ESSAYS ON HOUSEHOLD AND FAMILY ECONOMICS

by

YANG JIAO

B.S., Wuhan University of Technology, 2005
M.S., Wichita State University, 2008

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Economics
College of Arts and Sciences

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2016

Abstract

This dissertation consists of three essays in the field of household and family economics. Specifically, the research focuses on the optimal taxation and household behavior, gender inequality in the labor market during economics transition, and fertility choices and female labor supply.

Chapter 1 explores the welfare implications of an optimal tax-transfer schedule to dual-earner couples. A non-cooperative model is used to examine labor supply decisions of married couples to both individual- and joint-based taxation, and the results suggest that the impact of income taxation on family labor supply is largely dependent on spouses' relative wage income. I also investigate the welfare effect of a governmental imposed redistributive program on both spouses, the simulation results of moving from individual to joint taxation improves both spouses' well-beings and the welfare gain is higher for couples when income gap between the husband and the wife is larger.

Chapter 2 empirically examines the impact of privatization reform on gender wage gap in urban labor market based on a comprehensive nationwide survey, the Chinese Household Income Projects (CHIP). We observe, between 1995 and 2007, the gender wage gap rises, and the progress of privatization increases women's productivity. The results of decomposition suggest that the increase in gender discrimination, which is associated with the rapid growth of non-state sector, contributes to widening gender wage gap. Although privatization increase gender segregation in occupational attainments, it is less obvious that segregation can account for the gender wage gap.

In Chapter 3, using the 1979 cohort of the National Longitudinal Survey of Youth (NLSY79), we find mothers earn less on average even after controlling for other wage determinants. The wage penalty associated with motherhood is insignificant in the early career,

and arises partly due to mothers accumulating less work experience. As a result, late mothers experience stronger (weaker) returns to work experience before (after) their transition to motherhood. The differentials in returns to work experience are robust to controlling for occupational skill requirements and time spent out of employment.

ESSAYS ON HOUSEHOLD AND FAMILY ECONOMICS

by

YANG JIAO

B.S., Wuhan University of Technology, 2005
M.S., Wichita State University, 2008

A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Economics
College of Arts and Sciences

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2016

Approved by:

Major Professor
Yang-Ming Chang

Copyright

Abstract

This dissertation consists of three essays in the field of household and family economics. Specifically, the research focuses on the optimal taxation and household behavior, gender inequality in the labor market during economics transition, and fertility choices and female labor supply.

Chapter 1 explores the welfare implications of an optimal tax-transfer schedule to dual-earner couples. A non-cooperative model is used to examine labor supply decisions of married couples to both individual- and joint-based taxation, and the results suggest that the impact of income taxation on family labor supply is largely dependent on spouses' relative wage income. I also investigate the welfare effect of a governmental imposed redistributive program on both spouses, the simulation results of moving from individual to joint taxation improves both spouses' well-beings and the welfare gain is higher for couples when income gap between the husband and the wife is larger.

Chapter 2 empirically examines the impact of privatization reform on gender wage gap in urban labor market based on a comprehensive nationwide survey, the Chinese Household Income Projects (CHIP). We observe, between 1995 and 2007, the gender wage gap rises, and the progress of privatization increases women's productivity. The results of decomposition suggest that the increase in gender discrimination, which is associated with the rapid growth of non-state sector, contributes to widening gender wage gap. Although privatization increase gender segregation in occupational attainments, it is less obvious that segregation can account for the gender wage gap.

In Chapter 3, using the 1979 cohort of the National Longitudinal Survey of Youth (NLSY79), we find mothers earn less on average even after controlling for other wage determinants. The wage penalty associated with motherhood is insignificant in the early career,

and arises partly due to mothers accumulating less work experience. As a result, late mothers experience stronger (weaker) returns to work experience before (after) their transition to motherhood. The differentials in returns to work experience are robust to controlling for occupational skill requirements and time spent out of employment.

Table of Contents

List of Figures

List of Tables

Acknowledgements

First and foremost I want to express my sincerest appreciation to my advisor, Dr. Yang-Ming Chang for offering exceptional advice and support throughout my graduate studies. The joy and enthusiasm he has for his research was contagious and motivational for me, even during tough times in the Ph.D. pursuit. I am also thankful for the excellent example he has provided as a successful researcher, mentor and instructor.

I would like to express my gratitude to Dr. Dong Li, Dr. Philippe Belley, and Dr. Le Wang. Working with them has expanded my knowledge and deepened my understanding in labor economics and econometrics. For this dissertation, I would especially like to thank my other supervisory committee members, Dr. Tian Xia, Dr. Kristy Archuleta. Thank you for investing time and providing helpful suggestions and valuable feedback.

I gratefully acknowledge all of the economics graduate faculty, in particular Dr. William Blankenau, Dr. Leilei Shen, and Dr. Anson Ho. I would also like to thank Dr. Hugh Cassidy for his seminar course in labor economics. I learned a lot from his class and I hope to disseminate this attained knowledge effectively during my role as an educator.

I'd like to thank many people who have contributed, directly or indirectly, to my academic success throughout my journey at Kansas State University. I am especially grateful for time spent with my amazing friends, Ping Teoh, Jules Yigma, Xin Xie, Yunyun Lv, and Hedieh Shadmani.

Finally, my most heartfelt thanks go to my family. To my husband, Chee Sern Lim, thank you for constant understanding, supports and great patience at all times. To my parents, thank for their unconditional love, support, and encouragement which has always inspired me to chase my dreams.

Dedication

Dedicated to my beloved family.

Chapter 1 - Individual vs. Joint Taxation for Dual Earner Altruistic Households with Independent Time Allocation Decisions

1.1 Introduction

The appropriate tax treatment of family's personal income is one of the most controversial areas in practice of income tax. Under present law, the United States uses a system of joint taxation where married couples are taxed as a unit and family income tax is based on their total taxable income.[1] On the contrary, most countries use individual taxation, also known as separate taxation, taxing each person on his or her own income regardless of marital status.[2]

Whether married couples are taxed jointly or separately is a topic of much debate. A major criticism of the US system is that it does not treat married couples and single individuals in the same way, or "marriage neutral", in that a married couples may have different tax burden than two single persons. Some couples face marriage penalties, paying a higher tax bill if married than if single. Others enjoy marriage bonuses, paying less if married. Even though joint taxation lacks marriage neutrality, it provides horizontal equity, and married couples with the same income face the same tax liability, regardless of how income is divided between the spouses.[3] Another criticism is that joint taxation discourages non-working spouse from undertaking paid employment, because it increases marginal tax rate faced by secondary earner within a couple. According to Ramsey rule, tax rate on primary earners' income should be higher than the tax rate on secondary earners' income if the labor supply of secondary workers is more elastic. Boskin and Sheshinski (1983)

[1] Although married couples are permitted to file separately under current law, the applicable rate schedule is so disadvantage that only 1.3% of married couples do so (Yale Law Journal 1981).

[2] Alm and Melnik (2005) report that the U.S. is the only one in OECD countries to use joint taxation.

[3] O' Neill (1981) describes the trade-offs between marriage neutrality and horizontal equity inherent in the choice between individual and joint taxation.

simulate optimal tax rates for married couples, and their results show that optimal rates on primary earners can be two to three times as large as that on secondary workers. For such reason, they argue that joint filing system of taxing both spouses' earnings at the same marginal tax rate is economically inefficient compared to a system with lower tax rates on the secondary earners. This paper examines how individual and joint taxation affect spouses' labor supply over market work and home production. I find that the conventional wisdom in favor of individual-based taxation is delicate and joint taxation could improve both spouses' welfare of both if they fail to behave cooperatively.

In this study, family decision making is modeled in a non-cooperative setting, and the assumption of non-cooperation can be justified on both theoretical and empirical viewpoints. First, when the transaction costs associated with the implementation and enforcement of cooperative agreements within marriage are sufficiently high, it will be optimal for a couple to remain at a non-cooperative solution (Pollak 1985). Second, the equilibrium outcome in a cooperative model depends crucially on what happens in the event of disagreement, variously known as the "threat point" or "status quo". The seminal contributions in the cooperative bargaining literature are Manser and Brown (1980), and McElroy and Horney (1981). Both studies use divorce as the threat point. Lundberg and Pollak (1993) have developed models where the threat point is some form of non-cooperative behavior. Their studies all suggest that non-cooperation within marriage is the best choice of threat point, thus understanding of non-cooperative models is a prerequisite for understanding cooperative bargaining models. Furthermore, the empirical study of Del Boca and Flinn (2014) shows one fourth of households behaves non-cooperatively. Another study of Jia (2005) empirically examines labor supply of retiring couples and concludes that more than one-half of households behaves according to a non-cooperative family decision-making model. Non-

cooperation implies that there is an additional distortion of the primary-secondary labor input ratio in household production (Piggott and Whalley 1996). In a model with market and household production and with primary and secondary labor, individual-based income taxes change the shadow wage of each labor type in household activities and, hence, distort input decisions into household production for primary and secondary workers. Whether the costs of this distortion from individual taxation outweigh the benefits of setting different tax rates for individual household members depends on market labor supply elasticities.

To precede the analysis, I first present a two-stage non-cooperative game. In the first stage of the game, the government determines optimal tax rates in order to maximize total tax revenue for a representative household. In the second stage of the game, household members simultaneously decide on their time-allocation between market work and home production in order to maximize their respective utility functions. Then I use numerical estimation method since an analytical comparison across tax units is not tractable. The estimated results show that a switch from an individual- to a joint- basis can lead to higher utility of both spouses conditional on market values of labor supply and marginal household productivity. The welfare gain is positively related to intra-household altruistic preference. The higher degree of altruism is, the larger the welfare gain. Altruistic preference largely affects time allocation decisions of spouse, though its impact on labor supply is subject to taxation. The labor supply elasticity of primary earner is higher, under individual taxation, with respect to changes of altruism, relative to join taxation. On the contrary, the labor supply of secondary earner is more elastic to changes of altruism under joint taxation compared to individual taxation. I also examine the effect of intra-family transfer on household behavior. Under joint taxation, the impact of intra-family transfer on spouse's labor supply depends on family wage structure. A higher transfer increases primary earner's labor supply only

if spouse's wage rate is sufficiently high. On the contrary, a higher transfer increases the labor supply of secondary earner only if the spouse's wage rate is sufficiently low. Under individual taxation, intra-family transfer has little on both spouse labor supply decisions. Numerical estimates show that the use of intra-family transfer can be welfare-improving for spouses with disparate incomes.

Even though couples may act non-cooperatively, they make decisions that are not entirely self-interested. They voluntarily anticipate what they think to be the preferences of others and incorporate them into their decision making. They do this, not because of legal requirements or social norms, but because they are altruistic and care about the welfare of others (Bell and Keeney, 2009). There are two reasons to incorporate altruistic preferences in non-cooperative models. First, it enhances our understanding on whole continuum of household decision models that are situated between the fully cooperative model and the fully non-cooperative model without caring. Cherchye et al. (2011) present a consumption model of caring household members when they make non-cooperative decisions over public goods consumption. Following a revealed preference approach, they derive a testable implication of the model for empirical data. Their experimental applications suggest the empirical relevance of non-cooperative behavior and altruistic preference in household decision making. Second, households with different intra-family non-cooperative and altruistic preferences may achieve different equilibrium. Indeed, economists have long recognized the importance of altruistic preference in household behavior. However, previous studies mainly focus on the interaction of altruism and consumption and resource reallocation within family (Becker and Barro 1986; Stark and Falk 1998). To my knowledge, there have been no studies conducted on the effect of altruistic preferences, non-cooperative behavior and income tax. It is more informative for policy makers to measure welfare gain and loss originating from non-

cooperative behavior and altruistic preference determining optimal income taxation and redistributive policies. This study provides a quantitative measurement of altruistic preference on labor supply decision and household welfare.

This paper is also related to the theoretical literature on family taxation, which provides two distinct arguments in favor of individual taxation. Boskin and Sheshinski (1983) draw on labor supply elasticity considerations alone to support individual taxation. The standard labor supply elasticity argument to replace joint by individual taxation remains true even if the endogeneity of fertility is taken into account (Meier and Wrede 2011). Optimal income tax theory in the Ramsey tradition calls for separate taxation where women should be taxed at lower rates than men or that marginal taxation of one individual decreases in the income of the spouse (Apps and Rees 2011; Kleven et al. 2009; Alesina et al. 2011). Apps and Rees (2011) emphasizing household production indicate that joint taxation fares worse than individual taxation, because the shadow income of household production always remains untaxed, and higher welfare losses are associated with joint taxation because marginal tax rates are increasing in the income of the spouse. Miere and Rainer (2012) suggest that tax-induced labor supply distortions lead to over provision of the family public good, spouses' failure to internalize the collective effect of their choices points towards under provision. They find that a move from individual to joint taxation improves the welfare of both spouses. I see my results as complementary to their findings, whereas their paper focuses on single earner households. I show that joint taxation is also optimal for dual earner households, especially for couples with unequal incomes.

Empirical studies use policy changes to estimate the effects of moving from joint to individual taxation on labor supply decision. Gustafsson (1992) compares the labor supply of women in Sweden and Germany. The analysis suggests that the participation rate of Swedish wives who face

the individual taxation would fall by one fourth if the German system of joint taxation was adopted. Lalumia (2008) uses a quasi-experiment from the time of the U.S. conversion from separate to joint taxation. She points out tax change is associated with two percentage points decline in the employment rate of highly educated married women. In line with their studies, the simulated results show that a shift to joint taxation reduces wives' labor supply, particularly among the households with high earnings husbands. However, I see very little changes in labor supply of equal earner couples. I also find that higher welfare gain of moving from individual to joint taxation is associated with larger income gap between spouses. The present study also explores and investigates the importance of a governmental imposed income transfer program in family behavior. I find that the effects of this program on family labor supply decisions vary across different tax treatments. The impacts of such income re-distributive program on household's decisions are shown to vary by taxation. Under joint taxation, when the husband receives larger transfer share, he would supply more to home production and less to market work if his relative income is sufficiently low. When the wife gets larger share, she would supply less to home production and more to market work when her relative income is high. When the wife gets larger share, she would supply less to home production and more to market work when her relative income is high. On the contrary, under individual taxation, the transfer program has little impact on the labor supply decisions for both spouses.

The remainder of this paper is organized as follows. Section 1.2 lays out the analytical framework of altruistic spouses when they make their time-allocation decisions independently. The theoretical results are discussed in section 1.3. Section 1.4 presents numerical estimation results. Section 1.5 elaborates on an extension in which no transfer program is presented. Section 1.6 concludes.

1.2 Household Decisions with Intra-Family Transfers

1.2.1 Household Decision Making Model

Consider a simple economy that is composed of representative households where each household has two members (i), husband (m) and wife (f). Each family member allocates one unit of time endowment over labor market activities (L_i) and home production (g_i). I assume the utility of each member takes the following functional form (see Konrad and Lommerud, 2000):

$$U^i = x_i + \theta \cdot G - a(g_i),$$

where x_i is individual's private consumption, G is the consumption on family public goods, θ indicates the marginal utility of the household public good to each spouse, and $a(g_i)$ represents the utility costs associated with time contributing to the production of family goods.

The private consumption on good x_i is determined by individual i′s disposable income,

$$x_i = (1 - \tau_i)w_i L_i + \rho_i T,$$

where $w_i L_i$ labor income with wage rate w_i is exogenously determined; τ_i is marginal tax rate and subject to different taxation. Another income source for family members comes from interfamily income transfer, imposed by the government, equals to a portion ρ_i of household's tax liability(T). The calculation of household tax liability is subject to income tax scheme, and the amount varies from individual- to joint-based taxation. One possible example of this transfer policy is tax refund of the United States.[4] For simplicity, I assume that full amount of taxes are refunded to household and divided between two spouses. Suppose that the husband receives ρ portion, the wife receives the rest or $(1 - \rho)$ portion of the transfer.

[4] A tax refund or tax rebate is a refund on taxes when the tax liability is less than the taxes paid. Taxpayers can often get a tax refund on their income tax if the tax they owe is less than the total amount they paid.

The family public goods G include any situation which requires the joint performance of the spouses (e.g. raising the children or the maintenance of the home), but it excludes the possibility that the provision of the family good would be obtained in the market. This assumption is reasonable because it takes into consideration that, for some couples, the private provision of family goods cannot substitute their own contribution to the family goods. The family public goods are described by the sum of individual time contributed to family production,

$$G = \sum g_i = (g_m + g_f).$$

In line with Konrad and Lommerud (2000), I suppose that individuals increasingly dislike spending more time on the production of family goods. The contribution to family goods not only reduces the time available to the labor market but also has utility or psychological cost $a(g_i)$, which is represented by an quadratic function,

$$a(g_i) = \frac{1}{2} C_i g_i^2,$$

where $C_m = \alpha$ for the husband (m) and $C_f = \beta$ for the wife (f).

In contrast to self-centered preferences, spouses are assumed to be altruistic, care about each other. The level of individual's well-being depends on his or her own individual (egocentric) utility as well as the utility of the spouse. Each spouse's preference is represented by altruistic function Z^i. To keep the model tractable, I assume the altruistic function is additive and described by,[5]

$$Z^i = U^i + \delta U^{-i}.$$

Where δ describes the scaling factor and takes the value between 0 and 1, reflecting the altruism that individual i feels for his or her spouse.

[5] Bell and Keeney (2009) discuss different specification of altruistic utility function.

That is to say, the altruistic functions Z^i for husband (m) and wife (f) are represented by,

$$Z^m = U^m + \delta U^f = x_m + \theta(g_m + g_f) - \frac{1}{2}\alpha g_m^2 + \delta\left[x_f + \theta(g_m + g_f) - \frac{1}{2}\beta g_f^2\right],$$
$$Z^f = U^f + \delta U^m = x_f + \theta(g_m + g_f) - \frac{1}{2}\beta g_f^2 + \delta\left[x_m + \theta(g_m + g_f) - \frac{1}{2}\alpha g_m^2\right].$$

One of the main reasons I choose to work with the special functional form above is for simplicity. With linearity, the Nash solution in equilibrium takes on a simple but appealing form. In addition, utility as specified also makes strategic interaction between spouses simple. Because even though their utilities are intertwined through the existence of a family public good, each partner's behavior is still independent when the spouses act non-cooperatively. This simplicity makes the non-cooperative outcome a "clearer" benchmark for understanding the family's decision making (Funcia et al. 2013).

The overall welfare of each representative household is the sum of individual's altruistic utility, written as:

$$W = \sum Z^i = Z^m + Z^f.$$

1.2.2 Optimal Taxation

Following Apps and Rees (1999), I examine two income tax schemes: individual taxation and joint taxation. Under individual taxation, husband (m) and wife (f) have different tax rates. The government is to determine an optimal tax rate τ_i^* for each individual (i) to maximize tax revenue. The marginal tax rates are different for the husband and the wife $(\tau_m^* \neq \tau_f^*)$,

$$max\, T = \sum \tau_i w_i L_i.$$

Under joint taxation scheme, the government chooses the revenue-maximizing tax rate τ^* for each household unit, thus husband and wife are taxed at the same tax rate τ^*.

$$max\, T = \tau \sum w_i L_i$$

Another important feature of this study is that I allow the tax rate to be endogenously related to individual's labor supply. This assumption captures the progression of income tax schedule. Individual's tax rate is determined either on the basis of personal income under individual taxation, or on the basis of household income under joint taxation. Even though the change in the tax schedule is exogenous to an individual's initial behavior, it would affect the individual's endogenous response by increasing or decreasing the labor supply to the new tax schedule. Thus, changes in the design of income taxation would affect individuals' labor supply decision; meanwhile, changes in the labor supply would also influence the individual's marginal tax rate. Past economic theory does not predict how individuals' labor supply affects tax rate, because the marginal tax rate is exogenously given.

1.3 Equilibrium

1.3.1 Individual Taxation

The household allocation decision is made in two stages. In the first stage, the government determines the revenue-maximizing tax rate for each household. The same amount of tax revenue will be re-distributed back to households so each household member is entitled to a share of it. The sharing rule for each spouse is also determined by the government and thus considered exogenous. In the second stage of the game, household members simultaneously make their independent consumption choices and allocate their time optimally between market work and home production, conditional on the given tax rates and received transfers. The household decision making is subject to the taxation system that individuals are facing. The family's decision-making problem can be solved through backwards induction.

Applying the backward induction procedure, I begin with the second stage of the game and obtain the equilibrium corresponding to the husband and the wife. Under individual taxation, the utility maximization problem for spouse (i) is given by,

$$\max_{L_i, g_i} Z^i = x_i + \theta G - \frac{1}{2} C_i g_i^2 + \delta(x_{-i} + \theta G - \frac{1}{2} C_{-i} g_{-i}^2)$$

$$st\ :\ x_i \le (1-\bar{\tau}_i) w_i L_i + \rho_i(\sum(\bar{\tau}_i w_i L_i)),$$

$$G = g_i + g_{-i},$$

$$L_i = 1 - g_i,$$

$$0 \le L_i, g_i \le 1.$$

The optimal labor supply L_i^I , and time spent on housework g_i^I for each spouse can be solved by the first-order conditions. The solutions are written as,

$$\bar{L}_m^I = \frac{\alpha + w_m - \theta(1+\delta) - (1-\rho)(1-\delta)\bar{\tau}_m w_m}{\alpha}; \bar{L}_f^I = \frac{\beta + w_f - \theta(1+\delta) - \rho(1-\delta)\bar{\tau}_f w_f}{\beta}.$$

The optimization problem for government is to maximize tax revenue function, while taking each family member's labor supply as given, or written as,

$$\max_{\tau_m^I, \tau_f^I} T = \tau_m^I w_m L_m^I + \tau_f^I w_f L_f^I.$$

Under individual taxation, the equilibrium tax rates are calculated as follows,

$$\tau_m^I = \frac{\alpha + w_m - \theta(1+\delta)}{2(1-\rho)(1-\delta)w_m}; \tau_f^I = \frac{\beta + w_f - \theta(1+\delta)}{2\rho(1-\delta)w_f}.$$

The optimal labor supply for husband and wife can be calculated by substituting the optimal tax rates back into their labor supply functions, or

$$L_m^I = \frac{\alpha + w_m - \theta(1+\delta)}{2\alpha}; L_f^I = \frac{\beta + w_f - \theta(1+\delta)}{2\beta}.$$

The equilibrium obtained are interior solutions. To examine the effects of intra-family transfer and altruistic preference on individuals' time allocation decisions, I take the derivative of the labor supply and marginal tax rate with respect to sharing rules (ρ) and degree of altruism (δ). (Proof see Appendix A)

Proposition 3.1. *Under individual taxation, intra-household transfer* (ρ) *does not affect the time allocation decision* $\left(\frac{\partial L_i^*}{\partial \rho} = 0\right)$ *and the time spent on market production decreases with the degree of altruism* $\left(\frac{\partial L_i^*}{\partial \delta} < 0\right)$ *for both husband and wife.*

Under individual taxation, the time allocation over market production and home production is dependent on shares of intra-household transfer shares. With a linear income tax scheme, the proportional income redistribution program exerts no impact on households. However, the degree of altruistic preferences toward other household members does affect the household's time allocation decision. If spouses care more about each other, they will reduce their labor supply to market work and allocate more of their time to home production.

Proposition 3.2. *Under individual taxation, a larger share of transfer to the husband increases his l tax rate* $\left(\frac{\partial \tau_m^*}{\partial \rho} > 0\right)$*, and reduces the wife's tax rate* $\left(\frac{\partial \tau_f^*}{\partial \rho} < 0\right)$*. Individual tax rate decreases when altruism increases for husband* $\left(\frac{\partial \tau_m^*}{\partial \delta} < 0\right)$ *if* $2\theta > \alpha + w_m$*, the wife* $\left(\frac{\partial \tau_f^*}{\partial \delta} < 0\right)$ *if* $2\theta > \beta + w_f$.

Labor supply decision and marginal tax rates depends on the proportion of intra-family transfer and the degree of altruism for both spouses. For the husband, the marginal tax rate is positively related to the shares of transfer he received, since he has more incentives to supply more time to labor market. By contrast, the labor supply for the wife falls as the husband receives a larger share of transfer. This explains why the marginal tax rate for the wife falls as the shares of transfer to the husband increases.

1.3.2 Joint Taxation

Under joint taxation, the optimization problem for spouse is described as,

$$\max_{L_i, g_i} Z^i = x_i + \theta \cdot G - \frac{1}{2} C_i g_i^2 + \delta (x_{-i} + \theta \cdot G - \frac{1}{2} C_{-i} g_{-i}^2)$$

$$st \ : \ x_i \le (1 - \bar{\tau}^J) w_i L_i + \rho_i \bar{\tau}^J (\sum (w_i L_i)),$$

$$G = g_i + g_{-i},$$

$$L_i = 1 - g_i,$$

$$0 \le L_i, g_i \le 1.$$

The optimal labor supply L_i^J and time spent on housework g_i^J of both spouses are given by

$$\bar{L}_m^J = \frac{\alpha + w_m - \theta(1+\delta) - (1-\rho)(1-\delta)\bar{\tau}_J w_m}{\alpha}; \bar{L}_f^J = \frac{\beta + w_f - \theta(1+\delta) - \rho(1-\delta)\bar{\tau}_J w_f}{\beta}.$$

The government solves its optimization problem given the optimal labor supply,

$$\max_{\tau^J} T = \tau^J \left(w_m L_m^J + w_f L_f^J \right)$$

Under joint taxation, the equilibrium tax rate and labor supply for both spouses are written as,

$$\bar{\tau}^J = \frac{\beta w_m (\alpha + w_m - \theta(1+\delta)) + \alpha w_f (\beta + w_f - \theta(1+\delta))}{2(1-\delta)((1-\rho)\beta w_m^2 + \rho \alpha w_f^2)}$$

$$\bar{L}_m^J = \frac{X(\alpha + w_m - \theta(1+\delta)) - \alpha w_f^2 (E - 2\alpha\rho) + K}{2\alpha((1-\rho)\beta w_m^2 + \rho \alpha w_f^2}$$

$$\bar{L}_f^J = \frac{\alpha \rho w_f^3 - P(\theta(1+\delta) - \beta) - \beta w_m^2 w_f (3\rho - 2) + Y}{2\beta((1-\rho)\beta w_m^2 + \rho \alpha w_f^2}.$$

Where

$$X = (1-\rho)\beta w_m^2; E = (1-3\rho) w_m + 2\theta\rho(1+\delta);$$

$$K = \alpha(1-\rho) w_m w_f (\theta(1+\delta) - \beta); P = 2\beta(1-\rho) w_m^2 + \alpha\rho w_f^2;$$

$$Y = \beta\rho w_m w_f (\theta(1+\delta) - \beta).$$

Proposition 3.3. *If the husband receives a larger share of intra-family transfer, his labor supply increases* $\left(\frac{\partial L_m^*}{\partial \rho} > 0\right)$ *only if the household's income is sufficiently high, such that* $w_f > \theta(1+\delta) - \beta$. *By contrast, higher transfer to husband will increase the labor supply of the wife* $\frac{\partial L_f^*}{\partial \rho} > 0$ *only if the household income is sufficiently low, such that* $w_m < \theta(1+\delta) - \alpha$. .

