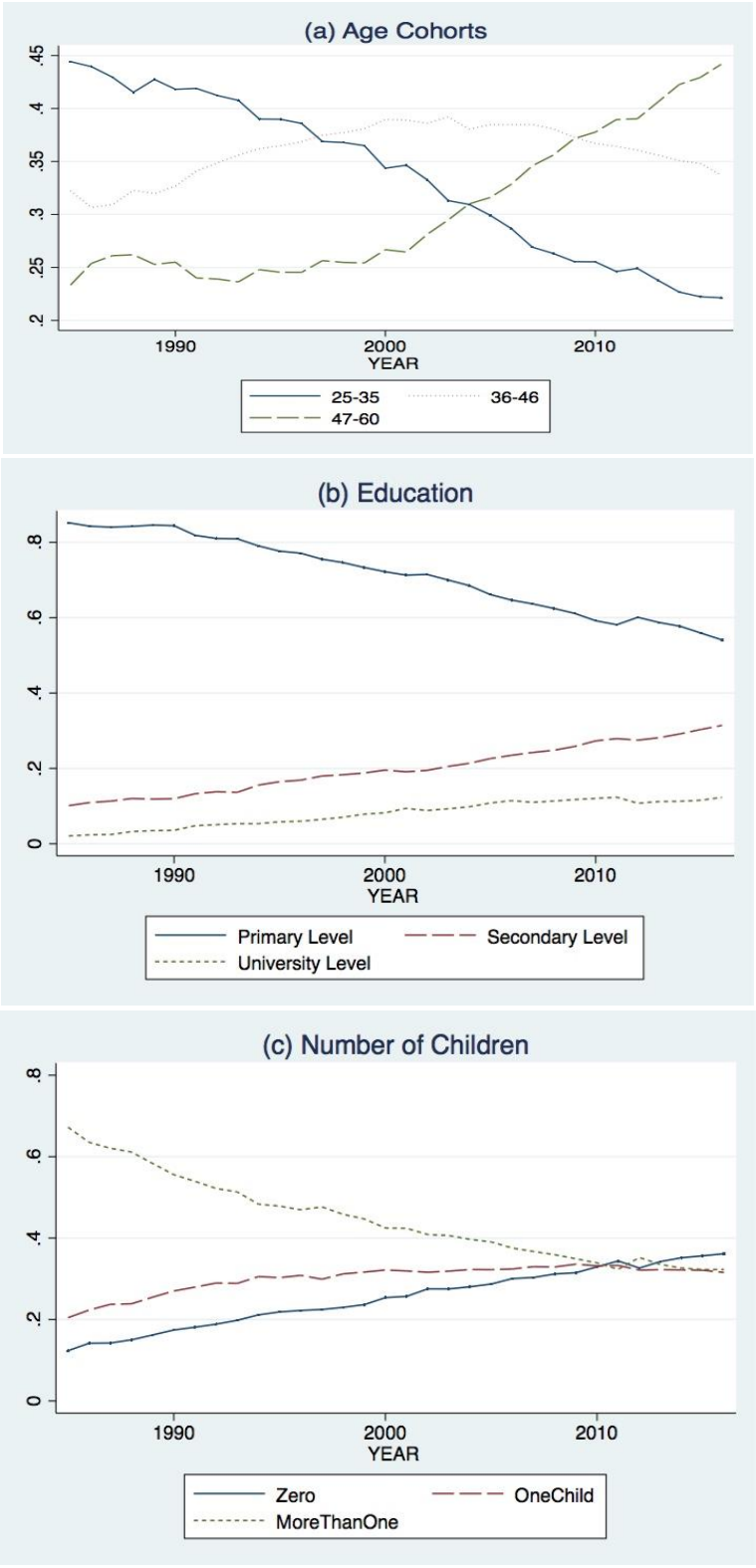
Source: Authors' calculation

Figure 3: Average weekly working hours trends for married women (1985-2016)



Source: Authors' calculation

Figure 4: Percentage of married women for age, education attainments, number of children groups



Source: Authors' calculation

Table1 - Selected Explanatory Variables of Married Female Sample, 1985-2016

	(1) No. Of Observations	(2) Mean	(3) Standard Deviation	(4) Min	(5) Max
Age	136,948	39	9	25	60
Weekly working hours	136,948	44	12	0	98
Number of children	136,948	1.303	1.101	0	12
Weekly log wage	136,948	7.443	0.847	1.829	11.878
Weekly log spouse wage	136,948	7.662	0.816	2.523	12.320
Own Education:					
Primary level	136,948	0.557	0.498	0	1
Secondary level	136,948	0.275	0.449	0	1
University level	136,948	0.160	0.373	0	1
Spouse Education:					
Primary level	136,948	0.470	0.499	0	1
Secondary level	136,948	0.343	0.475	0	1
University level	136,948	0.178	0.378	0	1

Note-The explanatory variables also include age squared, and four region categories.