Proposition 3.3 implies that intra-family transfer program has an ambiguous effect on labor decisions for a two-earner household. When the family income is sufficiently high, an increase in the governmental transfer more to the husband will increase his labor supply and reduce the labor supply of the wife. When the family income is sufficiently low, an increase in the governmental transfer to the husband will increase the labor supply of the wife and reduce the husband's labor supply. This is because the model assumes that individual's labor supply decision, marginal tax rate and the share of intra-family transfer are mutually related. A higher share of transfer increases either the husband's or the wife's labor supply, and the marginal tax rate will increase for both spouses. Under joint taxation, the tax rates for spouses are jointly determined at household unit. For high income family, the benefit obtaining from a larger transfer to the husband exceeds the penalty associated with higher tax rates. The husband will increase his labor supply when he receives a greater amount of the transfer. At the same time, both transfer and tax-induced effects discourage the wife's labor supply for the case of a high income family. For a low income family, the penalty of increasing tax rates dominates the benefit from a higher transfer, with the consequence that the husband will reduce his labor supply to market work. Surprisingly, the wife's labor supply increases when more of the governmental transfer is given to the husband.

Proposition 3.4. *Higher degree of altruism will increase the joint tax rate* $\frac{\partial \tau^*}{\partial \delta} > 0$. *When the husband receives a higher share of transfer, the joint tax rate increases* $\frac{\partial \tau^*}{\partial \rho} > 0$ *on the condition that his relative wage is sufficiently high* $\left(\frac{w_m}{w_f}\right)^2 > \frac{\alpha}{\beta}$.

Proposition 3.4. indicates the role of altruism on joint tax rates. Although the effect of the degree of altruism on the labor supply is shown to be ambiguous, the impact of altruism on tax rates is positive. Higher tax rates are associated with higher degrees of altruism. The influence of altruism on tax rates is dependent on the husband's wage. When the husband's wage is sufficiently high relatively to wife $\left(\frac{w_m}{w_f} > \sqrt{\frac{\alpha}{\beta}}\right)$, an increase in the amount of transfer to husband will increase the tax rate.

1.3.3 Considering Two Types of Households

So far, I do not make any assumption about how a household is formed. I will discuss two cases in which the formation of households is under different assumptions. In the first case, family is formed based on the assumption of assortative mating. Under this assumption, individuals choose their spouses with similar backgrounds such as age, education, earning ability, etc. Both spouses are equivalently productive in both market work and home production. In the second case, the formation of family is based on specialization, and each individual has comparative advantage in either market work or home production. In addition, I assume the husband is the primary earner and more productive in market work and receives a higher wage rate while the wife is more efficient with home production and bears lower marginal cost.

Type 1 Households of Equal Earners

When spouses have similar earning abilities and other characteristics, they have the same wage rates and marginal costs of home production. That is, $w_m = w_f = w$ and $\alpha = \beta = \bar{\alpha}$.

Under individual taxation, the optimal labor supply to market work and home production are identical for the husband and the wife. And the labor supply in equilibrium for husband and wife is $L_m^I = L_f^I = \frac{\bar{\alpha}+w-\theta(1+\delta)}{2\bar{\alpha}}$.

The optimal marginal tax rates for husband and wife are

$$\tau_m^I = \frac{\bar{\alpha}+w-\theta(1+\delta)}{2w(1-\rho)(1-\delta)};\ \tau_f^I = \frac{\bar{\alpha}+w-\theta(1+\delta)}{2w\rho(1-\delta)}.$$

It comes as no surprise that when spouse have the same amount of earnings, their time allocation decisions are equivalent and they supply the same amount of time to market work and home production. However, their marginal tax rates are not identical. The ratio of their marginal tax rates is equal to that of the transfer shares or $\frac{\tau_m^I}{\tau_f^I} = \frac{\rho}{1-\rho}$.

Under joint taxation, the optimal labor supply for husband and wife are

$$L_m^J = \frac{\rho[\bar{\alpha}+w-\theta(1+\delta)]}{\bar{\alpha}};\ L_f^J = \frac{(1-\rho)[\bar{\alpha}+w-\theta(1+\delta)]}{\bar{\alpha}}.$$

And the optimal marginal tax rate is $\tau_m^J = \frac{\bar{\alpha}+w-\theta(1+\delta)}{w(1-\delta)}$.

Unlike individual taxation, individual's labor supply is not equivalent under joint taxation. The ratio of their labor supply is determined by the ratio of the transfer shares, or $\frac{L_m^I}{L_f^I} = \frac{\rho}{1-\rho}$.

Comparing the optimal labor supply and marginal tax rate across different taxation systems would provide a clear picture of how taxation affects the household member *i* 's equilibrium outcomes:

(1) for $\rho > \frac{1}{2}$; $L_m^J > L_m^I(L_f^I) > L_j^J$; $\tau_m^I > \tau^J > \tau_f^I$;

(2) for $\rho = \frac{1}{2}$; $L_m^J = L_m^I(L_f^I) = L_j^J$; $\tau_m^I = \tau^J = \tau_f^I$, $Z^I = Z^J$;

(3) for $\rho < \frac{1}{2}$; $L_f^J > L_m^I(L_f^I) > L_m^J$; $\tau_f^I > \tau^J > \tau_m^I$.

When the husband receives a larger share of transfer, as stated in the first condition, he will supply more to market work under joint taxation than he would have under individual taxation. It's also interesting to see that his labor supply is higher than that of his spouse's under joint taxation, even though they have the same earning ability and earn the same wage rate. The marginal tax rate under joint taxation is lower than the marginal tax rate for the husband and higher than the marginal tax rate for the wife, if spouses are taxed separately.

When spouses equally share the income transfer, as stated in the second condition, their equilibrium choices are the same, regardless of taxation. Therefore they are indifferent to how they are taxed. Moving from individual to joint taxation or vice versa have no impact on a household's time allocation decisions or well-beings.

When the wife receives a large share of transfer, as stated in the last condition, she will supply more than her spouse under joint taxation, and the labor supply is higher than what she would have under individual taxation. This is the opposite situation for the first condition. The welfare comparison between the husband and the wife based on numerical calculation is discussed in Section 1.4.

Type 2 Households of Income Disparate Earners

When husband is the primary and wife is the secondary earner, $w_m > w_f$ and the marginal cost of home production for husband is greater, $\alpha > \beta$. Due to the complexity of the solution, I will discuss this case in more detail using numerical estimation in Section 1.4.

1.4 Numerical Evaluation

In the framework discussed in Section 1.3, it is difficult to derive conclusions about the optimal taxation when the labor supply is endogenously determined by an individual's earning ability. The effects of taxation on household behavior and the well-being of household members are also ambiguous. Thus, numerical estimation is needed to provide a better understanding. In the following, I use the framework derived in Section 1.3 with estimated household productivity parameters and family members' altruistic preferences to simulate the optimal labor supply and welfare for a representative household under both individual and joint taxation. For the analysis, the spouses' incomes are computed based on the methodology in Blau and Kahn (2007), and the values for household productivity estimates are based on Grahamm and Green (1984). The values used for calculation are provided in Table 1.1.

Table 1.1 Numerical Values for Evaluation

	Equal Earners	Disparate Earners
Log Wage Income (w_i)		
- Husband (w_m)	3.15	3.15
- Wife (w_f)	3.15	2.55
Marginal Utility of Home Production (θ)	2.20	2.20
Marginal Cost of Home Production (C_i)		
- Husband (α)	0.85	0.85
- Wife (β)	0.85	0.55

Note: The subscript m indicates husband; f indicating wife.

1.4.1 Household of Equal Earners

The numerical estimation for spouses having similar earnings but different shares of transfer is provided in Table 1.2. When spouses split the income transfer equally, the optimal labor supply and utility of household members are identical under joint and individual taxation. Spouses are indifferent to individual or joint taxation and moving from individual to joint taxation or vice versa

would not improve the welfare for either spouse or the household as a whole. This scenario serves as the benchmark scenario for my analysis.

Under individual taxation, for both spouses, the marginal tax rate increases with the received share of transfer. A larger share of transfer to the husband or the wife increases his or her incentive to supply market work. Meanwhile, he or she is taxed at a higher rate when the labor supply increases. The rising tax rate would lead to a reduction in his or her labor supply. These two opposing effects on spouse labor supply decision work at the same time. Based on my calculation, the optimal labor supply for both spouses are independent of the sharing rules. Moreover, the welfare of household members is not affected by the sharing rules, and both spouses are indifferent to income distribution rules.

Table 1.2 Evaluating the Effect of Transfer Shares on Equal Earner Households

	$\rho = 0.4$	$\rho = 0.5$	$\rho = 0.6$
Individual Taxation			
Tax Rate	$t_m = 0.450$; $t_f = 0.675$	$t_m = 0.540$; $t_f = 0.540$	$t_m = 0.675$; $t_f = 0.450$
Labor Supply	$L_m = 0.800$; $L_f = 0.800$	$L_m = 0.800$; $L_f = 0.800$	$L_m = 0.800$; $L_f = 0.800$
Individual Utility	$Z_m = 4.060$; $Z_f = 4.060$	$Z_m = 4.060$; $Z_f = 4.060$	$Z_m = 4.060$; $Z_f = 4.060$
Household Welfare	8.119	8.119	8.119
Joint Taxation			
Tax Rate	$t_m = t_f = 0.540$	$t_m = t_f = 0.540$	$t_m = t_f = 0.540$
Labor Supply	$L_m = 0.640$; $L_f = 0.960$	$L_m = 0.800$; $L_f = 0.800$	$L_m = 0.960$; $L_f = 0.640$
Individual Utility	$Z_m = 3.622$; $Z_f = 4.472$	$Z_m = 4.060$; $Z_f = 4.060$	$Z_m = 4.472$; $Z_f = 3.622$
Household Welfare	8.093	8.119	8.093

Under joint taxation, changing the rules of transfer does affect the labor supply decision of spouses. If the husband receives a higher share of transfer, his labor supply increases and is higher than that in the benchmark scenario; at the same time, the wife's labor supply decreases and is lower than what she would have supplied in the benchmark case. Recall that in joint taxation, the marginal tax rate is determined by total income at the household level. Increases in the husband's labor supply have positive effects on the tax rate while decreases in the wife's labor supply have negative effects. Based on my calculation, the optimal marginal tax rates remain constant,

regardless of sharing rules. It's worth mentioning that the welfare of a household is lower in any cases when spouses claim different shares of transfer. From the welfare perspective, the estimated value under individual taxation is greater than that under joint taxation when income transfer is not equally distributed among household members.

Therefore, based on my calculation, the optimal taxation for households when spouses have similar earning ability is individual taxation. When both receive the same share of transfer, household members would be indifferent to taxation schemes and their optimal welfare is the same under individual and joint taxation. My results are consistent with that of Haan and Navarro (2008), who empirically estimated the optimal income taxation in a structural discrete choice labor supply model based on German Socio Economic Panel Study (SOEP). They find that the system of individual taxation is optimal when the government has a priority for redistribution towards couples in which both partners earn a similar amount of income.

1.4.2 Household of Income Disparity Earners

In what follows, I analyze the optimal labor supply and welfare for households in which spouses have different income. It's important to understand the role of shares of intra-family transfer, ρ and the degree of altruism, δ in household decision making. I calculate the marginal tax rates, the labor supply, and net income, the level of individual's well-being and the welfare of the household with different parameter values under both individual and joint taxation. Two restrictions are imposed. The lower bound is set under the assumption that the marginal tax rate for the wife is lower than that for the husband under individual taxation; the upper bound is set under the assumption that time endowment for both spouses allocated between market good and public good production is normalized to 1. The numerical results are presented through Table 1.3 -Table 1.5.

Table 1.3 demonstrates the results of the impact of shares of intra-family transfer for individual and joint taxation, respectively. Intra-family transfer affects both the husband's and the wife's labor supply and tax rates differently, and the influences also vary by taxation. Under individual taxation, the shares of intra-family transfer and the tax rates for individuals move in the same direction. The tax rates of the husband and the wife are higher when they receive a larger share of transfer. It's interesting to point out that under individual taxation; the labor supply for each individual is independent of the shares of transfer. The impact of shares of intra-family transfer on the labor supply could be through two channels. An increase in an individual's share increases his or her labor supply, but meanwhile it also increases the individual's marginal tax rate, which discourages his or her labor supply. These two opposing effects offset each other, with the results that individuals' labor supply is unaffected by the shares of transfer.

On the other hand, under joint taxation, there is very little change in tax rates when shares of transfer change. Even though the joint tax rates remain fairly constant, the labor supply for both spouses increases as they receive larger portions of transfer. This is because, based on the derivation, the variables for both spouses' labor supply are mutually determined by the joint tax rates. If the husband receives greater shares of transfer, the wife receives less. The joint tax rate rises when the husband supplies more to labor market; meanwhile, it decreases when the wife supplies less. The two opposing forces occur at the same time and almost cancel each other out; as a consequence, there is very little change to the joint tax rates. For policy implication such as the design of optimal taxation, it is useful to compare individuals' labor supply across different taxation. The husband's labor supply under joint tax is higher than that under individual tax, while the labor supply of the wife is lower under joint taxation than under individual taxation. This is

evidence that the tax distortion effect is bigger under joint taxation, since higher tax burden is levied on the secondary income earner under the joint tax system.

Table 1.3 Evaluating the Effects of Transfer Shares on Households with Disparate Earners

	$\rho = 0.21$	$\rho = 0.31$	$\rho = 0.41$
Individual Taxation			
Tax Rate	$t_m = 0.327$; $t_f = 0.320$	$t_m = 0.375$; $t_f = 0.217$	$t_m = 0.438$; $t_f = 0.164$
Labor Supply	$L_m = 0.671$; $L_f = 0.218$	$L_m = 0.671$; $L_f = 0.218$	$L_m = 0.671$; $L_f = 0.218$
Individual Utility	$Z_m = 5.005$; $Z_f = 4.542$	$Z_m = 5.005$; $Z_f = 4.542$	$Z_m = 5.005$; $Z_f = 4.542$
Household Welfare	9.547	9.547	9.547
Joint Taxation			
Tax Rate	$t_m = t_f = 0.326$	$t_m = t_f = 0.325$	$t_m = t_f = 0.325$
Labor Supply	$L_m = 0.674$; $L_f = 0.214$	$L_m = 0.759$; $L_f = 0.109$	$L_m = 0.844$; $L_f = 0.004$
Individual Utility	$Z_m = 5.014$; $Z_f = 4.536$	$Z_m = 5.265$; $Z_f = 4.363$	$Z_m = 5.508$; $Z_f = 4.182$
Household Welfare	9.551	9.629	9.691

When the shares of transfer that each individual receives change, the impacts on their labor supply and tax rates vary by taxation. Because each individual claims a portion of the transfer and the portions of both should be add up to one, if the husband claims more, the wife will receive less and vice versa. For individual taxation, a higher share of transfer increases the tax rate an individual's facing because he or she is disincentive to supply more to market work. Higher tax rates discourage their incentives such that the labor supply decreases. Therefore, the labor supply remains constant while individual tax rates increase under individual taxation. For joint taxation, higher shares for one individual directly increase his or her labor supply but decrease the supply of his or her spouse. Since the labor supply of both spouses jointly affects the tax rates, there will be little change in joint tax rates.

Table 1.3 also shows the impact of shares of transfer on an individual and a household's net income, which also differs by taxation. Under individual taxation, tax rates increase as an individual receives a higher share of transfer; meanwhile, the tax rate of his or her spouse decreases. Thus, if the share to the husband rises, the tax rate of the husband increases; with the constant labor supply, his net income decreases. By contrast, the tax rate of the wife decreases,

and her net income increases, provided that her labor supply remains unchanged. The decline in the husband's net income exceeds the gain of the wife's, so the total net income of the household decreases. Under joint taxation, on the contrary, the tax rates remain constant. The labor supply of the husband increases if he receives more shares, and so does the net income. But the labor supply of the wife decreases if her spouse (the husband) receives more, so her net income decreases, holding tax rates constant. Since the gain in the husband's net income almost equals the loss of the wife's, there is very little change in the family's net income.

The last two columns of Table 1.3 illustrate the impacts of transfer shares on an individual's utility and the welfare of the household. The following analysis is given under the scenario that the husband receives a larger share of transfer. Under individual taxation, utility for both spouses as well as the household's welfare are constant regardless of the shares of transfer. The explanation for this result could be the specification of utility function. Recall that altruistic instead of individual utility function is used in the model. Increasing the shares of transfer leads to an increase in the husband's individual utility but decreases that of the wife's. Since both spouses are assumed to care for each other and behave altruistically, the altruistic utility may be unaffected by the shares of transfer. Under joint taxation, utility for the husband increases while that for the wife decreases. The gain for the husband exceeds the loss for the wife; therefore, the aggregate welfare of the household increases as do the shares received by the husband. For policy implication, household welfare could increase under joint taxation if government compensates the primary earner with higher shares of intra-family transfer. Relative to individual taxation, joint taxation is optimal and improves the household welfare when spouses have inequality income, especially when the government subsidizes the secondary earner with higher transfer.

The numerical evaluation of the influence of altruism on tax rates, labor supply and net income are presented in Table 1.4. Based on the evaluation, both tax rates and labor supply decrease when household members are more altruistic, and this pattern is quite consistent for both individual and joint taxation. However, individuals respond in different ways in terms of their labor supply decisions. As the degree of altruism increases, the labor supply of the wife declines more than that of the husband. This could be the explanation for why the elasticity of the labor supply is higher for women. Moreover, the impact of altruism on the female labor supply varies based on taxation. The optimal labor supply level for the wife falls under joint taxation. The impact of the degree of altruism on individuals' net income also differs based on taxation.

Table 1.4 Estimating the Effect of Altruism on Households with Disparate Earners

	$\delta = 0.19$	$\delta = 0.25$	$\delta = 0.33$
Individual Taxation			
Tax Rate	$t_m = 0.392$; $t_f = 0.376$	$t_m = 0.383$; $t_f = 0.295$	$t_m = 0.369$; $t_f = 0.164$
Labor Supply	$L_m = 0.813$; $L_f = 0.438$	$L_m = 0.735$; $L_f = 0.318$	$L_m = 0.632$; $L_f = 0.158$
Individual Utility	$Z_m = 4.246$; $Z_f = 3.931$	$Z_m = 4.656$; $Z_f = 4.262$	$Z_m = 5.216$; $Z_f = 4.712$
Household Welfare	8.177	8.918	9.929
Joint Taxation			
Tax Rate	$t_m = t_f = 0.387$	$t_m = t_f = 0.356$	$t_m = t_f = 0.305$
Labor Supply	$L_m = 0.823$; $L_f = 0.425$	$L_m = 0.788$; $L_f = 0.195$	$L_m = 0.741$; $L_f = 0.023$
Individual Utility	$Z_m = 4.280$; $Z_f = 3.907$	$Z_m = 4.820$; $Z_f = 4.148$	$Z_m = 5.530$; $Z_f = 4.498$
Household Welfare	8.187	8.968	10.028

Under individual taxation, the individual's net income decreases when the degree of altruism increases and so does the household income. Under joint taxation, on the other hand, a higher degree of altruism increases the husband's net income and lowers the net income of the wife; overall household income increases with altruism δ. One possible explanation for the disparity in individual's net income is the tax rates and labor supply are jointly determined in the model. The tax rates are lower as individuals supply less to the market work. However, joint taxation penalizes the secondary earner by imposing a higher tax rate. Thus, the labor supply for secondary earner is more elastic. On the contrary, joint taxation lowers the effective tax rate for the primary earner; as

a result, his labor supply is more inelastic. The numerical results suggest that distortion effect to labor supply is greater for females, especially when they are more altruistic towards their spouses.

Table 1.4 also shows the numerical evaluation of altruism on individual utility and the welfare of the household. From the welfare perspective, both individuals' utility and family welfare increase as the degree of altruism increases. Although Table 4 does not present the estimated value of tax dollars for both individuals and the household are also calculated. Based on the calculation, the tax dollars are lower when both spouses are more altruistic. The numerical results suggest that the amount of tax dollars may be the major contributor to determine the utility of individuals as well as household welfare. The influence of tax dollars on welfare is more prominent when individuals are more altruistic. Household welfare increases with household members' altruistic preferences. Compared to individual taxation, joint taxation is also optimal and improves the welfare of spouse with unequal earnings. The more altruistic the household members, the more welfare gains from joint taxation.

Comparing with the numerical results of two cases discussed above, the choices of optimal taxation for household members are dependent on their earning abilities, wage structure of household, and the proficiencies with household production and their preferences towards other household members. When designing the income taxation for spouses, the government should take these factors into consideration.

1.5 Extension

1.5.1 Model without Transfer Program

In this section, I present a comparable model without intra-family transfer of any form in order to gain a better understanding of how taxation structure affects the time allocation decisions of

household members. In the model with no transfer or when $\rho_m = \rho_f = 0$. The derivation results and proofs can be found in Appendix A.

Proposition 5. *Under individual taxation, both husband's and wife's labor supply and tax rate decrease as he or she is more altruistic towards the spouse, when no transfer is available. That is,* $\frac{\partial \mathrm{L_i}}{\partial \delta} < 0$ *and* $\frac{\partial \tau_\mathrm{i}}{\partial \delta} < 0$ *for* $\mathrm{i} = \mathrm{m}, \mathrm{f}$.

Proposition 5 implies that, in the absence of intra-family transfer, both spouse supply less to market work as he or she is more altruistic, given they are taxed individually. Therefore, the tax rate for each individual is lower.

Proposition 6. *Under joint taxation, the wife supplies less of her time to market work* $\left(\frac{\partial \mathrm{L_i}}{\partial \delta} < 0\right)$ *when the degree of altruism increases, but the effect on the husband's labor supply is indeterminate with respect to the degree of altruism. The marginal tax rate decreases if spouses are more altruistic to each other* $\left(\frac{\partial \tau}{\partial \delta} < 0\right)$.

Under joint taxation, the influence of altruism on the husband's labor market supply is ambiguous but the wife will decrease their labor supply as she is more altruistic.

1.5.2 Numerical Comparison between Transfer and Non-transfer Model

Table 1.5 presents the numerical results of the baseline model with intra-family transfer and the model without such a program. For both models, joint taxation lowers the tax rate for the husband (primary earner) but raises the tax rate for the wife (secondary earner). These results are consistent with the study of Crossley and Jeon (2006).

For both models, under joint taxation, the husband supplies more of his time to the market work and the wife supplies less of her time than they would under individual taxation. These results can be used to explain the differences between men's labor supply in the United States (joint

taxation) and that in the majority of OECD countries (individual taxation). A recent study by Bick and Fuchs-Schundeln (2014) shows that married men aged 25 and 54 in the United States work the longest, 1970.4 hours per year. Their studies also indicate that married men work between 9 to 17 percent fewer hours in Europe than they do in the US. The joint taxation distorts the labor supply in two ways, by reducing the wife's supply to the market work while increasing the supply of the husband's. However, joint taxation improves the household's welfare. One possible explanation is that the tax dollars paid by each household are lower when couples are taxed jointly. Another possibility lies in the value assigned for altruism, or how much family members care about each other. When family members are more self-centered, they will enjoy higher utility by supplying insufficient time to home production. For a given value set for the degree of altruism in the analysis, household welfare under joint taxation is higher than which under individual taxation for both models with and without transfer.

Table 1.5 Estimation of With (Without) Transfer

	With Transfer	Without Transfer
Individual Taxation		
Tax Rate	$t_m = 0.413$; $t_f = 0.228$	$t_m = 0.146$; $t_f = 0.056$
Labor Supply	$L_m = 0.541$; $L_f = 0.291$	$L_m = 0.541$; $L_f = 0.291$
Individual Utility	$Z_m = 5.286$; $Z_f = 5.136$	$Z_m = 5.221$; $Z_f = 4.788$
Household Welfare	10.423	10.009
Joint Taxation		
Tax Rate	$t_m = t_f = 0.326$	$t_m = t_f = 0.325$
Labor Supply	$L_m = 0.654$; $L_f = 0.166$	$L_m = 0.727$; $L_f = 0.085$
Individual Utility	$Z_m = 5.557$; $Z_f = 4.919$	$Z_m = 5.693$; $Z_f = 4.463$
Household Welfare	10.476	10.156

Even though the welfare gain is smaller in the model with transfer, the estimated welfare in the model with transfer are higher than those in the model with no transfer, under both individual and joint taxation. However, the net welfare gain under joint and individual taxation is not evenly distributed across household members. Compared to the results under individual taxation, the welfare gain to the husband at the expense of the welfare loss of the wife. Since tax rates are

endogenously determined in the model, they are mutually dependent on each individual's parameter factors and wage rates. Under individual taxation, both spouses enjoy higher altruistic utility, but the welfare gain is higher for the husband.

Under both taxation schemes, the tax rates are inversely related to marginal productivity of home production. As mentioned before, the tax rates and labor supply are jointly determined in the model. This interactive relation reflects the characteristics of progressive tax. As individuals become more productive in home production, it will take them less time to prepare a home-cooked meal, to iron the clothes, to mow the lawn, etc. They could supply the "extra" time to market work, which in turn increases their tax rates and aggregate household tax dollars. The degree of altruism has a similar influence on the utility of each individual through tax rates. If household couples are less altruistic towards each other, they will supply less to home production and more to market work. As a result, tax rates as well as tax dollars increase; by contrast, their utilities will decrease. In conclusion, given the results from numerical estimation, the baseline model challenges the conventional Ramsey consideration and suggests that moving from individual to joint taxation could possibly improve household welfare.

The numerical estimation regarding the intra-family transfer program is presented in the third column. To shed light on the influence of an intra-family policy on household labor division, I assume that the values of transfer shares are exogenously taken. For future studies, one could relax this assumption and let the value be chosen by couples according to their bargaining power. One of the prominent features when imposing the transfer program is that the tax rates under both individual and joint taxation increase. Based on the previous calculation, tax rates are also determined by the shares of transfer. If each individual is entitled to a higher share of transfer, it would encourage him or her to supply more to the market work and contribute more to the

aggregate transfer. Therefore, the tax rates will increase. Interestingly, even though the tax rates increase, the labor supply for each spouse remains unchanged under individual taxation. The possible interpretation is that intra-family transfer influences the labor supply decision through two opposite effects. A higher share of transfer increases the spouse's labor supply. However, the tax rate of the recipient increases as a result when he or she supplies more time to the market work. A higher tax rate depresses the spouse's labor supply choice. Intra-family transfer program has two opposite effects on spouse's labor supply that roughly cancel out.

Compared to the numerical results estimated by model with transfer, the husband supplies less while the wife supplies more to the market work. It's helpful to reduce the distortion effect to labor supply if intra-family transfer is enacted under the joint taxation. Furthermore, the numerical estimation in the last column indicates that the household welfare under joint taxation dominates which of individual taxation. Additionally, the results also show that a larger welfare gain is achieved through intra-family transfer, moving from individual to joint taxation.

1.6 Conclusion

Not only does the taxation system but also the redistribution of income across household members affect spouse's time allocation decisions and welfare outcomes. That is because both intra-family altruistic preference between household members and the interaction between their labor supply and marginal tax rates need to be considered in modeling the household decision. Household members endogenously choose their labor supply and marginal tax rates to maximize their welfare preferences. Factors affecting individuals' labor supply would also influence the choice of marginal tax rate. And those choices are also affected by individual's altruistic preference towards other household members. Motivated by this finding, I have explored the welfare

implications of tax-transfer schedule using a non-cooperative approach to household behavior. The following conclusions are obtained. First, the degree of altruism affects household members' labor supply and optimal tax rate. The well-beings of both spouses are greater when they are more altruistic. These conclusions are consistent across different taxation systems, while the wife's labor supply is relatively more sensitive under joint taxation. Many studies have been done on estimating the labor supply elasticity of married couples across countries (Blau and Kahn 2007; Bargain et al. 2014). My model provides a rigorous theoretical foundation for such empirical work.

I also show that each spouse's labor supply decision is independent of the intra-family transfer under individual taxation. A larger share of intra-family transfer increases the recipient's incentive to supply more to the labor market but also increase the recipient's marginal tax rate, which discourages his or her labor supply. The two conflicting forces offset each other. By contrast, under joint taxation, changes in the sharing rules of intra-family transfers significantly affect both spouse's labor supply while leaving the marginal tax rates fairly stable. That is because the tax liability is determined on the basis of total family income under joint taxation, and the marginal tax rate is related to total household labor supply. Changes in the sharing rules of intra-family transfer increase the labor supply of one spouse while the labor supply of the other. As a consequence, the total family labor supply does not change much relative to the individual labor supply. The results also show that if the government targeting increase the female labor supply, especially for low income family, the effective way is to subsidize the wife with larger shares of income transfer. The model developed in this paper provides a theoretical explanation for the exercise of Earned Income Tax Credit.

The paper has a few limitations. First, it does not examine the optimal design of income taxation in the context of a non-cooperative household (Meier and Rainer 2012). This paper can

be thought of as complementary to theirs in that it can explain why particular variables, such as the altruistic preference, influence intra-household allocations. Second, I do not consider dynamic aspects of household decision making, such as investment in children (Ott 1995) or education (Konrad and Lommerud 2000). While a valuable project, it is beyond the scope of this paper. Third, I do not discuss the "threat point". It's well understood that the "threat point" provides a lower limit on the well-being each spouse can achieve in marriage (Rubinstein 1982). However, formally including it as such is beyond the scope of this analysis. A number of avenues for future research exist. A particularly interesting issue is to focus on the dynamics of marriage relationships. When spouses interact repeatedly, it is possible to design relational or self-enforcing contracts so that any short-term incentive to behave non-cooperatively is offset by a long-term benefit from adhering to efficient patterns of behavior (Thomas and Worrall 2010). It would be interesting to study how alternative tax regimes affect the properties of such relational contracts. Future theoretical research in the area of family taxation might also explore other dynamic aspects of household behavior, such as the effects of different tax regimes on human capital investments or on marriage formation and dissolution.

Chapter 2 - Gender Wage Inequality during the Privatization Reform in Urban China

2.1 Introduction

Given the long history of state-owned enterprises (SOEs) and the enormous social responsibilities imposed, reforming SOEs has been an important component of China's transformation into a socialist market economy. This paper examines the effects of SOEs reform on labor market outcomes, focusing on the gender wage differentials.

Due to economic disturbance and political turmoil in late 1980s, China's economic growth fell sharply and GDP growth was only 4.0% in 1988 and 2.8% in 1989 (Chow and Perkins 2014). In order to prevent any economic or political crises, the 14th National Congress of Communist Party of China (CPC) in 1992 proclaimed that the ultimate objective of economic reform was "socialist market economy", and confirmed the necessity of establishing modern corporate system. Therefore, the year of 1992 was a major turning point in the history of Chinese development (Garnaut and Song 2006). As competition emerged in the Chinese economy and prices increasingly became market determined, many state-owned enterprises (SOEs) performance deteriorated quickly and the share of state-owned economy declined. According to the State Assets Management Administration, total losses by SOEs increased from 2.6 billion yuan in 1984 to 18.6 billion in 1992 and to 47.4 billion in 1995. Between 1978 and 1993, the state share of industrial output decreased from 78% to 43% and the share of SOE employment fell from 75% to 60% in the urban area (China Statistical Yearbook 1994). By the end of 1994, China had about 300,000 SOEs with about 75 million state employees. Although these SOEs consumed a great portion of bank credit and other resources, close to half of them were loss makers. In September 1995, the Fifth Plenary Session of the 14th CPC Central Committee required restructuring the ownership

structure of state-owned enterprises. By the end of 1995, there were 100 large and medium industrialized SOEs selected by the State Council, to participate the program of "corporatization experiment". This program has initiated China's SOE reform.

Guided by the principle of "grasp the large, release the small", the central government maintained control over the largest 300 SOEs in strategic industries, and granted local governments the authority to lease or sell smaller SOEs. The purpose of the SOEs reform was to improve production efficiency and decentralization of management decisions. According to Cao, et al. (1999), SOEs reform has proceeded in three areas: privatization of smaller SOEs, massive layoff in the SOEs, and restructuring of large SOEs. By the end of 2001, about 86% of SOEs were restructured and about three quarters of the restructured enterprises were either fully or partially privatized. At the same time, China's non-state owned sector has been steadily growing. Between 1992 and 2001, the proportion of total industrial output by the non-state owned industry in that of the national total increased from 48.5% to 78%, at an average growth rate of 5.5%; the proportion of the non-state owned sector in the urban employment rose from 39.0% to 68.1%, an average annual increase of 6.4%.[6] The emergence of enterprises with different types of ownership structures was a major feature of China's SOE reform.

State policy efforts to establish a market-oriented economy and to implement SOEs reform have had a profound influence on the structures of labor market. First, SOEs reform was intended to promote market efficiency and correct the misallocation of labor between the state and the non-state sectors. Before the reform, soft budget constraints and the government's full employment goals had led to substantial redundant labor in SOEs. In 1995, the Ministry of Labor issued new

[6] See Development of the Non-state Owned Sector. China.org.cn (2003). *[online]* Available at: http://www.china.org.cn/english/2003chinamarket/79519.htm

rules allowing listed SOEs to set their own wages as long as wage growth exceeded profit growth but did not exceed labor productivity growth, and encouraged enterprises to consider skills and productivity in addition to occupation and rank in determining wages. These new rules affected about 40% of SOEs. Tens of millions of workers in the state sector have been laid off (Yueh 2004). In addition to increased unemployment, there was a sharp reduction in the labor force participation rate, especially among older workers. As reported by World Bank (2013), the share of employment by SOEs has declined from 60.5% in 1998 to 19.4percent in 2010. The labor mobility across sectors, especially from the low productivity to the high productivity sectors became a major source of economic growth in China. Second, SOE reform increased the incentives and autonomy of managers of SOEs. Under the model of separating ownership from operation, SOEs were granted a certain level of autonomy in decision making, including some authority and power on decisions about marketing, technical innovation, and most importantly, recruitment and selection, dismissal, promotion, rewards, and even the arrangement of vocational training programs (Warner, Goodall, and Ding 1999). Third, the radical SOE reform widens the income disparities across different provinces and regions, especially the gap between coastal areas and interior areas. Faster economic growth in coastal regions was evidenced by the remarkable growth of private firms and their increasing share in total industrial output in those regions. Enormous literature has investigated the causes and the impact of regional disparities in economic growth in China. Maurer-Fazio and Hughes (2002) confirmed that regional disparity is strongly associated with the implementation of economic reforms in China. One of the consequences of regional disparities was the migration from the less developed interior regions to the more developed coastal regions. There were regional disparities in labor market development during economic reforms.

Privatizing the state-owned enterprises (SOEs) is a major step in transforming centralized economies into market economies. By the end of 2005, over two-thirds of SOEs with 11.4 trillion RMB (1.4 trillion USD) worth of state assets were privatized. Unlike the Russia or Central and Eastern Europe, China adopted multiple approaches to privatize its SOEs. These approaches include both complete privatization with changes in ownership, such as management buy-outs (MBO) and sales to outsiders, and partial privatization without ownership changes, such as share issue privatization, joint ventures with foreign firms, and leasing (Zhang 2006). Consequently, a large number of foreign-invested enterprises, private enterprises, urban collective enterprises, and mixed ownership state-owned enterprises were born.

While the labor market outcomes of privatization of the SOEs reform have been greatly studied, few studies on this topic provide a clear picture. There is also little know about the impact of cross-regional heterogeneity of privatization process on the gender outcomes. This study fills the gap in literature and examines the relationship between progress of privatization and gender wage inequality in urban China. Moreover, we investigate the changes in gender earnings differentials and gender discrimination during the process of economic transition from 1995 to 2007. Instead of analyzing the progress of economic reforms on different geographic locations, we measure regional variation of progress in economic transition by the extent of privatization. The scope of privatization can be evaluated by the performance of non-state owned enterprises by provincial-level indicator: non-state share of employment. Thus we are able to identify the effect of the change in employment shares for non-state sector through decomposition method on urban wage inequality between men and women.

The remainder of this paper is structured as follows. Section 2.2 provides some background on gender inequality of earnings in urban China. Section 2.3 describes the data and the methodology. Results are reported in Section 2.4. Section 2.5 concludes the paper.

2.2 Gender Earnings Inequality in Urban China

Increasing attention has been given to the impact of economic transition on gender wage differentials as the Chinese economic reforms have progressed. Previous studies showed that the gender earnings gap increased since late 1980s in the Chinese urban labor market (Kanbur and Zhang 2005; Meng 2012; Zhang and Junsen 2003). Different arguments exist for explaining the rising gender gap of earnings. According to one perspective, returns to human capital increased and the differences in educational attainments and work skills between female and male workers were reflected more in earnings differentials. Khan et al. (1999) found rapid increases in returns to education in post-reform China. If education attainment and work skills of female workers are significantly lower than those of males, higher earnings will be compensated to males while lower earnings as a penalty would be given to females. Based on the national census data (2000), women received 0.93 fewer years of schooling than men in urban China; and more than half wage gap was attributable to the gender differences in education and other human capital characteristics between 1988 and 1995 (Gustafsson and Li 2000). Alternative perspective claimed that the segregation of women in female-concentrated, low-paying occupations is the most direct source of the gender gap in earnings (Marini and Fan 1997). The pre-reform labor market in urban China was characterized by a segmented labor market between the advantageous state sector and the disadvantageous non-state sector; and men were concentrated in the former and women in the latter (Bian 1994). Under the socialist planned economy, SOEs were the dominating form of

production units. Workers were assigned to jobs by administrative measures and wages were centrally regulated in wage-scales. Economic reform in China has not completely reversed this order. Furthermore, the reform of pay rule for civil servants of 1993 allowed different regions to set up their own extra-pay scheme, which related the pay increase of regional civil servants to their local economic growth. In other words, the reform authorized local governments set wages for civil servants according to public budget. Since then, the gap between civil servants earnings has increased across provinces and varies by different government agencies of the same region. Besides, the pay for civil servants was collective-owned enterprises (COEs) and private firms (Dai et al. 2005). The state-owned sector was privileged over the collectively owned and private sectors, with better rewards for employees (Naughton 1997). Throughout the decade of our study, women are consistently concentrated in the non-state sector of the economy, where the average incomes were 20% to 30% below the overall average. In contrast, the sector with the highest average income was "joint-venture", in which average incomes were 40% to 80% higher than the overall average and in which women held a declining share of positions over the 1990s. Another important reason that why women generally earn less than men in the literature was explained by the fact that interruption of their working career for child births. However, such interruptions have generally been rather short among mothers in urban China. After leaving school almost all women entered the labor force and their number of working hours have been remarkably similar to men (Gustafsson and Li 2000). In addition, majority of population in urban China was subject to strict "one child policy" until recently; thus one would expect only one such career interruption for about half of the mothers. The interruption in career due to childbearing in China is quite different from which in many other countries.

One consequence of SOEs reform was that local authorities and enterprises had greater autonomy in hiring and compensation decisions. The decentralization of wage setting provided more room for discrimination. The urban income inequality has increased significantly since mid-1990s (Khan and Riskin 2005; Xia et al. 2009). The Gini coefficient of earnings in urban China increased by 45.5% from 1988 to 2007 (Shen and Deng 2008). The enactment of the nationwide Labor Law in 1995 notably gave employers increasing discretion and flexibility in their labor market decisions. Given the abundant labor force and the patriarchal social norms, the loosening of the Chinese government's iron grip on the economy may also encouraged a resurgence of workplace gender discrimination (Maurer-Fazio and Hughes 2002; Ng 2007; Knight et al.2009). On the other hand, massive economic reforms intensified market competition and thus may reduce gender discrimination in the labor market (Naughton 1996). These two obviously opposite effects of economic reform on gender wage inequality are echoed by conflicting empirical evidence. Some researcher's documented a declining trend in gender wage disparity in the post-reform Chinese economy. Liu, et al. (2000) showed that gender-based discrimination in the overall gender wage differential declines substantially in firms across different ownerships. Even though, Gustafsson & Li (2000) found no significant effect of economic reform on gender wage discrimination in China from 1988 to 1995. Li & Song (2013) reported larger gender wage disparity in urban China from 1995 to 2007. Recent study carried out by Braunstein and Brenner (2007), which investigated the effect of FDI on male and female wages in urban China. They showed that women experienced larger gains from FDI than men in 1995, but that the gender-based wage advantage reversed by 2002. Based on a firm-level data set, Zhang and Dong (2008) found no evidence of gender wage discrimination for either export oriented or non-export oriented firms. Chen et al. (2013) examined the inter-firm variations in gender inequality. One of their main findings was that there is no

significant sign of gender discrimination for foreign and exporting firms, even though the gender gap is larger in those firms. Meanwhile, sizable income disparity across the different types of ownership further stirs the debate. Maurer-Fazio and Hughes (2002) showed a smaller gender wage gap among collective-owned enterprises (COEs). Zhang and Dong (2008) showed that unskilled female workers in state-owned enterprises (SOEs) received higher wage premiums than those in other types of firms. Cai and Wang, (2008) investigated the inter-and intra-sector gender gaps in urban labor market and found that most of the gender earning differentials coming from within-sector and that only 14% of the within-sector earning differentials can be explained by differences in human capital and other characteristics between men and women. They pointed out women are more likely to be discriminated against in the labor market, partly because of their earlier retirement age.

Given that our data consist of cross-sectional surveys taken in 1995, 2002, and 2007, it is useful to consider the major changes that took place in the sub-periods between the surveys. The surveys were timed to give fairly equal intervals between them and to some extent align with notable changes in the Chinese economy and, to some extent, political leadership. The first sub-period, 1995-2002, can be characterized as a period of retrenchment within the urban state sector, as it coincided with the period of radical urban reforms known as "Xiagang" under the premiership of Zhu Rongji (1998-2003). Falling profitability in the state-owned sector led to a mass retrenchment program, breaking the "iron bowl" (job security) in the state sector and creating space for the emergence of a private sector. By the end of 2003, the number of lay-off workers reached 28.18 million (News Office of State Council 2004). In other words, roughly one fourth of SOE workers were laid off. Not all workers were equally at risk of lay-off. For example, older workers and women were significantly more likely to be laid off than others (Appleton et al. 2002). The

threat of redundancy was one factor influencing wages under a rent-sharing model. At the same time, some urban workers also started to face more competition from rural-urban migrants. Starting in 1992, controls on rural-urban migration were gradually relaxed, with the result that the number of rural urban migrants rose from an estimated 15 million in 1990 to 145 million in 2009 (National Bureau of Statistics of China 2011), accounting for roughly a third of urban employment. Appleton et al. (2004) showed that migrants were less educated and were more likely to compete with low skilled urban workers. The second sub-period, 2002-2007, can be characterized as fast growing privatization. A significant private sector has already started to emerge, as urban workers responded to lay-off of the late 1990s by turning to the non-state sector. As a consequence, the share of employment in state-owned enterprises started to fall, a trend that accelerated after 2000 by the restructuring of firm ownership. Based on the data of the Chinese Household Income Project, about 84.5% of workers were employed in state-owned enterprises (SOE) in 1995. The share of SOE workers fell to 66.1% in 2002 and further to 37.4% in 2007. This period was also characterized by increased openness, coming just after China's accession to the WTO in 2001. Growth accelerated (from 8 to 10%) but the leadership of President Hu Jintao and Premier Wen Jia Bao (2003-13) sought to moderate the pursuit of growth with a concern for equity, under the slogan of "socialist harmonious society". This included a more tolerant attitude to rural-urban migrants, a concern for balanced development across the regions and the enforcement of minimum wages in cities.

2.3 Data and Methodology

2.3.1 Methodology

To address earning differentials between males and females by region, estimating an earning function by gender and region is the first step. The following log earning functions for men ($W_{m,t}$) and women ($W_{f,t}$) are estimated:

$$\ln W_{m,t} = X_{m,t}\beta_{m,t} + \varepsilon_{m,t}; \quad (1)$$

$$\ln W_{f,t} = X_{f,t}\beta_{f,t} + \varepsilon_{f,t}. \quad (2)$$

Where $X_{m,t}$ and $X_{f,t}$ represent various earning determinants including personal characteristics (education, marital status, work experience), job related information (occupation, industry sector, ownership type, and nature of job positions); $\beta_{m,t}$ and $\beta_{f,t}$ are corresponding estimated coefficients; $\varepsilon_{m,t}$ and $\varepsilon_{f,t}$ are random error terms. The subscripts m and f refer to the male and female groups in year t. Earnings functions in Eq. (1) and Eq. (2) are estimated by 1995, 2002 and 2007 Chinese Household Income Project, respectively. And the gender wage gap in a particular year (t) can be analyzed by the well-known procedure developed by Oaxaca (1973), which is specified as:

$$\ln \bar{W}_{m,t} - \ln \bar{W}_{f,t} = \bar{X}_{m,t}\beta_{m,t} - \bar{X}_{f,t}\beta_{f,t}. \quad (3)$$

Where $\ln \bar{W}_{m,t}$ and $\ln \bar{W}_{f,t}$ are the average logarithm of male and female earnings, respectively; $\bar{X}_{m,t}$ and $\bar{X}_{f,t}$ are the vectors of average earnings-determining characteristics of the male and female samples, respectively.

To disentangle the contributions of various factors to the gender gap, we adopt the decomposition method proposed by Neumark (1988). The main advantage of this decomposition method over the traditional Oaxaca-Blinder decomposition is that the former can identify the contribution of earnings inequality to the gender earning gap. The Oaxaca-Blinder (1973)

decomposition approach, also known as bi-fold decomposition, which has been operated based on reduced form regression and breaks down the raw differential between men and women into its components parts. Given that the logarithm of monthly wage income for males and female represented by $\ln \bar{W}_{m,t}$ and $\ln \bar{W}_{f,t}$; the gender difference in logarithm wage income, $\ln \bar{W}_{m,t} - \ln \bar{W}_{f,t}$ can be decomposed into two components:

$$\ln \bar{W}_{m,t} - \ln \bar{W}_{f,t} = \left(\bar{X}_{m,t} - \bar{X}_{f,t}\right)\beta_{m,t} + \bar{X}_{f,t}\left(\beta_{m,t} - \beta_{f,t}\right). \quad (4)$$

The first component of Eq. (4) is gender differences attributable to observable productivity-related characteristics. It is usually interpreted as explained or endowment effects. The second component in Eq. (4) is the earning gap due to differences in the male and female returns to these productivity related characteristics -it is commonly regarded as unexplained or discrimination effects. Because the differences in male and female productive characteristics are valued according to the male returns in Eq. (4), it presumably considers the male earnings structure as the earnings structure prevails in the absence of discrimination. It can also be argued that if the female earning structure prevails in the absence of discrimination, and Eq. (4) can be rewritten as

$$\ln \bar{W}_{m,t} - \ln \bar{W}_{f,t} = \left(\bar{X}_{m,t} - \bar{X}_{f,t}\right)\beta_{f,t} + \bar{X}_{m,t}\left(\beta_{m,t} - \beta_{f,t}\right). \quad (5)$$

Even though functionally equivalent, the overall pattern using the male wage structure as the non-discriminatory wage structure is closer to the results adopting the pooled male and female wage structure (Neumark 1988). However, these two decompositions generally yield different estimates for the earnings differential components, also named as index number problem (Brown, Moon, and Zoloth 1980). The decomposition used in our study follows Oaxaca & Ransom (1994), which assume that nondiscriminatory wage structure can be represented by a weighted regression based on a pooled regression. This decomposition is based on three components

$$\ln \bar{W}_{m,t} - \ln \bar{W}_{f,t} = \left(\bar{X}_{m,t} - \bar{X}_{f,t}\right)\beta_t^* + \left[\bar{X}_{m,t}\left(\beta_{m,t} - \beta_t^*\right) + \bar{X}_{f,t}\left(\beta_t^* - \beta_{f,t}\right)\right]. \quad (6)$$

Where $\beta_t^*$is the vector of estimated coefficients for pooled sample of male and female individuals at year t. The first term on the right-hand side of Eq. (6) is the difference in the male and female average productivity characteristics evaluated as the market in the absence of discrimination; and the other two terms in the bracket contribute to the treatment (unexplained) component. The first term in the bracket $\bar{X}_{m,t}(\beta_{m,t} - \beta_t^*)$ measures treatment advantage on male workers if $\beta_{m,t} > \beta_t^*$; the second term in the bracket $\bar{X}_{f,t}(\beta_t^* - \beta_{f,t})$ measures female's treatment disadvantage if $\beta_t^* > \beta_{f,t}$. These two terms represent the amount of which male are overvalued and of which female are undervalued in terms of labor market returns to productivity factors. The limitation of this method is that it is not able to capture the variation of wage distribution across males and females over time and across regions on the gender income gap. It is more likely that workers with low levels of education, lack of skills, and employed in the non-public ownership sectors face larger extent of discrimination. Even for workers with similar education levels and skills in the same ownership sector, the extent of discrimination across different regions may not be the same. To correct for the possible bias, we further decompose the gender wage differentials for different economic region across time.

To analyze the changes in gender wage differentials across time by region, we adopt the technique proposed by (Wellington 1993). In the spirit of the Oaxaca one period decomposition, the change in the wage gap between time periods t and $t + a$ for a particular region is decomposed by the following equation:

$$\begin{aligned}\left(\ln \bar{W}_{m,t+a} - \ln \bar{W}_{f,t+a}\right) - \left(\ln \bar{W}_{m,t} - \ln \bar{W}_{f,t}\right) \\ = \left[\beta_{m,t+a}\left(\bar{X}_{m,t+a} - \bar{X}_{m,t}\right) - \beta_{f,t+a}\left(\bar{X}_{f,t+a} - \bar{X}_{f,t}\right)\right] \\ + \left[\bar{X}_{m,t}\left(\beta_{m,t+a} - \beta_{m,t}\right) - \bar{X}_{f,t}\left(\beta_{f,t+a} - \beta_{f,t}\right)\right]; \quad (7)\end{aligned}$$

The first term of the decomposition on the right-hand side represents the change in the wage gap due to changes in the means evaluated at their own $t + a$ coefficients. It answers the following question, "what portion of the wage gap can be accounted for by changes in the means, when the returns to the independent variables were constant at their $t + a$ levels". The second term represents the portion of the wage gap can be explained by changes in the returns to the characteristics. Even though alternative methods (Blau and Beller 1988; Smith and Welch 1989) are available to gauge the change in the wage gap over time, Wellington (1993) points out neither specification is clearly better than the other. In addition, given the difficulties in interpreting the interaction terms, we choose to use Wellington (1993) method.