Table 2 Means for Unpaid workers and Those Working Less Than 25 Hours, Married Women 25-60

	(1) Unpaid workers	(2) Less Than 25 Hours	(2)-(1) 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' calculation

Table3 - OLS Estimations for Labor Supply of Married Women 1985-2016

	OLS			
	Model1	Model2	Model3	Model4
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

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table4 - Instrumental Variable Labor Supply Estimations of Married Women 1985-2016

	IV			
	Model1	Model2	Model3	Model4
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

All models include four region categories, age and age squared. Own wage equal to actual wage unless individual's wage is missing. The regressors include age, age squared, three education categories, number of children and four region categories.

Table5 - Education Disaggregation

Model 4	Primary Level	Secondary Level	University Level
Own log wage	-5.277***	-17.13***	3.797***
	(0.52)	(0.498)	(0.586)
Spouse log wage	-0.778***	-1.313***	-0.655***
	(0.143)	(0.137)	(0.136)
Number of children	0.467***	-0.123*	-0.643***
	(0.0548)	(0.0634)	(0.0609)
Observations	65,200	39,433	30,519
Control for own and spouse education	Yes	Yes	Yes
Control for number of children	Yes	Yes	Yes
Computed Elasticities (at means)			
Own log wage	-0.761	-2.993	0.810
Spouse log wage	-0.117	-0.236	-0.142

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table6 - Age Disaggregation

Model 4	Age 25-35	Age 36-46	Age 47-60
Own log wage	-10.25***	-17.15***	-17.29***
	(0.547)	(0.454)	(0.747)
Spouse log wage	-0.873***	-0.789***	-0.777***
	(0.137)	(0.134)	(0.193)
Number of children	-0.235***	0.737***	1.133***
	(0.0593)	(0.0561)	(0.0887)
Observations	57,474	54,868	24,606
Control for own and spouse education	Yes	Yes	Yes
Control for number of children	Yes	Yes	Yes
Computed Elasticities(at means)			
Own log wage	-1.615	-2.938	-3.147
Spouse log wage	-0.142	-0.139	-0.145

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table7 - Number of Children Disaggregation

Model 4	No Children	With Children
Own log wage	-12.88***	-15.01***
	(0.524)	(0.368)
Spouse log wage	-1.214***	-0.779***
	(0.157)	(0.103)
Number of children		0.842***
		(0.0513)
Control for own and spouse education	Yes	Yes
Control for number of children	Yes	Yes
Observations	40,823	96,125
Computed Elasticities(at means)		
Own log wage	-2.134	-2.519
Spouse log wage	-0.206	-0.134

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table8 - Income Level Disaggregation

Model 4	Low income	High income
Own log wage	-12.52***	0.578
	(0.517)	(7.745)
Spouse log wage	-1.077***	-0.815***
	(0.0993)	(0.142)
Number of children	0.339***	-0.3
	(0.0469)	(0.611)
Control for own and spouse education	Yes	Yes
Control for number of children	Yes	Yes
Observations	105,638	31,310
Computed Elasticities(at means)		
Own log wage	-1.917	0.129
Spouse log wage	-0.171	-0.183

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table9 - Residence Area Disaggregation

Model 4	Urban	Rural
Own log wage	-14.00***	-15.86***
	(0.478)	(0.409)
Spouse log wage	-1.063***	-0.591***
	(0.12)	(0.123)
Number of children	0.410***	0.534***
	(0.0532)	(0.0513)
Control for own and spouse education	Yes	Yes
Control for number of children	Yes	Yes
Observations	62,793	74,155
Computed Elasticities(at means)		
Own log wage	-2.247	-2.749
Spouse log wage	-0.176	-0.105

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table10 - Sector Disaggregation

Model 4	Agriculture	Non-Agriculture
Own log wage	-5.184***	-14.47***
	(1.076)	(0.329)
Spouse log wage	-2.198***	-1.516***
	(0.365)	(0.0863)
Number of children	1.340***	0.293***
	(0.11)	(0.0378)
Control for own and spouse education	Yes	Yes
Control for number of children	Yes	Yes
Observations	19,643	117,305
Computed Elasticities (at means)		
Own log wage	-0.779	-2.459
Spouse log wage	-0.339	-0.265

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table11 - Instrumental Variable Estimations for Marriage Selection Correction

	Model1	Model3
Own log wage	-11.51***	-10.86***
	(0.0699)	(0.13)
Control for own education	No	Yes
Control for number of children	No	No
Observations	284,475	284,475
Computed Elasticities (at means)		
Own log wage	-1.925	-1.816

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table12 - Instrumental Variable Estimation for Different Time Periods

	1985-1994	1995-2004	2005-2016
Own log wage	-4.996***	-10.14***	-5.566***
	(0.382)	(0.254)	(0.268)
Spouse log wage	-0.631***	-0.697***	-0.388***
	(0.191)	(0.136)	(0.134)
Observations	19,260	56,223	61,465
Computed Elasticities(at means)			
Own log wage	-0.808	-1.712	-0.931
Spouse log wage	-0.106	-0.121	-0.067

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table13 - Group Data Estimation for Married Women 1985-2016

	WLS
Own log wage	-3.586***
	(0.594)
Spouse log wage	-2.544***
	(0.935)
Observations	287
Computed Elasticities(at means)	
Own log wage	-0.611
Spouse log wage	-0.444

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1