Considering changes in wages over time, one may argue that changes in the wage distribution could be a concern. Juhn et al. (1991) introduced an innovative method of decomposing residual wage differentials among groups of workers. Their decomposition method was based on percentile rankings. The residual differentials between groups were decomposed into changes in the difference in their mean percentile ranks (changes in the level of unmeasured skill) and changes in the dispersion of the residual wage distribution (changes in the returns to unmeasured skill). Unfortunately, this decomposition method proved to be problematic. Suen (1997) provided a detailed discussion of the issue. Statistically, he argued that "the decomposition is unbiased only when percentile ranks are independent of the standard deviation of [residual wages]". In fact, such independence may not hold in general, because, if the wage dispersion ("price of skills") changes, the gap in percentile rank ("skill") may change. Thus, the meaning of decomposing wage residuals would be lost. The method will produce a false impression that the "unmeasured skill differentials" have declined while the "skill price" has risen (and vice versa) if the wage distribution becomes more (less) dispersed. More importantly, the decomposition implicitly assumes that labor market

discrimination is unimportant. Using Urban Household Income Surveys, Gustafsson and Li (2000) showed that the increase in the gender earnings gap in urban China between 1988 and 1995 was driven by increased earnings inequality, instead of a deterioration in the relative position of females in the earnings distribution.

To summarize, the decomposition formula presented in Eq. (6) is applied to the cross-sectional data by region so as to provide an overview of the gender earnings differentials across regions. The decomposition in Eq. (7) is then applied seeking to explain: (i) the importance of changes in productivity-related characteristics, and that of changes in the returns to these characteristics in contributing to the change in gender earnings differentials over time by region; and (ii) the relative position of females and males in the reward system across regions during the reform period. To provide a thorough understanding of the changes in the earning differentials across regions, the period of study is subdivided into two sub-periods 1995-2002, and 2002-2007.

2.3.2 Data

The data used in this study come from the Chinese Household Income Project (CHIP) for 1995, 2002, and 2007 conducted by the National Bureau of Statistics of China (NBS). CHIP data have been widely used in the literature for studying income, wealth and labor market outcomes in China. CHIP consists of both urban and rural surveys. CHIP collects rich information on individual's income, age, marital status, educational attainment, years of schooling, ownership structure of employer, industrial sector, occupational position, etc.

To examine the labor market outcomes of privatization, it is important to measure privatization properly. Since mid-1990s, privatization of SOEs has dramatically changed the ownership structure of enterprises and the structure of industrial sector. A distinct feature of China's privatization is that the government has adopted various privatization methods to suit the

sizes of SOEs. As a result, privatization reform has produced many different ownership forms of enterprises. Definitions of various business registration status by ownership classification are shown in Table 2.1.

Table 2.1 Definition of Enterprises of Registration Status by Ownership

Ownership Classification	Registration Status
State-owned Enterprises(SOEs)	(1) solely state-owned enterprises; (2) state holding enterprises; (3) state holding joint venture
Government Agencies and Institutions(GAIs)	(1) government and party agencies; (2) state and collective institutions
Urban Collective Enterprises(UCEs)	(1) solely collective-owned enterprises; (2) collective holding enterprises; (3) collective holding joint venture
Private/Individual Enterprises(PIEs)	(1) solely private-owned enterprises; (2) private holding enterprises; (3) private holding joint venture; (4) self-employed Individuals
Foreign Invest Enterprises(FIEs)	(1) solely foreign-owned enterprises; (2) foreign holding joint venture

Source: National Bureau of Statistics of China (2001).

Based on the definitions provided by China's National Bureau of Statistics (NBS), enterprises are classified into five different categories, state-owned enterprises (SOEs), government agencies or institutions (GAIs), urban collective enterprises (UCEs), private or individual enterprises (PIEs), and foreign-invested enterprises (FIEs). Each categories include two or more ownership types of enterprises. State sector include SOEs and GAIs, whereas UCEs, PIEs and FIEs are non-state owned enterprises. According to China Statistical Yearbook, SOEs can be either wholly state-funded or partially owned by the government (with two thirds or more assets share owned by the state). Due to restrictive information on FIEs, only solely foreign-invested companies and foreign-owned joint-venture companies are considered in our analysis.

The rapid growth of non-state sector has become the most important factor driving the economic growth of China. The share of industrial output produced by the non-state sector increases from about 32.5% in 1985 to more than 77.6% in 2008 (Fan & Hope, 2013). The state

sector, in contrast, the share of the state sector's contribution and the employment share of state sector have declined. National Bureau of Statistics of China shows that between 1990 and 2010, the share of state-sector employment in urban areas falls from 70.0% to 21.7%. Previous studies evaluate the development of economic reform by ratio of foreign direct investment (FDI) in total investment (Graham and Wada 2001; Lessmann 2013). One of the disadvantages using the share of FDI in total investment as indicator is that it would underestimate the contribution of domestic and other forms of private enterprises to economic development. Cao et al. (1999) show that fast growing of Regional Gross Value Added (RGVA) in coastal regions is highly dependent on the development of domestic owned private enterprises. Private enterprises can also be formed of domestic-foreign joint ventures and domestic-foreign share-holding; both ownership structures proved to be the most productive in urban China (Estrin et al. 2009). Therefore, the progress of economic transition by privatization would be a better measurement than FDI-related ones. Other studies measure the privatization by the number of privatized enterprises or share issue privatization (SIP). The measurement by the number of privatized firms is not accurate because it does not take into account the size of firms. This is especially true in China as privatization have taken different methods for different size of firms. And SIP is used for large SOEs and only accounts for one third of privatization (Gan 2009).

Following the method introduced in Zhou (2016), we use the share of employment of non-SOEs in total employment to measure the effects of privatization on ownership structure at provincial level. The reasons are twofold. First, due to lack of information. There is no firm level data in CHIPs survey, such as the performance of firms, profits/assets ratio, and share owned by the state if privatized. Second, privatization implies resource allocation - reallocating surplus labor from SOEs to private firms, and non-state sector has absorbed increasingly laid-off SOE workers.

Thus, the expanded employment in non-state sector reflects the pace and development of privatization. For each year, we estimate the employment share in non-state sector at city level, and differences in employment share across region is used to identify the extent of privatization. Based on our calculation of privatization, survey areas are classified into three categories, low, moderate and high privatized. More important, the panel structure of the data gives a better picture on the changes in privatization process over time. Table 2.2 summarizes the non-state share of employment in total employment for the three privatization categories in this study. Simple comparisons across three years suggest that the share of non-state employment increases with the progress of privatization reform. Our analysis consists both a trend analysis and a cross-sectional comparison of privatized regions. In the trend analysis, there are increasing share of non-state workers over the period of study. The average share of non-state workers is 34.2%, 52.8% and 73.0% in 1995, 2002 and 2007, respectively. Table 2.2 also shows the share of both low and moderate regions decline as the privatization reform moves forward. In 1995, there are 70.2% of observations in low regions and it covers most of the survey areas. Three provinces (Jiangsu, Guangdong and Liaoning) out of eleven are listed in the moderate region and none in high region. The proportion of low region declines sharply to 21.8% in 2002. From 1995 to 2002, the observations of moderate regions increases from 29.8% to 60.2%, or from 2,840 to 4,873. Since the rising employment share in non-state sector reflects the privatization progress, we are able to construct the measurement across geographic locations and over time.

This study focuses on urban samples because there is a large income gap between urban and rural residents. One of the most prominent structural features of contemporary China is the division between the rural and urban sectors, institutionalized by the household residential registration (Hukou) system. The establishment of Hukou system restricts free labor mobility across rural-

urban sectors and causes large urban/rural income gap. Heterogeneity between the two groups is too large to study the gender gap. Thus we exclude rural residents from our sample. We further restrict the sample to urban residents with urban registration (Hukou) and exclude rural-urban migrant households for two reasons. First, the lack of analytical data for rural-urban migrants in 1995 doesn't serve the purpose of comparison. Second, wage structures for migrants are expected to be very different from urban residents (Gustafsson and Li 2000).

Table 2.2 Summary Statistics of Privatization Indicators

	1995	2002	2007
Low Region	0.302	0.385	.
	(0.053)	(0.033)	.
No. of Obs.	6,699	1,749	.
Moderate Region	0.435	0.539	0.613
	(0.043)	(0.057)	(0.024)
No. of Obs.	2,840	4,784	1,879
High Region	.	0.662	0.781
	.	(0.016)	(0.064)
No. of Obs.	.	1,461	4,347
Total	0.342	0.528	0.730
	(0.079)	(0.100)	(0.095)
No. of Obs.	9,539	7,994	6,226

Note: Privatized Index is measured by private share of employment for each province. Standard errors in parenthesis.

Since the primary objective of the present study is to examine gender earnings differentials among working individuals, we restrict our sample to full-time working adults aged 16 to 60.[7] The minimum age for employment is 16 by law in China; while the mandatory retirement age could be extended with Party committee approval, the retirement age is 60 in general.[8] Self-employed individuals, rehired retirees, and household workers are excluded because only annual earnings (including non-labor income) are reported. In our study, monthly earning is served as the

[7] The number of weekly working hours is used as a proxy to control for full-time employment, and we limit it within the range between 35 and 75 hours.
[8] The announced maximum age is extended to 65 for men and 60 for women, depending on ranks.

dependent variable because we can't construct hourly income.[9] Monthly earning is calculated by the sum of individual salary, bonus, subsidies, and in-kind income related to work, and does not include non-labor peculiar benefits like pension, hardship subsidy, insurance for health and housing. All nominal wage incomes are adjusted into 1995 price level, based on urban consumer price indices published by the NBS. To control for biases arising from extreme values in the log of monthly earnings, we excluded observations that were more than three standard deviations below or above the mean.

We control for age in wage equation. As noted in Oaxaca and Regan (2009), potential work experience is commonly used as proxy for actual work experience in literature to estimate Mincer earning's equation. However, they point out potential whether or not it is reasonable to assume that individuals participating in the labor force right after leaving school. What's more, they show that in the presence of specification errors as opposed to classical errors-in-variables problems, age variable may be preferred over potential experience. For each survey year, four age groups (16-25, 26-35, 36-45, 46 and older) are considered. Education is one of the traditional human capital theory variables, which acts as a proxy for individual competence. In this paper, education attainment is a categorical variable indicating the highest educational degree achieved by an individual, with "high school and dropouts" as the reference group. We also include other socio-economic variables like marital status (equals to one if one is married, zero otherwise), ownership structure of the employers (equals to one if one works for state sector, zero otherwise), nature of jobs (equals to one if the contract is permanent, zero otherwise), occupation and industry sectors Two types of ownership have been defined in this study. State sector includes government agencies, institutes, and state-owned enterprises (SOEs). Non-state sector includes private sector,

[9] There is no information of the monthly working hours available in the CHIP survey.

new-formed sector and others. Private sector includes collective-owned enterprise, private enterprise, or foreign invested enterprise. New-formed sector includes share-holding and joint venture enterprises. From 1978 to 2006, non-state share in GDP increases from 22.4% to 88.9%. The development of the non-state sector provides remarkable support to the economic and employment growth in economic transition (Tusneem 2003). And faster development of non-state enterprise sector is associated with a further liberalized market and a better institutional environment (Cao, Qian, and Weingast 1999). The occupation and industry codes reported in the CHIP survey are used to create occupation and industry variables for each person in the sample. In our study, we sort workers into four occupational categories and five industry sectors. [10] The final sample includes 5,091 men and 4,448 women in 1995; 4,530 men and 3,464 women in 2002; and 3,595 men and 2,631 women in 2007. We find that both men and women experienced a dramatic decline in the labor market participation rate (from 97% in 1995for men and women to 89% for men and 81% for women in 2007). The rate declined much more sharply for women than for men. It is likely that more low-skilled women than low-skilled men exited from employment over time. Table 2.3 reports the logarithm of average monthly wage for both men and women by regions. Comparisons over period of study from 1995, 2002 to 2007 gives us a dynamic perspective on the progress of economic transition as well as its impacts on earnings. Regardless of region, men earn more than women during the period of study.

Consistent with other studies, we notice that gender wage gap increases over the period of study, from 18.2% in 1995 to 20.7% in 2002 and further to 28.9% in 2007. And gender wage differentials increase in all three regions over time. However, there are also regional differences in

[10] In our sample, occupations are coded into professional and highly skilled technicians, director or manager, office staff, and low-skilled labor; industry sectors are manufactory, commercial and retail, education, cultural and art, public service and financial and other consulting service.

earnings, both men and women earn more when they reside in more advanced region. In 1995, for example, the average monthly earnings for men and women in moderate privatized region are 603.0 and 485.9; and the average earnings for men and women in low region are 475.8 and 399.0, respectively.[11] A possible explanation is higher market efficiency in more privatized region. It's noticeable that the gender wage differentials increase as privatization progresses and that larger wage gap is observed in more highly privatized regions. In 2002, for example, the gender gap is 0.172 log points, indicating that women earn 85.2% of what men do in low privatized region. The gender gap for moderate region is 0.246 percentage points, or the earnings for women only are 78.2% of what men are paid. There is a remarkable increase in gender earning gap in high privatized region, and the earnings gap increases from 0.205 log points in 2002 to 0.295 in 2007.

Table 2.3 Summary Statistics of Log Earnings by Privatized Regions

	1995		2002		2007	
	Male	Female	Male	Female	Male	Female
Low Region	6.165	5.989	6.600	6.428	.	.
	(0.557)	(0.606)	(0.533)	(0.559)	.	.
No. of Obs.	3,576	3,123	1,515	1,325	.	.
Moderate Region	6.402	6.186	6.631	6.385	6.747	6.494
	(0.598)	(0.601)	(0.573)	(0.605)	(0.661)	(0.619)
No. of Obs.	983	766	2,764	2,020	783	678
High Region	.	.	7.172	6.967	7.125	6.830
	.	.	(0.563)	(0.578)	(0.685)	(0.649)
No. of Obs.	.	.	1,058	821	2,537	1,810
Total	6.284	6.087	6.801	6.593	6.936	6.662
	(0.577)	(0.603)	(0.556)	(0.581)	(0.673)	(0.634)
No. of Obs.	5,091	4,448	4,530	3,464	3,595	2,631

Note: Standard errors are in the parenthesis.

The average log wage earnings of our sample is breakdown by labor market characteristics in privatized regions.[12] Obviously the economic institutional reform in late 1990s have greater impact on women than men. The magnitude of the shift was much more pronounced for women, especially for women over 45. Younger retirement age than men and higher risk of being laid off both account

[11] Measured by Chinese Currency (RMB).
[12] Full tables are provided in Appendix B.

for the larger decline in woman's employment rate. Appleton et al. (2002) documented that the incident rate of layoff was 12% for men and 22% for women. After losing their jobs, many people left the labor market for good. Monthly wage premiums for education in both men and women were higher in more privatized region. Their findings also support the idea that productive characteristics have been under-rewarded in planned economy. The narrowing education gap suggests that the negative impact of economic transition on less educated women is greater than that on less educated men. Our data indicate that the smallest gender gap occurs in the youngest age group, and that the gap widens as the age increases. Our findings are consistent in all regions and over the period of study. One potential issue that is largely ignored by previous studies on the Chinese gender earning gap is the difference in mandatory retirement age between men and women. It is set at 60 for men and 55 for women in the state sector. Differences in retiring age between men and women further enlarge the gender earnings gap, as senior workers tend to be paid more than junior workers. Our data also show the earnings gap appears to be smaller between men and women with more education, but the gaps for all education groups are getting larger from 1995 to 2007. Women in the low privatized region have more college and professional or vocational (post-secondary) education, which contributes to narrowing the gender earning gap. It is clear that women are less likely to hold managerial positions for all privatized regions. The wage gap between married men and married women are greater than other marital status in all privatized regions and such trend appears consistent over the entire period of study. Gender earning gap in both state sector and private sector increase from 1995 to 2007 in all three privatized regions. However, earnings differentials between men and women are smaller in state sector than private sector. Because men have a higher probability of working in the state sector than women, changes in the relative earnings of workers in the state sector affect the gender earning gap.

2.4 Empirical Results

2.4.1 Regression Analysis on Wage Gaps by Gender

Before proceeding to the analysis, to ensure that the gender wage gap is not affected by differences in labor market participation, we measure the male and female workers' labor force participation rates for each privatized region across over the period of study. Although urban labor force participation remains consistently high, the mean level of labor force participation declines for both men and women. We also observe pattern of men's labor force participation is similar to women's between 1995 and 2007. As discussed above, we conclude that rising gender wage gap in urban China are not attributable to the changes in gender differences in labor force participation.

To determine whether the gender wage gap is due to gender, we first conduct multiple regression analyses in which gender is treated as a dummy variable (one for female) and with a number of control variables, such as marital status, education attainment, the ownership structure of work-unit, etc. We regress both personal and job characteristics against the natural logarithm of wage earnings for each privatized region in 1995, 2002 and 2007, separately.

Table 2.4 summarizes the regression results. Since we are interested in the gender wage gap and its determinants, only the coefficients of female are reported. Column 1 of Table 2.4 reports the total gender wage gap, that is, without controls for any observable characteristics. As expected, gender wage gap increases for regions over time. For moderate region, the gender wage gap of moderate privatized region increases from 21.7% in 1995 to 24.6% in 2002, and further to 25.2% in 2007. And the gap increases more from 20.5% to 29.6% for high region, between 2002 and 2007.

Table 2.4 Regression Analysis on the Gender Wage Gap

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Low Privatized Region						
1995	Female	-0.177***	-0.118***	-0.129***	-0.128***	-0.109***	-0.092***	-0.096***
		(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
2002	Female	-0.174***	-0.140***	-0.143***	-0.124***	-0.120***	-0.115***	-0.128***
		(0.026)	(0.026)	(0.026)	(0.025)	(0.025)	(0.024)	(0.023)
		Moderate Privatized Region						
1995	Female	-0.217***	-0.177***	-0.191***	-0.187***	-0.176***	-0.152***	-0.162
		(0.024)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
2002	Female	-0.246***	-0.207***	-0.213***	-0.185***	-0.181***	-0.168***	-0.172***
		(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
2007	Female	-0.252***	-0.270***	-0.279***	-0.257***	-0.256***	-0.244***	-0.229***
		(0.030)	(0.030)	(0.030)	(0.029)	(0.029)	(0.028)	(0.028)
		High Privatized Region						
2002	Female	-0.205***	-0.207***	-0.213***	-0.185***	-0.181***	-0.168***	-0.172***
		(0.030)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
2007	Female	-0.296***	-0.326***	-0.342***	-0.323***	-0.321***	-0.298***	-0.290***
		(0.020)	(0.021)	(0.021)	(0.021)	(0.021)	(0.020)	(0.020)
Controls								
Age		-	yes	yes	yes	yes	yes	yes
Marital Status		-	-	yes	yes	yes	yes	yes
Nature of Jobs		-	-	-	yes	yes	yes	yes
Ownership		-	-	-	-	yes	yes	yes
Education		-	-	-	-	-	yes	yes
Industry& Occupation		-	-	-	-	-	-	yes

Note: Robust standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.10.

Moreover, we find that privatization progress in urban China widens the gender wage gaps. And the more privatization the region is, the large gap is. Our results are not surprising, since the booming non-state sector absorbs a large amount of low skilled workers laid off from the reform, thus the employment share of low skilled workers increases a lot in more privatized region. Previous study shows that the gender wage gap is even larger for low-skilled workers in urban China (Zhang, et al., 2008). As discussed before, difference in observed wages between males and females can be explained by gender differences in wage-related characteristics. To investigate the impact of each factor on the gender wage differentials, sequential regressions are performed by adding one of the control variables (age-group, marital status, the nature of jobs, education, employer's ownership, etc.) at a time, the coefficients are presented from column (2) to column

(8). As shown of column (2) in the upper panel, the inclusion of age variable reduces the raw gender gap without controlling for any characteristics by approximately 50% in 1995 (from 17.7% to 11.8%) and by 24.3% in 2002 (from 17.4% to 14.0%) for low privatized region. Empirically, age is commonly regarded as indicative of work experience. The significant decline in wage gaps imply that gender differences in work experience explains a significant portion of the wage gap in low privatized region. The results suggest that age also plays an important role explaining the wage gap for moderate privatized region. However, it is worth mentioning that the gender wage gap widens at the panel of high privatized region. We observe that, by including age variable, the gender wage gap increases slightly by 0.2 percentage point to 20.7% in 2002, and by 3 percentage point to 32.6% in 2007. One potential explanation is the fact that there are substantial numbers of workers are employed by state-owned enterprises in low and moderate privatized region, especially at the earlier stage of privatization reform. Wages of state employees are institutionally determined according to a national systems of ranking, scales and seniority, with education and skill receiving little reward (Knight & Song, 1993). And the age-wage profile of female workers in state-owned enterprises is similar to that of male workers, implying a convergence in the returns to experience and smaller gender wage gap for senior workers. By contrast, the wages of workers in private sectors are determined by productivity. As women reduced their commitment to the labor force, it is possible that discrimination against them increased, or changes in unobservable skills such as gender-specific human capital investment widened the gender earnings gap. As a result, we expect that wage inequalities will be much larger in high privatized region, where most workers are employed in non-state enterprises.

The coefficients of inclusion marital status in column (3) suggest that men receive a marriage premium while women do not, and marital status contributes to a wider gender wage gap. The

gender wage gaps of workers with permanent positions and workers employed at state sector are smaller, however the contribution to the wage gap declines over time. Column (6) indicates that the gender wage gap falls for all regions when we control for education. We observe the most significant drop from 32.1% to 29.8% suggests that gender difference in college premium explains a significant portion of the gender wage gap for high privatized region in 2007. Our results also show that gender wage gap shrinks with educational attainment. That is because female workers are, on average, less educated than male workers, and the returns to higher education is higher for female workers (Li and Song 2013). The regression results with controlling for industry and job occupation are shown in the last columns. It is interesting to see that inclusion of industry and occupation variables have very small effects on the gender wage gap. A possible reason for the neglect change in coefficients of column (7) that both industry sectors and occupations are not narrowly defined in our dataset. And it is common to find that the gender pay gaps are quite small within narrowly defined industries and occupations (Gunderson 1989). Our findings highlight the fact that decentralization of wage setting generally allows more room for discriminatory practices. Thus the differentials widen with further privatized reforms. One potential explanation for the steady deterioration of female workers at the bottom of the earnings distribution is that lower-paid women are more likely to work in sectors with relatively slow earnings growth. Another potential explanation is the increase in the price of unobserved skill. As long as women's level of unobserved skills is lower than that of men, a rising price will widen the gender earning gap at both the bottom and the top of the earnings distribution.

2.4.2 Results of Male and Female Wage Functions

To examine which personal and employment characteristics are important determinants of the gender wage gap, we carry out estimations of the wage equations for male and female workers

separately. The regression results by privatized region and at different point of time are shown in Table 2.5. There are many results worth commenting on, the coefficients of age dummies measure the average differences between two age groups. Male and female workers aged between 46 and 60 are the reference group. In this specification, positive (negative) coefficient indicates higher (lower) wage earning, compared to the oldest age group. According to the estimated results, age clearly influences wage for both men and women over the period of study, especially in the year of 1995. The age coefficients also represent the age-earning profile. The results suggest that the profiles are somewhat steeper for women, especially for whom in low privatized region of 1995. Age is used as proxy for work experience for our analysis. By this measure, wages grow at a faster rate for women than for men in that group, as more experiences accumulate. In other words, the widest wage gap between the oldest and the youngest are in the region with the lowest level of privatization. Our findings supports that seniority is the most important factor determining wages under the central planned system. The coefficients of age at two different time points suggest that the profiles change over time for both men and women. In 1995, women have steeper age-earnings profiles than men at low and moderate privatized regions. However, the age-earnings profiles are flatter for female workers than which for male workers in 2007, at each privatized region. The changes in the shape of earnings profile reflect the impact of privatized reform on wage structure in the urban labor market of China. From 1998 to 2003, a total of 28.18 million persons had been laid off from the SOEs, of which 13.36 million were women (State Council of the People's Republic of China 2004). Because the decline in women's employment prospect shortens women's working life, it discourages women's human capital investment. If differences in human capital investments play an important role in determining the size of the gender earnings gap, the theory

would predict female workers have a flatter age-earnings profiles than male workers. Our regression results support the prediction of theory.

Married women's intermittent labor force participation is the most common explanation for wider gender wage gaps experienced by married women compared to their single counterparts in most developed countries. Because the labor force participation and attachment of Chinese women does not vary significantly with marital status (Liu 2011), the theory predicts that high labor force participation and attachment of both single and married Chinese women should have yield the same gender wage gap. Our results show that the average monthly income for married men is higher than unmarried men. For instance, the marriage premium for men is 25.7% in low and 27.5% in moderate privatized region of 1995. However, the differences in earnings between married and single women are not statistically significant for any privatized regions. We suggest that the gender wage gap is larger for married women in urban China, despite the fact that female workers exhibit strong and continuous labor force attachment. Another noticeable of the regression results is the coefficients on education attainment. As expected, the higher the education level, the more a worker earned. The coefficients also suggest that return to education increases from 1995 to 2007 for both men and women. Table 2.5 shows that in 1995, compared to high school and dropouts, the college graduates earn 17.2% more for men and 26.4% more for women in low private region. By 2002, the earning gaps between college and high school graduates in low privatized region increase to 22.1% for men and 31.8% for women. Our results supports the importance of education in wage earnings, especially in post-reform China (Khan, et al., 1999). The estimated coefficients of College variable suggest that women's return to education is higher than men's in all regions. Our findings are in line with the results of earlier studies indicating that the returns to additional years of schooling were higher for women in China (Maurer-Fazio 1999;

Li 2003). We thus believe that education influences earnings of females than of males in China's urban labor market. Regression results reported in Table also show returns to education is positively associated with implementation of economic reforms. In 2007, the college premium for men slightly increases from 44.7% in moderate to 47.7% in high privatized region. And the wage premium for college degree has increased greatly for women, as the progress of privatization. In 2007, from moderate to high privatized region, the college premium increases from 44.9% to 58.8% for female workers. Given the disparities in returns to education across different regions are more prominent over time and over the stage of privatization progress, we expect that substantial heterogeneity in wage distribution across regions in urban China.

Even though there were a remarkable transformation in China's economy, it was still dominated by state sector and workers in state sector earned a considerable premium than whom in non-state sector (Xia et al. 2014). In 1995, the wage premium of state sector is 32.9% and 28.4% for men and women, respectively. The coefficients of state-owned sector suggest the size of the premium decreases over time and not statistically significant in 2007. We believe that the changes in state sector wage premium is due to the changes in the employment share of state sector. Table 2.5 shows that state sector share of employment share declines from 84.4% and 77.7% for male and female workers in 1995, to 71.3% and 64.1% in 2002, and further falls to 41.4% and 35.8% in 2007. Given the effects of state sector on wage differentials in urban China, we believe that the contribution of ownership to gender wage gap is substantial at the early stage of privatization reform. The coefficients of occupation and industry Variables suggest that the gender wage gaps within the same occupation and industry vary by time. It is interesting that women receive higher wage earnings than men if they take the position with advanced skills, like professional and technician, or the position of direction or manager.

Table 2.5 Estimates of Wage Earnings for Men and Women in Three Privatized Regions

	Low				Moderate						High			
	1995		2002		1995		2002		2007		2002		2007	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Intercept	5.734***	5.609***	6.113***	5.987***	6.131***	5.987***	6.311***	6.109***	6.291***	6.032***	6.672***	6.658***	6.602***	6.292***
	(0.052)	(0.056)	(0.085)	(0.081)	(0.088)	(0.089)	(0.051)	(0.062)	(0.080)	(0.088)	(0.092)	(0.092)	(0.054)	(0.060)
Age Group														
16-25	-0.455***	-0.497***	-0.216*	-0.348	-0.302***	-0.333***	-0.329***	-0.319***	-0.171	0.03	-0.083	-0.182	-0.139*	-0.023
	(0.048)	(0.049)	(0.094)	(0.095)	(0.088)	(0.083)	(0.063)	(0.068)	(0.110)	(0.099)	(0.108)	(0.103)	(0.066)	(0.065)
26-35	-0.312***	-0.191***	-0.115**	-0.115*	-0.185***	0.117*	-0.153	-0.162***	0.149**	0.152**	0.035	-0.124*	0.083*	0.133**
	(0.024)	(0.029)	(0.044)	(0.052)	(0.044)	(0.052)	(0.029)	(0.035)	(0.055)	(0.058)	(0.067)	(0.061)	(0.037)	(0.043)
36-45	-0.105***	-0.032	-0.039	-0.017	-0.063	0.236***	-0.053	-0.080*	-0.026	0.072	0.023	-0.144**	0.120***	0.088*
	(0.021)	0.027	(0.035)	(0.046)	(0.036)	(0.047)	(0.023)	(0.031)	(0.044)	(0.053)	(0.042)	(0.048)	(0.031)	(0.039)
Ownership Sector														
State-Owned	0.284***	0.250***	0.082*	-0.007	0.026	0.039	0.136***	0.108***	-0.103*	0.010	-0.020	0.064	0.012	0.034
	(0.029)	(0.028)	(0.040)	(0.043)	(0.042)	(0.039)	(0.024)	(0.028)	(0.045)	(0.046)	(0.043)	(0.046)	(0.031)	(0.034)
Education														
College and above	0.172***	0.264***	0.243***	0.276***	0.200**	0.160	0.360***	0.451***	0.447***	0.449***	0.324***	0.436***	0.477***	0.588***
	(0.032)	(0.048)	(0.056)	(0.073)	(0.061)	(0.092)	(0.037)	(0.054)	(0.058)	(0.068)	(0.067)	(0.088)	(0.040)	(0.046)
Professional School	0.076***	0.138***	0.078*	0.187***	0.089*	0.230***	0.154***	0.204***	0.181***	0.246***	0.128**	0.176***	0.230***	0.329***
	(0.021)	(0.025)	(0.039)	(0.044)	(0.037)	(0.046)	(0.025)	(0.030)	(0.045)	(0.048)	(0.046)	(0.048)	(0.031)	(0.035)
Occupation														
Professional or Technician	0.096***	0.223***	0.167***	0.236***	0.055	0.162**	0.115***	0.201***	0.205***	0.201***	0.342***	0.312***	0.205***	0.273***
	(0.027)	(0.030)	(0.051)	(0.053)	(0.047)	(0.054)	(0.031)	(0.038)	(0.051)	(0.061)	(0.058)	(0.061)	(0.035)	(0.041)
Director of Government	0.127***	0.283***	0.216***	0.236**	0.237***	0.391***	0.162***	0.252***	0.326***	0.237*	0.432***	0.519***	0.420***	0.250**
	(0.028)	(0.044)	(0.051)	(0.081)	(0.050)	(0.083)	(0.035)	(0.062)	(0.073)	(0.105)	(0.061)	(0.094)	(0.051)	(0.076)
Office Stuff	0.007	0.126***	0.066	0.042	0.131**	0.120**	0.042	0.141***	0.155**	0.167**	0.260***	0.243***	0.118***	0.166***
	(0.025)	(0.027)	(0.049)	(0.054)	(0.044)	(0.045)	(0.030)	(0.033)	(0.054)	(0.055)	(0.053)	(0.053)	(0.034)	(0.036)

Together with the fact that the return in higher education (especially with college and above) is higher, we believe that women in urban China are more incentive to invest in human capital.

2.4.3 The Decomposition Analysis of Gender Earnings Differentials

Following the Oaxaca & Ransom (1994) approach, we decompose the gender wage gap (R) into two components; the first is due to gender differences in the characteristic endowments (E), and the second is due to differences in the coefficients (C) of the wage function which can be attributed to the labor-market discrimination and to other omitted variables. The first component is commonly regarded as explained component, and the second is regarded as unexplained or discrimination component. Table 2.6 reports the decomposition results and the relative contribution of endowments and unexplained components (or discrimination) by privatized region for 1995, 2002, and 2007.

Table 2.6 Contribution of Different Components to Gender Wage Gaps

	1995		2002			2007	
	Low	Moderate	Low	Moderate	High	Moderate	High
Raw differential (R):	0.179*** (0.014)	0.217*** (0.024)	0.174*** (0.026)	0.246*** (0.017)	0.205*** (0.030)	0.252*** (0.030)	0.296*** (0.020)
-Due to Endowments (E)	0.089*** (0.008)	0.070*** (0.012)	0.066*** (0.012)	0.093*** (0.010)	0.035** (0.016)	0.049*** (0.016)	0.041*** (0.016)
-Due to Coefficients (C)	0.090*** (0.012)	0.147*** (0.012)	0.108*** (0.012)	0.153*** (0.014)	0.170*** (0.026)	0.203*** (0.025)	0.255*** (0.018)
E as % Total	49.7%	32.3%	37.9%	37.8%	17.1%	19.4%	13.9%
C as % Total	50.3%	67.7%	62.1%	62.2%	82.9%	80.6%	86.1%

Note: The numbers in the first three rows indicate what percent the wages of male workers are higher than those of female workers. *** p<0.01, ** p<0.05, * p<0.10. Source: CHIP urban household data, 1995, 2002, and 2007.

The first row of Table 2.6 indicates that the raw gender wage gaps increases for all regions, and this increase has been especially sharp for high privatized region between 1995 and 2007. As shown in the bottom panel, the gender differences in characteristic endowments explain 49.7% in

1995 and 37.9% in 2002 for the low privatized region. Meanwhile, the share of the wage gap due to differences in the coefficients (or discrimination) increases from 50.3% to 62.1%. Our results suggest that while the gender wage gap increases over the study period, the contribution of endowment differences to the gender wage gap declines. By the end of 2007, only 19.7% and 13.9% of the wage differentials are attributable to endowment differences in moderate and high privatized region, respectively. Since the results of the endowment component mirrored those of the discrimination component, as indicated by the results shown in the lower panel, discrimination is relatively more serious in 2007. Our results highlights the fact that discrimination against women in urban China gets worse over time.

Table 2.6 also illustrates the impact of the privatization process on gender pay gap. Indeed, the relative importance of endowments in explaining wage gap is reversely related to privatized progress, and discrimination against women is higher in more privatized region. Of the overall gender wage gap, the differences in characteristic endowments between males and females account for 49.7% for low and 37.9% for moderate region in 1995. In the meantime, the fraction of wage gap due to discrimination is greater in more privatized region. In 2002, more than 82.0% of the wage gap cannot be explained by endowment differences for high privatized region, compared to 62.2% for moderate and 62.1% for low region. Our results suggest that discrimination against women is more likely in the regions with more non-state enterprises. The privatization reform on state-owned enterprises has speed up the process of transition to market-oriented economy and encourages the growth of non-state sector, which consists of collective enterprises, private or individual enterprises, and foreign-invested enterprises. However, the impact of privatization reform on gender wage gap and gender wage discrimination remains unclear. On one hand, the decentralization of wage setting provides room for discrimination. On the other hand, privatization

reform on state-owned sector promotes economic competition and performance efficiency. Therefore, in contrast to decentralization, competition associated with the reform can be considered a force tending to minimize discrimination. The magnitude of "decentralization" and "competition" effects would vary by region with different scale of economic reform. Our results suggest that, for low privatized region, "competition" effect dominates the "decentralization" effect region at the early stage of reform such that the least discrimination against women is estimated. With further economic development in regions with larger scale of privatization, the effect of "decentralization" override that of "competition" has worsened gender discrimination.

Decomposing gender earnings differentials into endowment differences and discrimination phenomena allows exploring the determinants of the gender wage gap for different privatized region at different point of time. Further decomposition of the gender wage differentials into various sub-components suggests that working experience, education, and occupation are the main contributors to the explained component for all three regions between 1995 and 2007. More importantly, no less than 40% of the explained earnings differential is attributable to the differences in working experience between the gender groups. Education is found to be more important in influencing the earnings of females than of males in all regions, and the fraction of gender differences in education is smaller for more privatized region. A declining trend of enterprise ownership factor in the explained component highlights the role of institutional reform in shaping the market structure in urban China.

Unlike previous findings arguing that occupational segregation in China is not an issue (Liu et al. 2000; Liu 2011), we find that occupation plays an important role to explain the wage gap in China's urban labor market. The decomposition results suggest that about one-fifth of the explained component of the gender earnings differential could be attributed to gender differences

in occupational distribution. Such strong effect of occupation in explaining the gender earnings differentials implies the labor market has been transforming towards a more competitive environment. Economic reform and economic development have facilitated the mobility of labor across occupations and types of enterprises. This is particularly the case of the high privatized region which includes more developed areas and most rapid growth of non-state owned enterprises. However, further examination of this issue in relation to gender discrimination is called for.

2.4.4 Changes in Determinants to the Gender Wage Gap

There are debates in the literature about the economic status of women during the process of economic transition. Some studies argued that women are disadvantaged (Blau and Kahn 1994), while others stated that women could also proportionately share more or less benefits than that of men from the reform (Blau 1996).

To see how these arguments are applicable to the privatized reform, it is more informative to examine the changes of gender wage differentials by region. Table 2.7 presents the overall results, as well as the computed decomposition components by region for the period of 1995-2002, and 2002-2007. Following Wellington (1993) approach outlined in Equation (7) , the overall changes in gender wage gap are decomposed into the changes attributable to gender differences in characteristics endowments (component (a)-(b)), and the changes attributable to gender differences in the coefficients (component (c)-(d)). A positive sign in overall changes implies an increase in the wage gap over time. The bigger absolute value for component (c)-(d) indicates the relative importance of changes in wage structure in contributing to the overall changes. It suggests that the effect of "competition" dominates that of "decentralization" as the development and growth of non-state sector. The effects from both labor market competitiveness and wage decentralization

are more prominent in the moderate region. Between 1995 and 2002, almost all changes in wage differentials (0.030 percentage points) are due to changes in endowment differences between men and women (0.029 percentage points for (a)-(b)). This confirms the idea that the relative importance of competition at the early stage of reform. The increasing gender wage gap between 2002 and 2007 implies the effect of wage decentralization starts to take over and promote discriminatory practices. Contrary to the findings for the period between 1995 and 2002, changes in wage structure accounts for all the differences in wage gap.

Table 2.7 Over Time Changes in Gender Earnings Differentials by Regions, 1995-2007

	1995-2002	2002-2007
High Privatized Region		
Overall Changes		0.090
(a) Over time differences in male characteristics		0.014
(b) Over time differences in female characteristics		0.006
(a)-(b)		0.008
(c) Over time differences in the return to male characteristics		-0.051
(d) Over time differences in the return to female characteristics		-0.132
(c)-(d)		0.082
Moderate Privatized Region		
Overall Changes	0.030	0.006
(a) Over time differences in male characteristics	0.047	-0.003
(b) Over time differences in female characteristics	0.018	0.012
(a)-(b)	0.029	-0.015
(c) Over time differences in the return to male characteristics	0.203	0.120
(d) Over time differences in the return to female characteristics	0.202	0.099
(c)-(d)	0.001	0.021
Low Privatized Region		
Overall Changes	-0.005	
(a) Over time differences in male characteristics	0.050	
(b) Over time differences in female characteristics	0.055	
(a)-(b)	-0.005	
(c) Over time differences in the return to male characteristics	0.577	
(d) Over time differences in the return to female characteristics	0.576	
(c)-(d)	0.001	

Note: (a)-(b) denotes the changes in the differences attributable to characteristic endowments; (c)-(d) denotes the changes attributable to differences in the coefficients of the explanatory variables.

For high privatized region, as shown on the top panel, the gender wage gap increases between 2002 and 2007. The decomposition results indicate that although increasingly competitive labor market enhanced the productivity-related characteristics (positive values of (a) and (b)), the accumulation is slightly higher for male workers (positive (a)-(b)). It is quite interesting to see that the returns to productivity-related characteristics declines for both men and women (both (c) and (d) are negative). The possible explanation would be experience becomes less important in wage determination, and the return to experience is over-rewarded prior to the reform in which payments for seniority have been a central feature of the pre-reform wage structure. Our results supports the idea that the transformation from planned to competitive market would led to productive characteristics being more effectively rewarded. The reform on state-owned enterprises also changes the structure of industrial sector and different ownership enterprises in urban China. And changes in wage structure has generated considerable unemployment and reshaped the composition of occupations for urban labor (Appleton et al. 2005). The results indicate that almost 90.0% of the overall changes in wage gap is attributable to the changes in wage structure.

For low privatized region, both characteristics endowment and the returns increase for both men and women (positive for component (a), (b), (c), and (d) at the bottom panel) between 1995 and 2002. Greater access to education allows for greater investment in human capital, especially for females. The reducing gender gap in educational attainments contributes to narrowing the gender wage (negative (a)-(b)). Therefore, the increasing gender wage differentials is the result of the dominance of the wage decentralization effect which promotes discrimination practices. This is particularly the case at the early stage of reform (the negative value of component (a) - (b) is outweighed by the positive value of component (c) - (d)). Compared to the moderate privatized

region, the relatively slower pace of development suppress the effect of wage decentralization, leading to smaller gender earnings differentials.

In summary, there is a substantial improvement in productive characteristics for both male and female workers over time. The emergence of different ownership enterprises changes the wage structure in urban China, and the market appears to be evolving towards a competitive market similar to those found in OECD countries. With more competitive market environment, characteristics endowments are more appropriated rewarded at the earlier stage of reform. Further decomposition on the rise in the overall gender wage gap between 2002 and 2007 indicates that wage discrimination against women may have increased during that period. Appleton et al. (2002) show that women suffered more during retrenchment because they faced not only a higher risk of retrenchment but, if retrenched, they had a lower probability of re-employment than men.

2.5 Conclusion

Economic reforms and economic growth have dramatically raised the standard of living in urban China. On one hand, the decentralization of wage setting results in rising income inequality between women and men during economic transition. On the other hand, economic transformation stimulates market competition, which should reduce discrimination by penalizing the discriminatory wage setting behavior. The issue of gender wage differentials in China is thus complicated by this two conflicting forces during economic transition. Another feature of China's emerging market economy is the large variation in local labor markets. Rates of foreign investment, employment, economic growth, and standard of living all vary dramatically. This study focuses on the evolution of the gender wage inequality by the progress of privatization in urban China.

Based on a representative sample of national data in 1995, 2002 and 2007, we come to the following conclusions: (1) the gender wage gap has increased over time; (2) women are consistently segregated to engage in low-pay sectors, occupations, and industries; (3) the gender gap is smallest in the low privatized region. We observe positive relationship between gender discrimination in wages and the progress of economic transition over the period of study. The greater gender discrimination is associated with higher privatization level in transition process. Women have strong incentives to improve productivity characteristics which are increasingly rewarded in a competitive market and thus would reduce the gap. The rising gender inequality may reflect the fact that wage decentralization leads to more discrimination. This is consistent with our finding that least privatized region has lowest level of gender discrimination.

Following Wellington (1993), we further decompose the changes in the earnings gap over the period of t and $t + a$ in the three privatized regions. The decomposition of gender wage differentials reveals that in the early stage of reform (1995-2002), the "competition" effect dominates the "decentralization" effect. Most of the changes can be explained by the changes in the mean characteristics between men and women. With further progress in privatization development, decentralization in wage setting dominates the "competition" effect, resulting in a rising gap, especially in the highly privatized region. The growth of the discriminatory (unexplained) component by region closely follow the pace of regional reform and is consistent with the imbalance in regional growth during the second sub-period of study (2002-2007). The analysis of the decomposition of the trends in gender wage gap over time provides further support of a regional pattern of differentials that match the pattern of regional reforms. Widen gender wage gap is observed in more privatized region. With the growing importance of the discriminatory component in the cross-sectional results and the faster pace of privatization reform, one would expect the

differentials in urban China to grow continuously as China becomes more and more similar to OECD countries. The variations in discriminatory practices among the regions could have interesting implications for doing business in different locations. The greater gender differentials in more privatized region tend to raise the costs of production. Unless very high profit margins are available, competitive forces (Becker 1971), should act to push discriminatory employers out of business. Given that the information is extracted from national data sets, the generalization of the results from the restricted sample may not be an issue. However, with limited information on working hours, and no proxy for unobservable abilities and unmeasured skills, the present study is only able to provide an analysis of the lower bound on gender earnings differentials. With continuing growth in the all regions, patterns in the gender earnings gap in more recent years may deviate from those found in this study. This warrants further studies on these issues in the future.

Chapter 3 - Motherhood, Wages, and Wage Growth

3.1 Introduction

The presence of children, especially young ones, affects household behavior. One dimension of behavior that is most likely affected is female labor supply. As reported in BLS (2013) the labor force participation rate of women with children under 18 years old is 71.3%. It decreases to 64.0% for women with children under 6 years old, and 61.1% for women with children under 3 years old. Since most women have their first child in their twenties or early thirties, the lower labor force participation of mothers with young children is indicative that they leave employment during the prime period for career development when returns to work experience and labor market attachment are high. Not surprisingly there is evidence that female wages are affected by motherhood. Loughran and Zissimopoulos (2009) find that a first birth lowers female wages by 2 to 3 percent.

It is this relationship between motherhood, the accumulation of work experience, and wages that is the focus of this paper. Our main contribution is to study questions raised across a number of papers in the literature within one consistent wage regression framework. This wage regression framework is supported by our careful tracking of career and family developments. This is made possible by the detailed work experience and fertility information available in the 1979 cohort of the National Longitudinal Survey of Youth (NLSY79). It allows us to follow a cohort of women from their early twenties, when careers are launched and families are first formed, up until their mid to late forties, when careers are mostly established and new additions to families are unlikely.

The simple age profiles of average wages show that the family gap appears in the mid-twenties, and is mostly apparent when comparing early mothers (first birth before age 25) to non-mothers (women who have no children). In fact the age-wage profile of late mothers (first birth at age 25 or after) is very similar to that of non-mothers.

There are two components to explaining these age-wage profiles. First, early mothers accumulate work experience at a much slower rate than non-mothers whereas late mothers slow their accumulation of work experience during their late twenties. Second, early mothers experience weaker returns to work experience relative to non-mothers. That is, even if they accumulated work experience at the same rate, they would nonetheless have lower wages. As for late mothers, returns to work experience accumulated before their transition to motherhood are stronger than the returns experienced by non-mothers. We find however that work experience accumulated after the transition to motherhood for late mothers brings smaller rewards.

We then investigate two possible explanations to these returns to experience differentials. First, in a world where jobs have different occupational skill requirements, it is possible that mothers and non-mothers climb each skill ladder at different pace. We do find evidence that mothers tend to climb interpersonal skill ladder at a faster rate, and that early mothers climb the cognitive skill ladder at a slower rate. Accounting for this does not however change our finding of differential returns to work experience.

Second if time spent out of employment is associated with the costly loss of employer- or occupational specific human capital, then mothers who tend to spend more time out of employment should be observed as experiencing weaker returns to work experience in a model that does not account for time spent out of employment. We however find that the differentials in returns to work experience are robust to controlling for time spent out of employment.

We do not claim that our findings are causal estimates. They merely provide informative correlations between wages, work experience, and motherhood that are open to multiple interpretations. We do provide some interpretation but feel that further research is required to

ascertain these. We also hope that these correlations will inform the literature that jointly models labor supply, wage formation, and fertility for women.

Another caveat is the inability to track marital status and school attendance with the NLSY79 in the same manner that we track births and career progress. These are issues that are likely strongly related to wages, work experience accumulation, and fertility that would ideally be investigated as carefully.

The next section reviews the literature to provide some context. The third section discusses the data and the construction of our main variables of interest. The fourth section is a presentation of our results. We conclude in the last section.

3.2 Related Literature

There is ample evidence that mothers earn less than women with no child. This motherhood wage penalty or "family gap" has been observed for both young women and older women, see for example Waldfogel (1997), Waldfogel (1998), and Loughran and Zissimopoulos (2009). This family gap is also found in the U.K. (Waldfogel and Harkness 2003) and Canada (Drolet 2002). There is however mixed evidence of a motherhood wage penalty in Australia, Germany and Scandinavian countries (Todd 2001; Gupta and Smith 2002; Waldfogel and Harkness 2003; Nielsen et al. 2004; Simonsen and Skipper 2006).

The family gap literature has taken up the research concerned with documenting and interpreting estimated coefficients on children variables in hourly wage regressions. Hill (1979) found early that controls for the presence of children (and for marital status) act as proxies for measures of labor market productivity. As a result, she found that controlling for work experience and labor force attachment greatly reduces the motherhood wage penalty. This result has been

observed in all subsequent family gap studies. Another explanation is that mothers and non-mothers somehow differ in their unobserved ability to earn. To deal with this unobserved heterogeneity researchers have use the fixed-effects estimator. Some find that it partially explains the motherhood wage penalty (Waldfogel 1998; Budig and England 2001) while others find that it leads to no effect of children on wages (Korenman and Neumark 1992; Gupta and Smith 2002).

In addition to work experience and tenure, a number of papers consider in addition both time spent out of employment (Hill, 1979; Baum, 2002) and part-time employment (Waldfogel 1997; Joshi et al. 1999; Anderson et al. 2003). The interpretation is that being out of employment is associated with human capital depreciation, while part-time employment is usually associated with lower wages. Since part-time work and work interruptions are more prevalent among mothers, these variables are usually found to partially explain the motherhood wage penalty.

Related to work interruptions is the focus of some papers on how long mothers take before going back to work after a birth and whether they return to the same job they held pre-birth. Shorter work interruptions following a birth (Lundberg and Rose 2000; Phipps et al. 2001) and returning to the same pre-birth job (Waldfogel 1998; Baum 2002) are associated with weaker motherhood wage penalties. One exception to this is Anderson et al. (2003) which find that women who return to work with very young children at home (two years old or less) have lower wages.

Another important determinant of the family gap is the timing of the transition to motherhood. Women who make their transition to motherhood earlier in their career are found to have lower wages (Taniguchi 2000; Drolet 2002; Amuedo-Dorantes and Kimmel 2005). It is also found that the motherhood wage penalty varies by level of education whereas more educated mothers suffer from weaker wage penalties (Todd 2001; Anderson et al. 2003). These two issues are somehow

related as more educated mothers are on average older when they make their transition to motherhood.

Another possible explanation for the motherhood wage penalty is that they may suffer from weaker wage growth either because mothers-to-be face lower rewards to improving labor market productivity, or because mothers have less time to do so. Loughran and Zissimopoulos (2009) finds no evidence that mothers suffer from lower wage growth. Similarly Waldfogel (1997) finds no differential returns to part-time work experience, more prevalent among mothers, relative to full-time work experience. However Gupta and Smith (2002) find some evidence that wage-experience profiles are significantly flatter for mother with two or more children. Mincer and Polachek (1978) find that a longer work interruption following a birth is associated with weaker wage growth for women.

In the empirical work that follows in sections 3.3 and 3.4 we address all of these possible explanations for the motherhood wage gap.

3.3 NLSY79 Data

We use data on wages, work experience, and household composition from the NLSY79. It is a longitudinal survey of a representative sample of 12,686 young men and women aged 14 to 21 on December 31st 1978. It provides data on labor market experience, income, household and fertility for 6,283 women who were interviewed annually from 1979 to 1994 and every two years since then, with the last survey data available for 2010. In this study we focus on the 3,108 women of the cross-sectional sample of the NLSY79 and exclude the supplemental samples of blacks, Hispanics, and economically disadvantaged whites. My main wage regression sample includes multiple wage observations for 3,005 women.

We record the real hourly wage (in 2010 dollars) for the job held at that the time of each completed survey interview. If an individual holds more than one job, we select the job with the highest weekly hours of work. Only hourly wages above $4 and below $150 are considered. To exclude summer jobs and part-time student jobs, we start tracking wages by age 18 (age 21) for individuals whose final years of schooling is 12 or less (13 or more).

The NLSY79 Work History Data contain weekly arrays that track employment status and hours worked starting January 1st 1978. We use these arrays to create actual work experience variables (total weeks worked, total hours worked) as well as time spent out of employment (total weeks out of employment) at each interview date. As with wages, we start tracking work experience and time out of employment at age 18 (age 21) for individuals whose final years of schooling is 12 or less (13 or more).

For individuals who have children, the NLSY79 provides the date of birth and date of death (if applicable) of each child born to an individual. [13] After computing week of birth and death for each child, we can use the weekly arrays of employment status and hours worked to separate work experience accumulated with and without children. We do not count any child aged 18 or more, so that an individual is considered to have no child if all their children are 18 years old or more.

Table 3.1 presents basic descriptive statistics for the sample. The first row represents the individuals' distribution according to their final level of education. About 47% of women in the sample have high school or less (12 years of schooling or less), while 26% have some college (13 to 15 years of schooling), and about 27% are college graduates (16 years of schooling or more). Note that the race distribution within each educational category suggests that white women are

[13] Note that only month and year of birth and death are provided in the NLSY79. To identify the week these events took place we assume that birth and death always take place on the 15th of the month.

over-represented among college graduates, while minorities are over-represented among individuals with less than 16 years of schooling. About 80% of women in my sample have children at some point between 1979 and 2010. There is however a slightly negative correlation between motherhood status and educational achievement. At each survey we record the number of children aged 18 years old or less. Mothers have on average a maximum of two children across all these survey years. Mothers have on average their first child by the age 24 years old, but age at first birth is much higher for college graduates.

Table 3.1 Descriptive Statistics

	All	By Years of Schooling		
		12 or Less	13 to 15	16 or More
Distribution Education (%)		46.7	25.9	27.4
		(49.9)	(43.8)	(44.6)
Black (%)	12.6	13.1	16.6	7.9
	(33.2)	(33.8)	(37.3)	(27.0)
Hispanic (%)	7.1	8.5	8.0	4.0
	(25.7)	(27.9)	(27.1)	(19.7)
White (%)	80.3	78.4	75.4	88.1
	(39.8)	(41.2)	(43.1)	(32.4)
Mothers (%)	80.6	85.9	79.9	72.2
	(39.6)	(34.8)	(40.1)	(44.8)
Number of Children (Mothers)	2.3	2.3	2.2	2.2
	(1.1)	(1.1)	(1.0)	(1.0)
Age at First Birth (Mothers)	24.1	22.2	23.9	28.2
	(5.8)	(5.1)	(5.3)	(5.3)
Sample Size	2,999	1,402	776	821

Standard deviation in parenthesis. Sample includes women from the cross-sectional sample of the NLSY79 who have at least one valid wage observation from 1979 to 2010, and available information to build fertility and actual experience variables. The row "Number of Children (Mothers)" reports for mothers the maximum of number of children aged less than 18 at any survey year from 1979 to 2010.

Figure 3.1 provides the age profile of hourly wages by educational achievement. As expected wage growth is stronger as education increases, leading to sizeable wage gaps as this cohort reaches the early forties.

Figure 3.1 Women Age Profile of Hourly Wage by Education (with 95% Confidence)

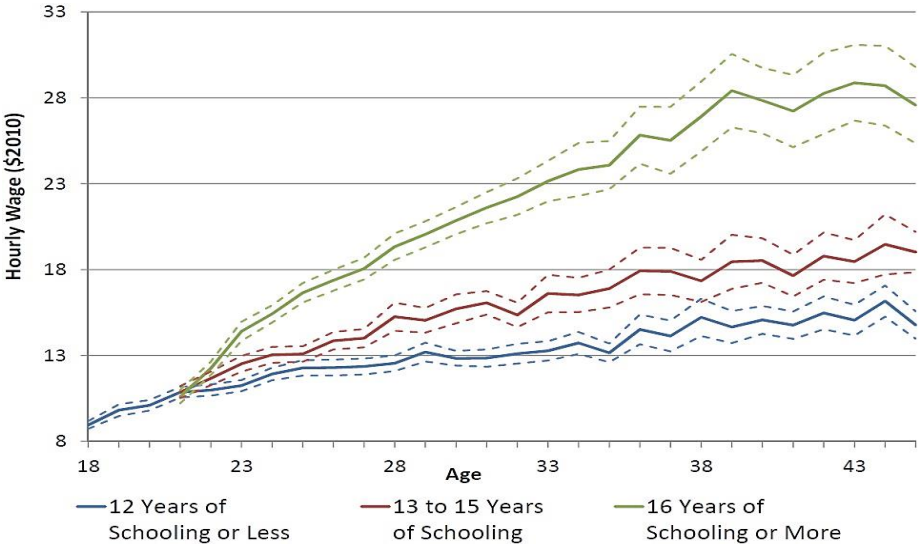


Figure 3.2 graphs the age profile of accumulated hours of work by educational achievement. These profiles are fairly similar across schooling levels, but the more educated workers have steeper profiles, suggesting that they have higher annual hours of work.

Figure 3.2 Women Age Profile of Accumulative Hours of Work by Education (with 95% Confidence)

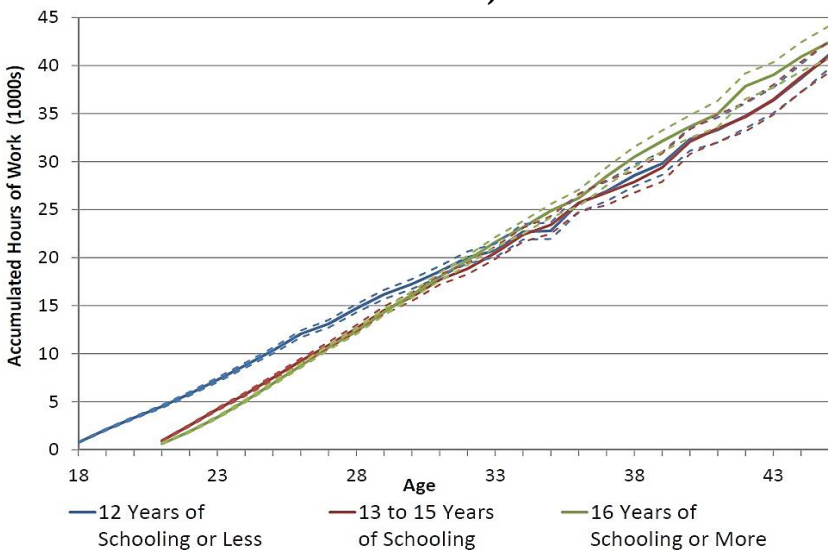
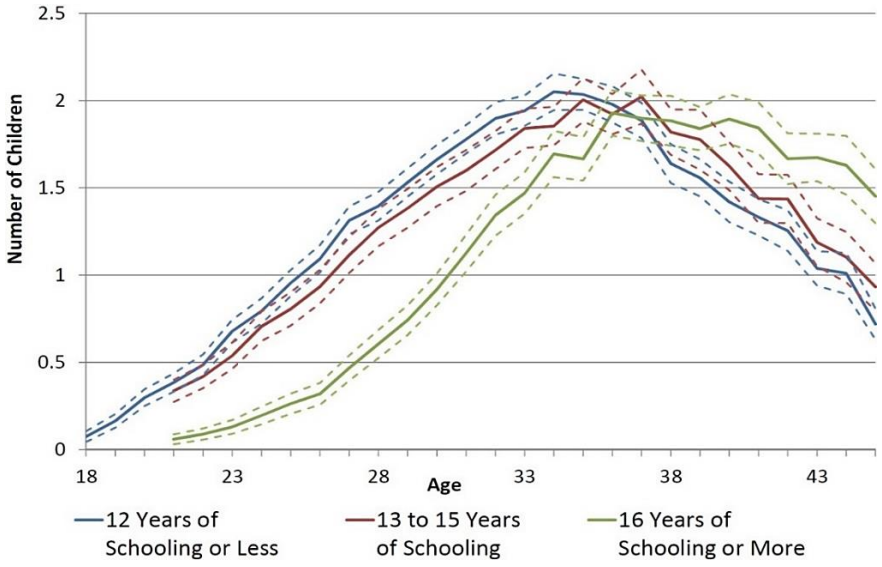


Figure 3.3 presents age profiles of number of children for mothers by educational achievement. The profile for women with 16 years of schooling or more is clearly to the right of less educated women, consistent with their higher average age at first birth. It is also noteworthy

that these profiles start decreasing as children turn 18 years old when mothers reach their late thirties and early forties.

Figure 3.3 Women Age Profile of Number of Children for Mothers by Education (with 95% Confidence)



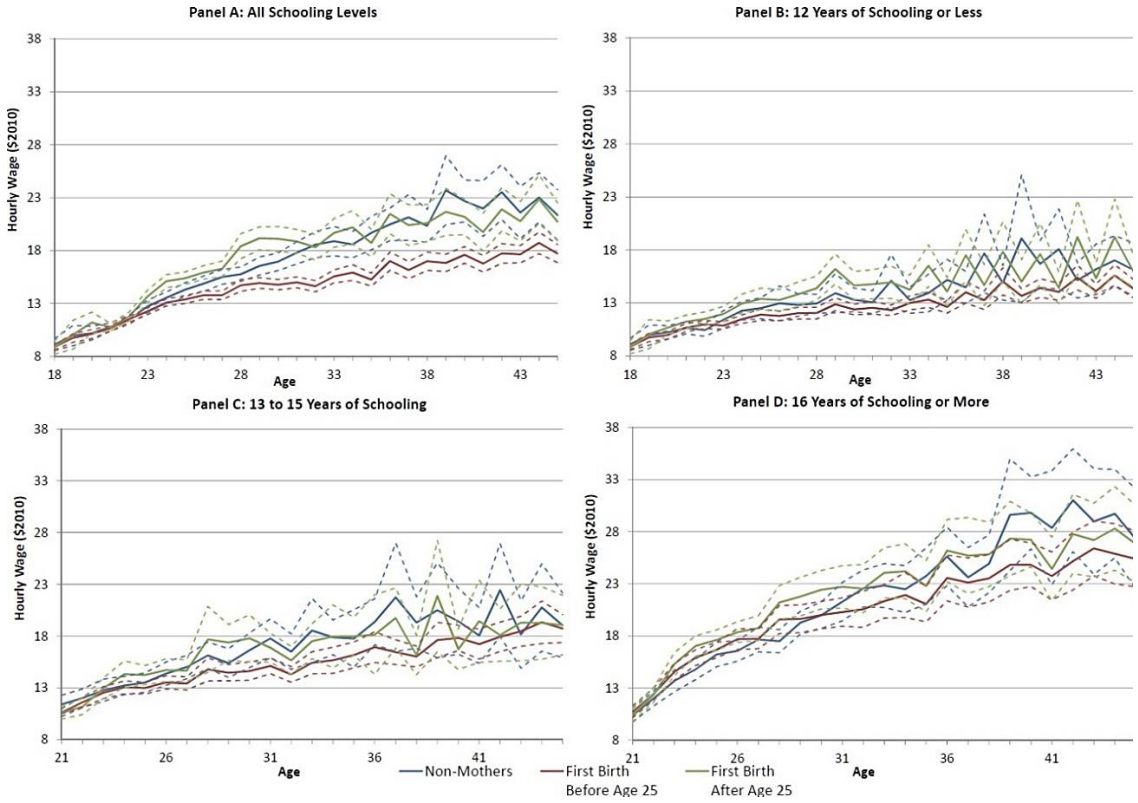
3.4 Wage Profile Analysis

3.4.1 The Returns to Work Experience and Motherhood

The main analysis presented here is based on a sample of about 38,500 log-wage observations for 3,005 women. [14] This is an unbalanced panel with an average of 13 log-wage observations per individual, ranging from a minimum of one observation to a maximum of 24 observations. Figure 3.4 presents wage-age profiles based on the age at which a mother had her first child. Here we distinguish between mothers whose age at first birth was less than 25, and those who had their first child after the age of 25.

[14] Out of 3,108 women in the NLSY79 cross-sectional sample.

Figure 3.4 Women Age Profile of Hourly Wage by Age at First Birth (with 95% Confidence Interval)



Panel A shows that mothers who have their first child later in their career (green line) have a wage progression very similar to that of non-mothers (blue line). Women who become mothers at an early age (red line) have much slower wage growth. Panels B to D present the same wage profiles separately for each level of schooling. They reveal weaker wage growth for early mothers as seen in Panel A but the distinction between early mothers and other women are more muted. This suggests that the differences in wage profiles found in Panel A are in part due to compositional effects: early mothers are more likely to be less educated workers with weaker wage growth whereas late mothers are more likely to be more educated workers with strong wage growth. It is worth noting that average wages in the early career are very similar across all panels of Figure 3.4. The weaker wage growth of early mothers is consistent with their slower accumulation of work experience.

Figure 3.5 Women Age Profile of Accumulated Hours of Work by Age at First Birth (with 95% Confidence Interval)

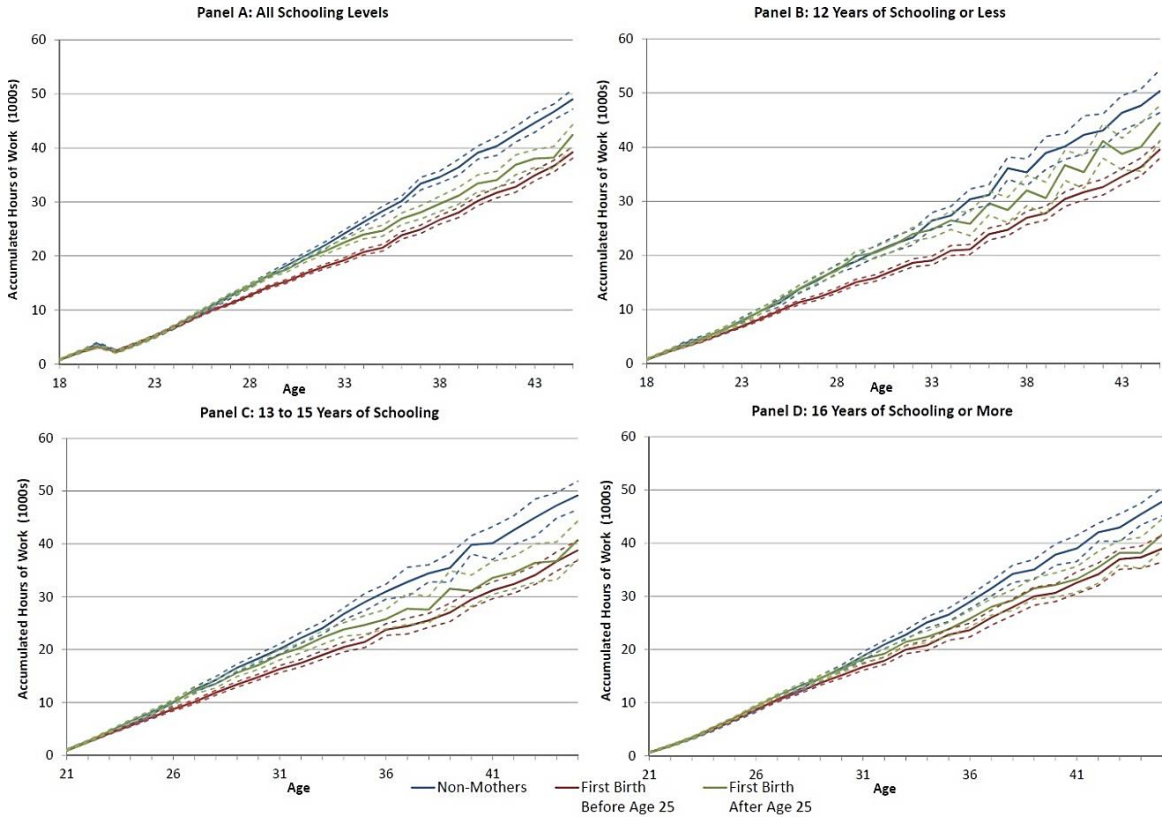


Figure 3.5 shows that their age profile of accumulated hours of work is consistently below that of late mothers and non-mothers. But these profiles also suggest that late mothers of all schooling levels decrease their labor supply in their late twenties and early thirties. This would explain why wage profiles for late mothers in Figure 3.4 seem to flatten in the late twenties and early thirties. Our analysis indicates so far that wage differentials between mothers and non-mothers are almost non-existent in the early career. However, we find that the wage growth of mothers, especially early mothers, is weaker and leads to a gap in average wage between mothers and non-mothers. Part of this slower wage growth is due to mothers accumulating less work experience.

We investigate further whether the accumulation of work experience explains the differences in wage profiles of non-mothers, early mothers and late mothers. Table 3.2 contains estimate of a

fixed-effects wage regression that controls simultaneously for work experience (measured by accumulated hours of work), years of tenure with a specific employer, and years since labor market entry. [15] As expected we find the returns to work experience, tenure, and years since labor market entry are positive and decreasing. In the early career, a year of full-time time work (about 2,000 hours of work) is associated with a wage growth of about 3.4%.

Table 3.2 The Returns to Work Experience for Non-Mothers, Early Mothers and Late Mothers

	All	By Years of Schooling		
		12 or Less	13 to 15	16 or More
At Least One Child (1st Birth Before Age 25)	-0.0285	-0.0121	-0.0454	-0.0333
	(0.0078)	(0.0093)	(0.0157)	(0.0256)
At Least One Child (1st Birth After Age 25)	-0.0431	-0.0581	-0.0498	-0.0211
	(0.0078)	(0.0118)	(0.0161)	(0.0138)
Accumulated Hours of Work (/1,000)	0.0172	0.0132	0.0152	0.0235
	(0.0010)	(0.0015)	(0.0019)	(0.0022)
Accumulated Hours of Work Squared	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Accumulated Hours X 1st Birth Before Age 25	-0.0020	-0.0007	-0.0007	-0.0053
	(0.0009)	(0.0013)	(0.0016)	(0.0022)
Accumulated Hours Squared X 1st Birth Before Age 25	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Accumulated Hours X 1st Birth After Age 25	0.0045	0.0034	0.0061	0.0041
	(0.0009)	(0.0015)	(0.0019)	(0.0016)
Accumulated Hours Squared X 1st Birth After Age 25	0.0000	0.0000	-0.0001	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Years of Tenure At Current Job	0.0298	0.0291	0.0296	0.0293
	(0.0010)	(0.0014)	(0.0019)	(0.0021)
Years of Tenure At Current Job Squared	-0.0009	-0.0008	-0.0009	-0.0009
	(0.0000)	(0.0001)	(0.0001)	(0.0001)
Years Since Labor Market Entry	0.0260	0.0199	0.0337	0.0242
	(0.0054)	(0.0075)	(0.0108)	(0.0114)
Years Since Labor Market Entry Squared	-0.0006	-0.0007	-0.0004	-0.0003
	(0.0000)	(0.0001)	(0.0001)	(0.0001)
Sample Size	38,071	17,113	9,972	10,966

Standard errors in parenthesis. See footnote to Table 1 for sample description. The dependent variable is log hourly wage for a job held at the time of interview. All regressions include dummy variables for years of schooling and calendar year. "At Least One Child" is an indicator variable for women who have at least one child aged 0 to 18 when the wage is reported.

Although columns two to four reveals that this returns varies based on years of schooling, with college graduates enjoying a 4.6% wage increase in their first year of full-time work. Wage growth after a year at the same job is about 3%, and the first year since labor market entry is

[15] Given our assumption that workers with no college (at least some college) enter the market at age 18 (age 21), years since labor market entry is just age minus 18 (21).

associated with about 2.6% wage growth. We also allow the returns to work experience to vary based on whether mothers had their child before or after the age of 25. These interactions should be statistically insignificant if wage profile differences are fully explained by work experience profiles. But what we find is that across all schooling levels, mothers who have their first child after the age of 25 enjoy higher returns to work experience. At the same time mothers who have their child before age 25 enjoy lower returns to work experience, although this seems to be mostly an issue for early mothers with a college degree. These estimates imply that within the 0 to 50,000 accumulated hours of work range (in which 95% of our sample is located) the average quadratic wage-experience profile of late mothers is above that of non-mothers, which is itself above that of early mothers, for all schooling levels.

Table 3.2 also reveals an apparent wage penalty associated with becoming a mother. Indeed this wage penalty seems especially large for late mothers. However it is worth noting that (in results not shown here) we find similar wage penalties when we exclude non-mothers from the estimation sample. We believe this is due to the fact that in a fixed-effects model these penalties are identified off of workers in our sample who make the transition into motherhood (in the early career when wages are lower and wage growth is strong) and out of motherhood (in the late career when wages are higher and wage growth is weaker). We could also obtain similar results if mothers make the transition into motherhood when hit with bad labor market shocks that translate into lower wages.

In Table 3.3 we investigate whether the higher returns to work experience for late mothers is related to the timing of the transition to motherhood. To do so, we distinguish work experience of late mothers based on whether it was acquired before or after the first birth.

Table 3.3 The Returns to Work Experience before and after the Transition to Motherhood

	All	By Years of Schooling		
		12 or Less	13 to 15	16 or More
a. Returns to Experience Before and After Motherhood				
Accumulated Hours of Work (/1,000)	0.0169	0.0129	0.0161	0.0228
	(0.0010)	(0.0014)	(0.0019)	(0.0021)
Accumulated Hours of Work Squared	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Accumulated Hours X 1st Birth Before Age 25	-0.0019	-0.0004	-0.0019	-0.0045
	(0.0008)	(0.0012)	(0.0016)	(0.0021)
Accumulated Hours Squared X 1st Birth Before Age 25	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Accumulated Hours Before 1st Birth X 1st Birth After Age 25	0.0112	0.0089	0.0125	0.0110
	(0.0013)	(0.0022)	(0.0030)	(0.0021)
(Accumulated Hours Before 1st Birth)^2 X 1st Birth After Age 25	-0.0001	-0.0001	-0.0002	-0.0001
	(0.0000)	(0.0001)	(0.0001)	(0.0001)
Accumulated Hours After 1st Birth X 1st Birth After Age 25	-0.0036	-0.0008	-0.0047	-0.0032
	(0.0010)	(0.0016)	(0.0020)	(0.0018)
(Accumulated Hours After 1st Birth)^2 X 1st Birth After Age 25	0.0001	0.0000	0.0001	0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
b. Returns to Experience Before and After Motherhood, and in the Early Career				
Accumulated Hours of Work (/1,000)	0.0198	0.0102	0.0177	0.0282
	(0.0013)	(0.0020)	(0.0027)	(0.0030)
Accumulated Hours of Work Squared	-0.0001	0.0000	-0.0001	-0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Accumulated Hours of Work Before Age 25 (/1,000)	0.0169	0.0181	0.0352	0.0626
	(0.0033)	(0.0047)	(0.0092)	(0.0100)
Accumulated Hours of Work Before Age 25 Squared	-0.0012	-0.0004	-0.0035	-0.0067
	(0.0002)	(0.0002)	(0.0008)	(0.0009)
Accumulated Hours of Work Ages 25 to 35 (/1,000)	-0.0033	0.0000	0.0050	-0.0038
	(0.0016)	(0.0024)	(0.0037)	(0.0041)
Accumulated Hours of Work Ages 25 to 35 Squared	0.0000	0.0000	-0.0003	-0.0001
	(0.0000)	(0.0001)	(0.0001)	(0.0001)
Accumulated Hours X 1st Birth Before Age 25	-0.0024	0.0002	-0.0029	-0.0048
	(0.0008)	(0.0012)	(0.0016)	(0.0021)
Accumulated Hours Squared X 1st Birth Before Age 25	0.0000	0.0000	0.0001	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Accumulated Hours Before 1st Birth X 1st Birth After Age 25	0.0092	0.0051	0.0099	0.0078
	(0.0014)	(0.0023)	(0.0031)	(0.0023)
(Accumulated Hours Before 1st Birth)^2 X 1st Birth After Age 25	-0.0001	-0.0001	-0.0002	0.0000
	(0.0000)	(0.0001)	(0.0001)	(0.0001)
Accumulated Hours After 1st Birth X 1st Birth After Age 25	-0.0034	-0.0001	-0.0044	-0.0027
	(0.0010)	(0.0016)	(0.0020)	(0.0018)
(Accumulated Hours After 1st Birth)^2 X 1st Birth After Age 25	0.0001	0.0000	0.0001	0.0000
	(0.0000)	(0.0000)	(0.0001)	(0.0000)
Sample Size	38,014	17,109	9,947	10,958

Standard errors in parenthesis. See footnote to Table 1 for sample description. The dependent variable is log hourly wage for a job held at the time of interview. All regressions include dummy variables for: years of schooling, calendar year, having at least one child aged 0 to 18 and becoming a mother before age 25, and having at least one child aged 0 to 18 and becoming a mother after age 25. Regressions also include controls for years of tenure and years since labor market entry.

In Panel a, the coefficient for hours of work accumulated by late mothers before the first birth is found positive and statistically significant for all schooling levels. This suggests that when

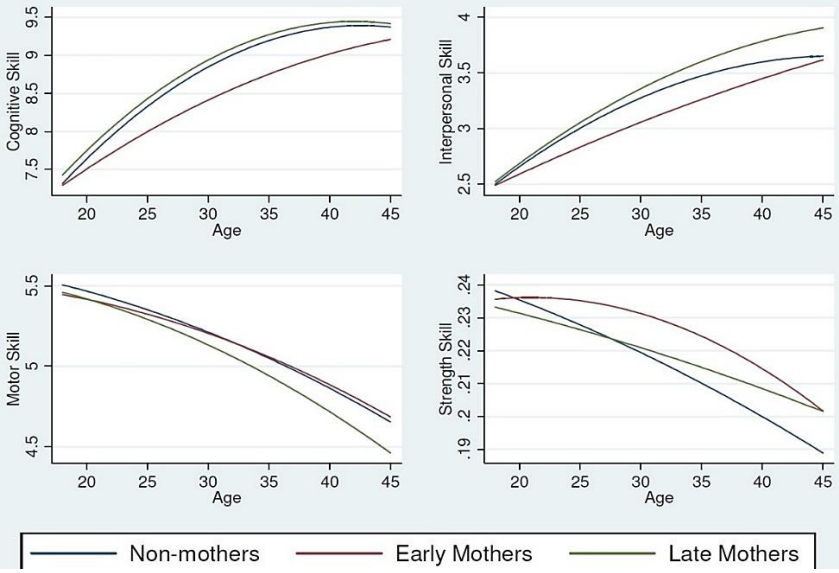
comparing the wage of two mothers with the same total amount of work experience, we would find that the wage is higher for the mother who has waited the longest before having her first child. This is compounded by the fact that we find the returns to hours worked by late mothers after the first birth to be lower, especially for mothers who have at least 13 years of schooling. It could be argued that hours of work before the first birth capture the stronger wage growth in the early career. We investigate this in Panel b where we differentiate work experience based on whether it was acquired before the age of 25, or from ages 25 to 35. If returns to work experience are higher during the early career, then the coefficients associated with these two measures of work experience should be positive. And we do find that work experience has a higher return for workers of all schooling levels if it is acquired before age 25. But we still find that late mothers experience stronger wage growth before their transition to motherhood, although the coefficients appear smaller than those found in Panel a.

3.4.2 Occupational Task Requirements and Wage Growth

We next investigate whether differences in wage growth can be explained by non-mothers, early mothers, and late mothers having careers progressions that take them through different occupations. Past literature has differentiated jobs on the basis of occupation codes. We instead follow (Ingram and Neumann 2006) and (Poletaev and Robinson 2006) in describing occupations as a vector of skill requirements. In our case occupations are described by how much cognitive, interpersonal, motor, and strength skills they involve. These skill requirements are not available in the NLSY79 but we can match its 1970 census occupational classification codes to the Dictionary of Occupational Titles (DOT). The DOT describes a large number of jobs on the basis of more than fifty different characteristics categorized as worker functions, educational requirements, temperaments, and aptitudes used for a job. We apply principal component analysis on four

mutually exclusive subsets of these characteristics to build our cognitive, interpersonal, motor, and strength skill occupational requirements. As an example, surgeons would have relatively high values for cognitive and motor skill requirements, whereas salespersons would have relatively high interpersonal skill requirement.

Figure 3.6 Average Predicted Women Age Profile of Occupational Skill Requirements



We regress these four different skill requirements on linear and quadratic terms in accumulated work experience, years since leaving the labor market and tenure, as well as interactions of these variables with indicator variables for early mothers and late mothers. The average age profile predicted by this model for each skill requirement is plotted in Figure 3.6. They show that all women see their cognitive and interpersonal skills increase throughout their careers, whereas motor and strength skills tend to decrease with career progression. Late mothers have on average the age profiles of late mothers are very similar to that of non-mothers. We also see that late mothers appear to move up the cognitive and interpersonal skill ladders at a faster rate, and to lose motor skill requirement at a faster rate. Therefore if cognitive and interpersonal (strength) skills are associated with higher wage, then we would expect stronger wage growth for late mothers.

Table 3.4 The Returns to Work Experience and Occupational Skill Requirements

	All	By Years of Schooling		
		12 or Less	13 to 15	16 or More
Cognitive Skill Requirement	0.0358	0.0236	0.0455	0.0497
	(0.0014)	(0.0020)	(0.0028)	(0.0028)
Interpersonal Skill Requirement	-0.0168	-0.0186	-0.0258	-0.0128
	(0.0018)	(0.0028)	(0.0036)	(0.0031)
Motor Skill Requirement	-0.0007	-0.0045	0.0015	0.0028
	(0.0010)	(0.0013)	(0.0019)	(0.0021)
Strength Skill Requirement	0.1061	0.0313	0.1787	0.0955
	(0.0152)	(0.0209)	(0.0294)	(0.0322)
At Least One Child (1st Birth Before Age 25)	-0.0232	-0.0066	-0.0377	-0.0347
	(0.0079)	(0.0095)	(0.0159)	(0.0256)
At Least One Child (1st Birth After Age 25)	-0.0378	-0.0511	-0.0452	-0.0185
	(0.0078)	(0.0120)	(0.0160)	(0.0137)
Accumulated Hours of Work (/1,000)	0.0169	0.0135	0.0143	0.0229
	(0.0010)	(0.0015)	(0.0019)	(0.0022)
Accumulated Hours of Work Squared	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Accumulated Hours X 1st Birth Before Age 25	-0.0024	-0.0010	-0.0018	-0.0048
	(0.0009)	(0.0013)	(0.0016)	(0.0022)
Accumulated Hours Squared X 1st Birth Before Age 25	0.0000	0.0000	0.0000	0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Accumulated Hours X 1st Birth After Age 25	0.0046	0.0032	0.0065	0.0042
	(0.0009)	(0.0015)	(0.0019)	(0.0016)
Accumulated Hours Squared X 1st Birth After Age 25	-0.0001	0.0000	-0.0001	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Sample Size	36,458	16,436	9,512	10,510

Standard errors in parenthesis. See footnote to Table 1 for sample description. The dependent variable is log hourly wage for a job held at the time of interview. All regressions include dummy variables for years of schooling and calendar year. "At Least One Child" is an indicator variable for women who have at least one child aged 0 to 18 when the wage is reported. Regressions also include controls for years of tenure and years since labor market entry.

Table 3.4 shows that these skill requirements are related to wages. Women who hold job with higher cognitive and strength requirements tend to earn more. However jobs that require more interpersonal skills, for the same levels of cognitive and strength skills, are associated with lower wages. Despite this effect of skill requirement on wages we still find that late mothers enjoy higher returns to work experience. Although late mothers climbing faster the cognitive skill ladder could explain their stronger wage growth, their faster climb of the interpersonal skill ladder should tamper this effect. As a result we still find that the interaction between accumulated work experience and being a late mother is positive and statistically significant at all schooling levels.

3.4.3 Work Interruptions and Wage Growth

We then study the relationship between work interruptions (time spent out of employment) and wages of women. These work interruptions obviously lead to less work experience accumulation, so our accumulated work experience variable should already account for that effect.

However work interruptions might also lead to loss in specific human capital, and these losses might be heavier as more time is spent out of employment. If non-mothers and late mothers spend less time out of employment, they suffer less from this loss of specific human capital relative to early mothers, and may look like they enjoy stronger wage growth if work interruptions are not accounted for.

Table 3.5 The Returns to Work Experience and Weeks Spent Out of Employment

	All	By Years of Schooling		
		12 or Less	13 to 15	16 or More
Weeks Out of Employment	-0.0006	-0.0006	-0.0007	-0.0007
	(0.0001)	(0.0001)	(0.0002)	(0.0001)
Weeks Out of Employment X 1st Birth Before Age 25	0.0005	0.0005	0.0004	0.0006
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Weeks Out of Employment X 1st Birth After Age 25	0.0002	0.0003	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0002)	(0.0001)
At Least One Child (1st Birth Before Age 25)	-0.0135	-0.0069	-0.0249	-0.0063
	(0.0081)	(0.0097)	(0.0170)	(0.0261)
At Least One Child (1st Birth After Age 25)	-0.0284	-0.0330	-0.0264	-0.0249
	(0.0092)	(0.0139)	(0.0190)	(0.0164)
Accumulated Hours X 1st Birth Before Age 25	-0.0052	-0.0033	-0.0029	-0.0097
	(0.0009)	(0.0014)	(0.0018)	(0.0024)
Accumulated Hours Squared X 1st Birth Before Age 25	0.0001	0.0000	0.0001	0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Accumulated Hours Before 1st Birth X 1st Birth After Age 25	0.0104	0.0088	0.0109	0.0095
	(0.0014)	(0.0024)	(0.0031)	(0.0023)
(Accumulated Hours Before 1st Birth)^2 X 1st Birth After Age 25	-0.0001	-0.0002	-0.0002	-0.0001
	(0.0000)	(0.0001)	(0.0001)	(0.0001)
Accumulated Hours After 1st Birth X 1st Birth After Age 25	-0.0043	-0.0023	-0.0042	-0.0047
	(0.0011)	(0.0017)	(0.0022)	(0.0020)
(Accumulated Hours After 1st Birth)^2 X 1st Birth After Age 25	0.0001	0.0001	0.0001	0.0001
	(0.0000)	(0.0000)	(0.0001)	(0.0001)
Sample Size	34,504	15,935	8,775	9,794

Standard errors in parenthesis. See footnote to Table 1 for sample description. The dependent variable is log hourly wage for a job held at the time of interview. All regressions include dummy variables for: years of schooling, calendar year, having at least one child aged 0 to 18 and becoming a mother before age 25, and having at least one child aged 0 to 18 and becoming a mother after age 25. Regressions also include controls for accumulated hours of work, years of tenure and years since labor market entry.

Table 3.5 shows that time spent out of employment is associated with significantly lower wages for all women at all levels of schooling. It is interesting to note however that this effect is less negative mothers relative to non-mothers. This may be due to mothers having a higher reservation wage and leaving unemployment only when they find a job with a sufficiently high wage. It is also worth noting that accounting for weeks of unemployment seems to make the indicator variables for having at least one child insignificant. So it seems that part of the negative effect of having children on wages that we found in Table 3.2 can be explained by mothers

spending more time out of employment. This is in line with results presented in Baum (2002). We however still find differential returns to work experience despite controlling for time out of employment. Early mothers experience lower returns to work experience whereas late mothers have higher (lower) returns to experience before (after) their transition to motherhood.

To understand better the how time spent out of employment affects the wages of mothers we study how birth related work interruptions impact the wage and occupational skill requirements upon returning to the labor market. In this section we rely on a sample of periods out of employment observed around the time of any birth. For any of these periods we record the hourly wage and skill requirements before and after the interruption. We also record the length, the birth order, and at what time during the career it took place. Mothers who have more than one birth have multiple observations in this sample.

Table 3.6 Birth Related Work Interruptions and Average Changes in Wages and Occupational Skill Requirements

	All	By Age at First Birth	
		25 Or Less	More Than 25
Log Wage Change	-0.0050	0.0212	-0.0433
	(0.3771)	(0.3535)	(0.4064)
Cognitive Skill Requirement Change	-0.0539	-0.0041	-0.1289
	(1.9462)	(2.0105)	(1.8439)
Interpersonal Skill Requirement Change	0.0512	0.0531	0.0483
	(1.2582)	(1.2456)	(1.2778)
Motor Skill Requirement Change	-0.1708	-0.1803	-0.1565
	(2.1701)	(2.2324)	(2.0740)
Strength Skill Requirement Change	0.0160	0.0161	0.0158
	(0.1468)	(0.1553)	(0.1331)
Sample Size	1,955	1,162	793
	By Years of Schooling		
	12 or Less	13 to 15	16 or More
Log Wage Change	-0.0028	0.0071	-0.0251
	(0.3460)	(0.3865)	(0.4352)
Cognitive Skill Requirement Change	-0.0318	-0.1276	-0.0217
	(1.9960)	(1.7774)	(2.0136)
Interpersonal Skill Requirement Change	0.0554	0.0584	0.0321
	(1.1671)	(1.1500)	(1.5654)
Motor Skill Requirement Change	-0.1753	-0.2636	-0.0498
	(2.2805)	(2.0480)	(2.0235)
Strength Skill Requirement Change	0.0138	0.0253	0.0102
	(0.1601)	(0.1363)	(0.1219)
Sample Size	1,032	508	415

Standard deviations in parenthesis. Log wage change is log-wage after birth related work interruption minus log-wage before work interruption. The same applies to each occupational skill requirements.

We first report the impact of birth related work interruptions on wages and occupational skill requirements in Table 3.6. We find that birth related work interruption lead to mothers going back to work with lower wages on average. But this negative impact is felt mainly by late mothers and mothers with a college degree. Work interruptions are associated with drops in cognitive and motor occupational skill requirements, and increases in interpersonal and strength skill requirements.

In Table 3.7 at the determinants wage changes following a birth related work interruption. We find that the most important determinants in explaining the change in wage following a work interruption is the change in cognitive and interpersonal skill requirements.

Table 3.7 Birth Related Work Interruptions and the Impact of Occupational Skill Requirement Changes on Wages

	All	By Age at First Birth	
		25 Or Less	More Than 25
Weeks Out of Employment	0.0001 (0.0002)	0.0004 (0.0002)	-0.0004 (0.0004)
Cognitive Skill Requirement Change	0.0718 (0.0147)	0.0664 (0.0169)	0.0769 (0.0270)
Interpersonal Skill Requirement Change	-0.0414 (0.0194)	-0.0755 (0.0231)	-0.0001 (0.0347)
Motor Skill Requirement Change	0.0038 (0.0081)	0.0019 (0.0092)	0.0058 (0.0155)
Strength Skill Requirement Change	0.2546 (0.1428)	0.3593 (0.1555)	-0.3448 (0.3073)
Sample Size	1,822	1,095	727
	By Years of Schooling		
	12 or Less	13 to 15	16 or More
Weeks Out of Employment	0.0003 (0.0002)	-0.0002 (0.0005)	-0.0004 (0.0006)
Cognitive Skill Requirement Change	0.0634 (0.0172)	0.1274 (0.0342)	0.0176 (0.0407)
Interpersonal Skill Requirement Change	-0.0733 (0.0246)	-0.0660 (0.0448)	0.0538 (0.0557)
Motor Skill Requirement Change	-0.0009 (0.0086)	0.0162 (0.0188)	0.0343 (0.0350)
Strength Skill Requirement Change	0.2268 (0.1515)	0.5475 (0.3518)	-0.2597 (0.5294)
Sample Size	970	462	390

Standard errors in parenthesis. The dependent variable is log-wage after birth related work interruption minus log-wage before work interruption. All regressions include dummy variables for years of schooling and birth order. Regressions also include controls for years since labor market entry at time of birth.

Work interruptions associated with a decrease in cognitive skills lead to significant wage losses for mothers. At the same time, increases in the interpersonal, whereas decreases in interpersonal skills are associated with higher wages. These results are consistent with those of

Table 3.4 where we find that a higher (lower) cognitive (interpersonal) skill requirement is associated with a higher hourly wage. Table 3.7 also shows that the length of the work interruption seems to have little significant impact on wages once changes in skill requirements are accounted for.

3.5 Conclusion

In this paper we study the family gap, the wage penalty associated with motherhood. Our basic raw age-wage profiles show that the family gap is insignificant in the early career. In fact late mothers and non-mothers have very similar hourly wage and that the family gap gradually appears in the mid-twenties, whereas the profile of early mothers grows much slower and is below that of other mothers quite early on.

We show that there are two components to explaining the wage penalty associated with motherhood. First, mothers accumulate work experience at a slower rate once they transition into motherhood. Second, mothers' returns to experience differ from that of non-mothers. Early mothers' returns to experience are lower throughout their career. Late mothers' returns to work experience are stronger (weaker) before (after) their transition to motherhood. This is how they can maintain their wage relative to non-mothers after their transition to motherhood despite their slower accumulation of experience after that transition. We show that these differentials in returns to work experience are robust to accounting for differences in occupational skill requirements, and costly losses in specific human capital due to time spent out of employment.

References

Alesina A, Ichino A, Karabarbounis L (2011). Gender-based Taxation and the Division of Family Chores. *American Economic Journal: Economic Policy*, 3, 1-40.

Alm J, Melnik MI (2005). Taxing the "Family" in the Individual Income Tax. *Public Finance and Management*, 5(1), 56-101.

Amuedo-Dorantes C, Kimmel J (2005). The Motherhood Wage Gap for Women in the United States: The importance of college and fertility delay. *Review of Economics of the Household*, 3(1), 17-48.

Anderson DJ, Binder M, Krause K (2002). The Motherhood Wage Penalty: Which Mothers Pay It and Why? *American Economic Review*, 92(2), 273-294.

Anderson DJ, Binder M, Krause K (2003). The Motherhood Wage Penalty Revisited: Experience, Heterogeneity, Work Effort, and Work-Schedule Flexibility. *Industrial and Labor Relations Review*, 56(2), 273-294.

Appleton S, Knight J, Song L, Xia Q (2002). Labor Retrenchment in China: Determinants and Consequences. *China Economic Review*, 13(2), 252-275.

Appleton S, Knight J, Song L, Xia Q (2004). Contrasting Paradigms: Segmentation and Competitiveness in the Formation of the Chinese Labour Market. *Journal of Chinese Economic and Business Studies*, 2(3), 185-205.

Appleton S, Song L, Xia Q (2005). Has China Crossed the River? The Evolution of Wage Structure in Urban China During Reform and Retrenchment. *Journal of Comparative Economics*, 33(4), 644-663.

Appleton S, Song L, Xia Q (2009). The Change of Wage Payment Structure of Urban China during the Transition. *China Population Science*, 135(6), 59-68.

Appleton S, Song L, Xia Q, Li S (2014). The Effects of the State Sector on Wage Inequality in Urban China: 1988-2007. *Journal of Chinese Economic and Business Studies*, 12(1), 29-45.

Apps P, Rees R (1999). Individual versus Joint Taxation in Models with Household Production. Journal of Political Economy, 107, 393-403.

Apps P, Rees R (2011). Optimal Taxation and Tax Reform for Two-earner Households. *CESifo Economic Studies*, 57(2), 283-304.

Bargain O, Orsini K, Peichl A (2014). Comparing Labor Supply Elasticities in Europe and the US: New Results. *Journal of Human Resources*, 49(3), 723-838.

Baum CL (2002). The Efffect of Work Interruptions on Women's Wages. *Labour*, 16(1), 1-37.

Becker GS (1971). The Economics of discrimination. Chicago: University of Chicago Press.

Becker GS, Barro RJ (1986). Altruism and the Economic Theory of Fertility. *Population and Development Review*, 12, 69-76.

Bell DE, Keeney RL (2009). Altruistic Utility Functions for Joint Decisions. In: Brams SJ, Gehrlein WV, Roberts FS (Ed.). The Mathematics of Preference, Choice and Order. Springer: New York.

Bian Y (1994). Work and Inequality in Urban China. Albany: State University of New York Press.

Bick A, Fuchs-Schundeln N (2012). Taxation and Labor Supply of Married Women across Countries: A Macroeconomic Analysis. CEPR Discussion Papers 9115.

Blau FD (1996). Where Are We in the Economics of Gender? The Gender Pay Gap. NBER Working Paper 5664.

Blau FD, Beller AH (1988). Trends in Earnings Differentials by Gender, 1971-1981. *Industrial and Labor Relations Review,* 41(4), 513-529.

Blau FD, Kahn L (1994). Rising Wage Inequality and the U.S. Gender Gap. *The American Economic Review*, 84(2), 23-28.

Blau FD, Kahn L (2007). Changes in the Labor Supply Behavior of Married Women: 1980-2000. *Journal of Labor Economics*, 25(3), 393-438.

Blinder AS (1973). Wage Discrimination: Reduced Form and Structural Estimates. *Journal of Human Resources,* 8(4), 436-455.

BLS (2013). Women in the Labor Force: A Databook. BLS Reports 1040, US Bureau of Labor Statistics.

Boskin MJ, Sheshinski E (1983). Optimal Tax Treatment of the Family: Married Couples. *Journal of Public Economics,* 20, 281-297.

Braunstein E, Brenner M (2007). Foreign Direct Investment and Gendered Wages in Urban China. *Feminist Economics,* 13(3), 213-237.

Brown RS, Moon M, Zoloth BS (1980). Incorporating Occupational Attainment in Studies of Male-Female Earnings Differentials. *The Journal of Human Resources,* 15(1), 3-28.

Budig MJ, Paula E (2001). The Wage Penalty for Motherhood. *American Sociological Review*. 66(2), 204-225.

Cai F, Wang M (2008). A Counterfactual Analysis on Unlimited Surplus Labor in Rural China. *China & World Economy,* 16(1), 51-65.

Callick R (2007). China Relaxes its One-Child Policy. The Australian.

Cao Y, Qian Y, Barry WR(1999). From federalism, Chinese style to privatization, Chinese style. *Economics of Transition,* 7(1), 103-131.

Cao Y, Qian Y, Weingast BR(1999). From federalism, Chinese style to privatization, Chinese style. *Economics of Transition,* 7(1), 103-131.

Chen Y, Diwan I (1999). When the Bureaucrats Move out of Business: A Cost-Benefit Assessment of Labor Retrenchment in China. Washington DC: The World Bank.

Chen Z, Ge Y, Lai H, Wan C (2013). Globalization and Gender Wage Inequality in China. *World Development,* 44, 256-266.

China Statistical Yearbook (1994). China Statistical Yearbook. Hong Kong: International Centre for the Advancement of Science & Technology.

Chow G, Perkins D (2014). Routledge Handbook of the Chinese Economy. New York: Taylor & Francis Group.

Crossley TF, Jeon S (2007). Joint Taxation and the Labour Supply of Married Women: Evidence from the Canadian Tax Reform of 1988. Fiscal Studies, 28(3), 343-365.

Cherchye L, Demuynck T, De Rock B (2011). Non-Cooperative Household Consumption with Caring. Working Paper, Tilburg University.

Del Boca D, Flinn CJ (2014). Household Behavior and the Marriage Market. *Journal of Economic Theory*, 150, 515-550.

Dai B, Lou Q, Wang X (2005). Ministry of Finance, People Republic of China. [Online] Available at: http://www.mof.gov.cn/pub/caizhengbuzhuzhan/zhengwuxinxi/diaochayanjiu/200806/t20080619_47096.html

Démurger S, Li S, Yang J (2011). Earnings Differentials between the Public and Private Sectors in China: Exploring Changes for Urban Local Residents in the 2000s. *China Economic Review*, 21(3), 138-153.

Drolet M (2002). Wives, Mothers and Wages: Does Timing Matter? Analytical Studies Branch Research Paper Series, Statistics Canada, Analytical Studies Branch.

Estrin S, Hanousek J, Kocenda E, Svejnar J (2009). The Effects of Privatization and Ownership in Transition Economies. *Journal of Economic Literature*, 47(3), 699-728.

Fang LC (2005). HRM, Work and Employment in China. London: Routledge.

Gan J (2009). Privatization in China: Experiences and Lessons: Challenges and Opportunities. In: China's Emerging Financial Markets. Springer, 581-592.

Garnaut R, Song L (2006). The Turning Point in China's Economic Development. Canberra: Austrialian National University.

Garnaut R, Song L, Tenev S, Yao Y (2005). China's Ownership Transformation: Process, Outcomes, Prospects. Washington DC: World Bank Publications.

Graham EM, Wada E (2001). Foreign Direct Investment in China: Effects on Growth and Economic Performance. Institute for International Economics Working Paper 01-03.

Gunderson M (1989). Male-Female Wage Differentials and Policy Responses. *Journal of Economic Literature*, 27(1), 46-72.

Gustafsson B, Li S (2000). Economic Transformation and the Gender Earnings Gap in Urban China. *Journal of Population Economics*, 13(2), 305-329.

Funcia JA, Marcern M, Chueca JA (2013). Which Spouse First Decides in the Household? The Dynamics of Bargaining. *Theoretical Economics Letters*, 3, 69-77.

Graham JW, Green CA (1984). Estimating the Parameters of a Household Production Function with Joint Products. *The Review of Economics and Statistics*, 66(2), 277-282.

Gupta ND, Smith N (2002). Children and Career Interruptions: The Family Gap in Denmark. *Economica*, 69(276), 609-629.

Gustafsson S (1992). Separate Taxation and Married Women's Labor Supply. *Journal of Population Economics*, 5, 61-85.

Haan P, Navarro D (2008). Optimal Income Taxation of Married Couples: An Empirical Analysis of Joint and Individual Taxation. IZA Discussion Paper 3819.

Hill MS (1979). The Wage Effects of Marital Status and Children. *Journal of Human Resources*. 14(4), 579-594.

Ingram BF, Neumann GR (2006). The Returns to Skill. *Labour Economics*, 13(1), 35-59.

Jia Z (2005). Labor Supply of Retiring Couples and Heterogeneity in Household Decision-Making Structure. *Review of Economics of the Household*, 3, 215-233.

Josephs HK (1990). Labor Law in China: Choice and Responsibility. Butterworth-Heinemann.

Joshi H, Paci P, Waldfogel J (1999). The Wages of Motherhood: Better or Worse? *Cambridge Journal of Economics*, 23(5), 543-564.

Juhn C, Murphy KM, Pierce B (1991). Accounting for the Slowdown in Black-White Wage Convergence. In: *In Workers and Their Wages: Changing Patterns in the United States.* Washington, D.C: American Enterprise Institute Press.

Juhn C, Murphy KM, Pierce B (1993). Wage Inequality and The Rise in Returns to Skill. *Journal of Political Economy*, 101(3), 410-442.

Kanbur R, Zhang X (2005). Fifty Years of Regional Inequality in China: a Journey Through Central Planning, Reform, and Openness. *Review of Development Economics,* 9(1), 87-106.

Khan AR, Griffin K, Riskin C (1999). Income Distribution in Urban China during the Period of Economic Reform and Globalization. *American Economic Review,* 89(2), 296-300.

Khan AR, Riskin C (2005). China's Household Income and Its Distribution, 1995 and 2002. *The China Quarterly*, 182, 356-384.

Kleven HJ, Kreiner CT, Saez E (2009). The Optimal Income Taxation of Couples. *Econometrica*, 77, 537-560.

Knight J, Song L (1993). Why Urban Wages Differ in China. In: K. Griffin(Ed). *The Distribution of Income in China.* London: Macmillan, 216-284.

Knight J, Song L, Gunatilaka R (2009). Subjective Well-Being and Its Determinants in Rural China. *China Economic Review*, 20(4), 635-649.

Korenman S, Neumark D (1992). Marriage, Motherhood, and Wages. *Journal of Human Resources*, 27(2), 233-255.

Konrad KA, Lommerud KE (1995) Family Policy with Non-Cooperative Families. The Scandinavian Journal of Economics, 97(4), 581-601.

Konrad KA, Lommerud KE (2000). The Bargaining Family Revisited. Canadian Journal of Economics, 33(2), 471-487.

Lessmann C (2013). Foreign Direct Investment and Regional Inequality: A Panel Data Analysis.. *China Economic Review*, 24, 129-149.

Li S, Song J (2013). Changes in the Gender-Wage Gap in Urban China, 1995-2007. In: Rising Inequality in China: Challenges to a Harmonious Society. New York: Cambridge University Press, 384-413.

Li H (2003). Economic Transition and Returns to Education in China. *Economics of Education Review*, 22(3), 317-328.

Liu H (2011). Economic Reforms and Gender Inequality in Urban China. *Economic Development and Cultural Change*, 59(4), 839-876.

Liu P-W, Meng X, Zhang J (2000). Sectoral Gender Wage Differentials and Discrimination in the Transitional Chinese Economy. *Journal of Population Economics*, 13(2), 331-352.

Loscocco KA, Wang X (1992). Gender Segregation in China. *Sociology and Social Research: An International Journal*, 76(3), 118-127.

Loughran DS, Zissimopoulos JM (2009). Why Wait? The Effect of Marriage and Childbearing on the Wages of Men and Women. *Journal of Human Resources*, 44(2), 505-545.

Lulumia S (2008) The Effects of Joint Taxation of Married Couples on Labor Supply and Non-Wage Income. *Journal of Public Economics*, 92(7): 1698-1719.

Lundberg S, Pollak RA (1993). Separate Spheres Bargaining and the Marriage Market. *Journal of Political Economy*, 101, 988-1010.

Lundberg S, Rose E (2000). Parenthood and the Earnings of Married Men and Women. *Labour Economics*, 7(6), 689-710.

Manser M, Brown M (1980). Marriage and Household Decision Theory-A Bargaining Analysis. *International Economic Review*, 21, 21-34.

Marini , M. M. & Fan, . P., 1997. The Gender Gap in Earnings at Career Entry. *American Sociological Review*, 62(4), 588-604.

Mincer J, Polachek S (1978). Women's Earnings Reexamined. *Journal of Human Resources*, 13(1), 118-134.

National Bureau of Statistics of China, 2011. *China Statistic Year Book* , Beijing: The Statistical Press of China.

Naughton B (1996). Growing Out of the Plan: Chinese Economic Reform, 1978-1993. New York: Cambridge University Press.

Naughton B, (1997). The Economic Foundation of a Unique Institution. In: Lu X, Perry EJ (Ed.) *Danwei: the Changing Chinese Workplace in Historical and Comparative Perspective.* Armonk: Sharp, 169-194.

Maurer-Fazio, M., 1999. Income and Education in China's Transition to a Market Economy Survey Evidence From 1989 and 1992. *China Economic Review*, 10(1), 17-40.

Maurer-Fazio M, Hughes J (2002). The Effects of Market Liberalization on the Relative Earnings of Chinese Women. *Journal of Comparative Economics*, 30(4), 709-731.

McElroy M, Horney M (1981). Nash-Bargained Decisions: Toward a Generalization of the Theory of Demand. *International Economic Review*, 22, 333-349.

Meier V, Rainer H (2012). On the Optimality of Joint Taxation for Non-cooperative couples. *Labour Economics*, 19(4), 633-641.

Meier V, Wrede M (2011). Reducing the Excess Burden of Subsidizing the Stork: Joint Taxation, Individual Taxation, and Family Tax Splitting. *Journal of Population Economics*, 26(3), 1195-1207.

Meng X (2012). Labor Market Outcomes and Reforms in China. *Journal of Economic Perspectives*, 26(4), 75-102.

Neumark D (1988). Employers' Discriminatory Behavior and the Estimation of Wage Discrimination. *The Journal of Human Resources*, 23(3), 279-295.

News Office of State Council (2004). White Paper of China's Employment Situation and Policies, Beijing.

Ng YC (2007). Gender Earnings Differentials and Regional Economic Development in Urban China, 1988-97. *Review of Income and Wealth*, 53(1), 148-166.

Nielsen HS, Simonsen M, Verner M (2004). Does the Gap in Family-Friendly Policies Drive the Family Gap? *Scandinavian Journal of Economics*, 106(4), 721-744.

Oaxaca RL (1973). Male-Female Wage Differentials in Urban Labor Markets. *International Economic Review*, 14(3), 693-709.

Oaxaca RL, Ransom MR (1994). On Discrimination and the Decomposition of Wage Differentials. *Journal of Econometrics*, 61(1), 5-21.

Oaxaca RL, Regan TL (2009). Work Experience As a Source of Specification Error in Earnings Models: Implications for Gender Wage Decompositions. *Journal of Population Economics*, 22(2), 463-499.

O'Neill J (1981). Family Issues in Taxation. In: Penner RG (Ed.) Taxing the Family. American Enterprise Institute, Washington.

Ott N (1995). Fertility and Division of Work in the Family: A Game Theoretic Model of Household Decisions. In: Kuiper E, Sap J (Ed.) Out of the Margin: Feminist Perspectives on Economics. London and New York: Routledge.

Phipps S, Burton P, Lethbridge L (2001). In and Out of the Labour Market: Long-Term Income Consequences of Child-Related Interruptions to Women's Paid Work. *Canadian Journal of Economics*, 34(2), 411-429.

Poletaev M, Robinson C (2006). Human Capital Specificity: Evidence from the Dictionary of Occupational Titles and Displaced Worker Surveys, 1984-2000. Journal of Labor Economics, 26(3), 387-420.

Shen J, Deng X (2008). Gender Wage Inequality In the Transitional Chinese Economy: A Critical Review of Post-Reform Research. *Journal of Organisational Transformation & Social Change*, 5(2), 109-127.

Smith J, Welch F (1989). Black Economic Progress after Myrda. *Journal of Economic Literatur*, 27(2), 519-564.

State Council of the People's Republic of China (2004). China's Employment Situation and Policies, Beijing.

Suen W (1997). Decomposing Wage Residuals: Unmeasured Skill or Statistical Artifact. *Journal of Labor Economics*, 15(3), 555-566.

Piggott J, Whalley J (1996). Tax Unit and Household Production. *Journal of Political Economy*, 104(2): 398-418.

Pollak RA (1985). A Transaction Cost Approach to Families and Households. *Journal of Economic Literature*, 23(2), 581-608.

Stark O, Falk I (1998). Transfers, Empathy Formation, and Reverse Transfers. *American Economic Review*, 88(2), 271-276.

Taniguchi H (2000). The Timing of Childbearing and Women's Wages. *Journal of Marriage and the Family*, 61(4), 1008-1019.

Thomas J, Worrall T (2010). Income Fluctuations and Asymmetric Information: An Example of the Repeated Principal Agent Problem. Levine's Working Paper Archive 2077.

The Case for Mandatory Separate Filing by Married Persons (1981). The Case for Mandatory Separate Filing by Married Persons. The Yale Law Journal, 91(2), 363-382. http://doi.org/10.2307/796016.

Todd EL (2001). Educational Attainment and Family Gaps in Women's Wages: Evidence from Five Industrialized Countries. Technical Report, Unpublished Manuscript.

Tusneem ME (2003). Private Sector Assessment: People's Republic of China. Asian Development Bank.

Waldfogel J (1997). The Effect of Children on Women's Wages. *American Sociological Review*. 62(2), 209-217.

Waldfogel J (1998). The Family Gap for Young Women in the United States and Britain: Can Maternity Leave Make a Difference? *Journal of Labor Economics*, 16(3), 505-545.

Waldfogel J, Harkness S (2003). The Family Gap in Pay: Evidence from Seven Industrialized Countries. In: Research in Labor Economics (ED). Polachek SW. 22, 369-413.

Warner M, Goodall K, Ding DZ (1999). The "Myth" of Human Resource Management in Chinese Enterprises. *Asia Pacific Business Review*, 5(3), 223-237.

Wellington A (1993). Changes in the Male Female Wage Gap (1976-95). *Journal of Human Resources*, 28(2), 383-411.

World Bank (2013). China 2030: Building a Modern, Harmonious, and Creative Society. Washington, DC: World Bank.

Yueh L (2004). Wage Reforms in China during the 1990s. *Asian Economic Journal*, 18(2), 149-164.

Zhang J, Han J, Liu P-W, Zhao Y (2008). Trends in the Gender Earnings Differential in Urban China, 1988-2004. *Industrial and Labor Relations Review*, 61(2), 224-243.

Zhang J, Zhang J (2003). Long-Run Effects of Unfunded Social Security with Earnings-Dependent Benefits. *Journal of Economic Dynamics and Control*, 28(3), 617-641.

Zhang L, Dong XY (2008). Male-Female Wage Discrimination in Chinese Industry Investigation Using Firm-Level Data. *Economics of Transition*, 16(1), 85-112.

Zhang Z (2006). Competition or Privatization: China's Experience in SOE Reform. *Journal of the Washington Institute of China Studies*, 1(1), 37-59.

Zhou M (2016). Labor's Share of Income: Another Key to Understand China's Income Inequality. Singapore: Spring Science Business Media.

Appendix A. Technical Notes for Chapter 1

With Transfer Program

Under individual taxation with intra-family transfer, the individual utility functions for husband and wife are given by

$$U^m = (1-\tau_m^I)w_m L_m + \theta(g_m + g_f) - \frac{1}{2}\alpha g_m^2 + \rho(\tau_m^I w_m L_m + \tau_f^I w_f L_f);$$

$$U^f = (1-\tau_f^I)w_f L_f + \theta(g_m + g_f) - \frac{1}{2}\beta g_f^2 + (1-\rho)(\tau_m^I w_m L_m + \tau_f^I w_f L_f).$$

The husband and the wife solve their own maximization of altruistic utility function, which is written as $Z^m = U^m + \delta U^f$ and $Z^f = U^f + \delta U^m$, respectively

$$\frac{\partial Z^m}{\partial g_m} = \theta - w_m + \theta\delta - \alpha g_m + (1-\rho)(1-\delta)\tau_m^I w_m = 0;$$

$$\frac{\partial Z^f}{\partial g_f} = \theta - w_f + \theta\delta - \beta g_f + \rho(1-\delta)\tau_f^I w_f = 0.$$

Comparative static analysis indicates that the impact of intra-household transfer and the degree of altruism on each spouse's labor supply and individual tax rates are given by the following:

$$\frac{\partial \bar{L}_m^I}{\partial \rho} = 0; \quad \frac{\partial \bar{L}^f}{\partial \rho} = 0; \quad \frac{\partial \bar{L}_f^I}{\partial \delta} = -\frac{\theta}{2\alpha}; \quad \frac{\partial \bar{L}^f}{\partial \delta} = -\frac{\theta}{2\beta};$$

$$\frac{\partial \bar{\tau}_m^I}{\partial \rho} = \frac{\alpha + w_m - (1-\delta)\theta}{2w_m(1-\delta)(1-\rho)^2} > 0; \frac{\partial \bar{\tau}_f^I}{\partial \rho} = -\frac{\beta + w_f - (1-\delta)\theta}{2w_f(1-\delta)\rho^2} < 0$$

$$\frac{\partial \bar{\tau}_m^I}{\partial \delta} = \frac{\alpha + w_m - 2\theta}{2w_m(1-\rho)(1-\delta)^2} > 0 \text{ if } \alpha + w_m > 2\theta;$$

$$\frac{\partial \bar{\tau}_f^I}{\partial \delta} = \frac{\beta + w_f - 2\theta}{2w_f\rho(1-\delta)^2} > 0 \text{ if } \beta + w_f > 2\theta.$$

Under joint taxation with intra-family transfer, the individual utility functions for husband and wife are given by,

$$U^m = (1-\tau^J)w_m L_m + \theta(g_m + g_f) - \frac{1}{2}\alpha g_m^2 + \rho(\tau^J w_m L_m + \tau_f^I w_f L_f);$$

$$U^f = (1-\tau^J)w_f L_f + \theta(g_m + g_f) - \frac{1}{2}\beta g_f^2 + (1-\rho)(\tau^J w_m L_m + \tau_f^I w_f L_f).$$

Husband and wife solve their own maximization of altruistic utility function $Z^i = U^i + \delta U^{-i}$ (for $i = m, f$) by using the first order condition:

$$\frac{\partial \bar{\tau}_f^I}{\partial \delta} = \frac{\beta + w_f - 2\theta}{2w_f \rho(1-\delta)^2} > 0 \text{ if } \beta + w_f > 2\theta;$$

$$\frac{\partial Z^f}{\partial g_f} = \theta - w_f + \theta\delta - \beta g_f + \rho(1-\delta)\tau^J w_f = 0.$$

Similarly, comparative static analysis investigates the impact of intra-household transfer and the degree of altruism on individual's labor supply and tax rate:

$$\frac{\partial \bar{L}_m^J}{\partial \rho} = \frac{w_m w_f^2(\beta w_m(\alpha + w_m - \theta(1+\delta)) + \alpha w_f(\beta + w_f - \theta(1+\delta))}{(2(1-\rho)\beta w_m^2 + \alpha\rho w_f^2)^2}.$$

For type 1 household or when spouses have same wage earnings $(\alpha + w_m = \beta + w_f)$, $\frac{\partial \bar{L}_m^J}{\partial \rho} > 0$ is satisfied if $\alpha + w_m > \theta(1+\delta)$ & $\beta + w_f > \theta(1+\delta)$. For type 2 household or when husband is the primary earner and earn higher wage income $\alpha + w_m > \beta + w_f$. And $\frac{\partial \bar{L}_m^J}{\partial \rho} > 0$ would be held if $\beta + w_f > \theta(1+\delta)$.In both cases, $\beta + w_f > \theta(1+\delta)$ is the sufficient condition for $\frac{\partial \bar{L}_m^J}{\partial \rho} > 0$.

$$\frac{\partial \bar{L}_f^J}{\partial \rho} = -\frac{w_f w_m^2(\beta w_m(\alpha + w_m - \theta(1+\delta)) + \alpha w_f(\beta + w_f - \theta(1+\delta))}{(2(1-\rho)\beta w_m^2 + \alpha\rho w_f^2)^2}.$$

For type 1 household when $\alpha + w_m = \beta + w_f$, the condition of $\frac{\partial \bar{L}_f^J}{\partial \rho} > 0$ holds if both $\alpha + w_m < \theta(1+\delta)$ & $\beta + w_f < \theta(1+\delta)$ holds. For type 2 household when $\beta + w_f < \alpha + w_m$, the condition that $\frac{\partial \bar{L}_f^J}{\partial \rho} > 0$ is satisfied when $\alpha + w_m < \theta(1+\delta)$. In both cases, the sufficient condition for $\frac{\partial \bar{L}_f^J}{\partial \rho} > 0$ is $\alpha + w_m < \theta(1+\delta)$.

$$\frac{\partial \bar{L}_m^J}{\partial \delta} = -\frac{\theta(2\alpha\rho w_f^2 + w_m(1-\rho)(\beta w_m - \alpha w_f))}{2\alpha((1-\rho)\beta w_m^2 + \alpha\rho w_f^2)} < 0 \text{ if } \frac{w_m}{\alpha} \geq \frac{w_f}{\beta};$$

$$\frac{\partial \bar{L}_f^J}{\partial \delta} = -\frac{\theta(2\beta(1-\rho)w_m^2 + w_f\rho(\alpha w_f - \beta w_m))}{2\beta((1-\rho)\beta w_m^2 + \alpha\rho w_f^2)} < 0 \text{ if } \frac{w_f}{\beta} \geq \frac{w_m}{\alpha}.$$

Individual i's labor supply strictly decreases as the degree of altruism if his or her marginal rate of substitution between market work and home production is greater and equal to which of his or her spouse's.

$$\frac{\partial \bar{\tau}^{J}}{\partial \rho} = -\frac{\bar{\tau}^{J}(\beta w_m^2 - \alpha w_f^2)}{\beta w_m((1-\rho)\beta w_m^2 + \alpha\rho w_f^2)} \geq 0 \text{ if } \frac{w_m}{\alpha} \geq \frac{w_f}{\beta}.$$

For type 1 household $\frac{w_f}{w_m} = \frac{\beta}{\alpha}$, the marginal tax rate doesn't affect by the shares of transfer $\frac{\partial \bar{\tau}^{J}}{\partial \rho} = 0$. While for type 2 household, the marginal tax rate increases with a higher share of transfer is given to the husband if his marginal rate of substitution between market work and home production is higher than which of his spouse's. The marginal tax rate is reversely related to the degree of altruism, under joint taxation.

$$\frac{\partial \bar{\tau}^{J}}{\partial \delta} = \frac{\bar{\tau}^{J}}{2\beta(1-\rho)w_m} > 0.$$

Without Transfer Program

For individual taxation, the individual utility functions for husband and wife are given by the following, when there is no intra-family transfer between them:

$$U^m = (1-\tau_m^I)w_m L_m + \theta(g_m + g_f) - \frac{1}{2}\alpha g_m^2;$$

$$U^f = (1-\tau_f^I)w_f L_f + \theta(g_m + g_f) - \frac{1}{2}\beta g_f^2.$$

Individual optimizes his or her time between work and home production to maximize the altruistic utility function, which is specified as $Z^i = U^i + \delta U^{-i}$ for $i = m, f$. The solution of optimal labor supply is given by following:

$$\bar{L}_m^I = \frac{\alpha + w_m - \theta(1+\delta)}{2\alpha}; \quad \bar{L}_f^I = \frac{\beta + w_f - \theta(1+\delta)}{2\beta};$$

The optimal individual tax rates are:

$$\bar{\tau}_m^I = \frac{\alpha + w_m - \theta(1+\delta)}{2w_m}; \quad \bar{\tau}_f^I = \frac{\beta + w_f - \theta(1+\delta)}{2w_f};$$

For joint taxation, similarly, the altruistic functions for both husband and wife are:

$$U^m = (1-\tau^J)w_m L_m + \theta(g_m + g_f) - \frac{1}{2}\alpha g_m^2;$$

$$U^f = (1-\tau^J)w_f L_f + \theta(g_m + g_f) - \frac{1}{2}\beta g_f^2.$$

The solution to each spouse's optimal time allocation between market and home production is given

$$\bar{L}_m^J = \frac{\beta w_m^2(\alpha + w_m - (1+\delta)\theta) + \alpha w_f^2(2\alpha + w_m - 2(1+\delta)\theta) + \alpha w_m w_f((1+\delta)\theta - \beta)}{2\alpha(\alpha w_f^2 + \beta w_m^2)};$$

$$\bar{L}_f^J = \frac{\alpha w_f^2(\beta + w_f - (1+\delta)\theta) + \beta w_m^2(2\beta + w_f - 2(1+\delta)\theta) + \beta w_m w_f((1+\delta)\theta - \alpha)}{2\beta(\alpha w_f^2 + \beta w_m^2)}.$$

The solution to the government's problem is

$$\bar{\tau}^J = \frac{\beta w_m^2 + \alpha w_f^2 + \alpha\beta(w_m + w_f) - \theta(1+\delta)(\beta w_m + \alpha w_f}{2(\alpha w_f^2 + \beta w_m^2)}.$$

Appendix B. Tables for Chapter 2

Summary Statistics of Log Earnings for Low Privatized Region

	1995		2002	
	Male	Female	Male	Female
Age Groups:				
16-25	5.621	5.509	6.133	6.035
	(0.660)	(0.761)	(0.631)	(0.511)
26-35	6.010	5.907	6.509	6.377
	(0.556)	(0.593)	(0.554)	(0.613)
36-45	6.225	6.113	6.643	6.473
	(0.466)	(0.482)	(0.488)	(0.527)
46-60	6.355	6.145	6.678	6.522
	(0.484)	(0.593)	(0.511)	(0.512)
Marital Status:				
Married	6.231	6.037	6.637	6.456
	(0.503)	(0.561)	(0.505)	(0.550)
Others	5.657	5.610	6.185	6.205
	(0.682)	(0.785)	(0.644)	(0.594)
Nature of Jobs:				
Permanent	6.209	6.053	6.685	6.591
	(0.528)	(0.554)	(0.490)	(0.474)
Temporary	5.975	5.610	6.185	6.205
	(0.638)	(0.725)	(0.576)	(0.581)
Levels of Education:				
College and above	6.414	6.300	6.930	6.769
	(0.445)	(0.422)	(0.467)	(0.486)
Professional School	6.210	6.133	6.671	6.563
	(0.476)	(0.581)	(0.513)	(0.499)
High School and Below	6.083	5.884	6.452	6.224
	(0.610)	(0.608)	(0.514)	(0.561)
Ownership Sector:				
State Sector	6.200	6.049	6.658	6.511
	(0.526)	(0.581)	(0.497)	(0.529)
Non-State Sector	5.830	5.665	6.393	6.217
	(0.610)	(0.608)	(0.604)	(0.583)
Occupation:				
Professional or technician	6.310	6.213	6.780	6.684
	(0.451)	(0.482)	(0.530)	(0.468)
Director of government	6.374	6.327	6.837	6.778
	(0.383)	(0.418)	(0.402)	(0.271)
Office Stuff	6.110	6.004	6.622	6.499
	(0.513)	(0.526)	(0.465)	(0.509)
Labor	6.015	5.796	6.381	6.168
	(0.651)	(0.666)	(0.539)	(0.561)
Industry:				
Manufacturing	6.110	5.932	6.451	6.242
	(0.606)	(0.624)	(0.494)	(0.541)
Commerce and Retail	6.210	6.133	6.206	6.081
	(0.476)	(0.581)	(0.656)	(0.607)
Education, Culture and Art	6.414	6.300	6.897	6.677
	(0.445)	(0.422)	(0.429)	(0.418)
Public Service	6.210	6.133	6.763	6.674
	(0.476)	(0.581)	(0.372)	6.674
Financial and Other Service	6.261	6.053	6.635	6.482
	(0.512)	(0.630)	(0.570)	(0.575)

Note: The samples consists of individuals aged 16 and 60. Means and standard deviations for the male and female workers, and gender mean earnings gaps, are measured in log points. Data source: CHIP 1995, 2002 and 2007.

Summary Statistics of Log Earnings for Moderate Privatized Region

	1995		2002		2007	
	Male	Female	Male	Female	Male	Female
Age Groups:						
16-25	5.930	5.854	6.228	6.113	6.324	6.464
	(0.611)	(0.722)	(0.603)	(0.720)	(0.503)	(0.490)
26-35	6.299	6.163	6.550	6.371	6.888	6.612
	(0.556)	(0.530)	(0.539)	(0.574)	(0.599)	(0.580)
36-45	6.457	6.299	6.654	6.395	6.751	6.490
	(0.612)	(0.525)	(0.553)	(0.576)	(0.682)	(0.659)
46-60	6.549	6.163	6.686	6.487	6.743	6.346
	(0.503)	(0.699)	(0.569)	(0.618)	(0.619)	(0.599)
Marital Status:						
Married	6.470	6.215	6.662	6.416	6.781	6.492
	(0.560)	(0.590)	(0.560)	(0.587)	(0.632)	(0.638)
Others	5.959	5.980	6.356	6.210	6.554	6.501
	(0.648)	(0.635)	(0.615)	(0.691)	(0.780)	(0.524)
Nature of Jobs:						
Permanent	6.444	6.239	6.741	6.591	6.965	6.789
	(0.598)	(0.586)	(0.547)	(0.540)	(0.625)	(0.511)
Temporary	6.242	6.036	6.481	6.207	6.596	6.346
	(0.575)	(0.624)	(0.575)	(0.603)	(0.645)	(0.617)
Levels of Education:						
College and above	6.634	6.374	7.000	6.889	7.148	6.944
	(0.533)	(0.546)	(0.552)	(0.497)	(0.526)	(0.488)
Professional School	6.481	6.413	6.726	6.528	6.785	6.599
	(0.579)	(0.559)	(0.537)	(0.609)	(0.687)	(0.570)
High School and Below	6.322	6.079	6.487	6.220	6.535	6.222
	(0.603)	(0.592)	(0.550)	(0.553)	(0.605)	(0.578)
Ownership Sector:						
State Sector	6.425	6.237	6.722	6.519	6.825	6.674
	(0.597)	(0.606)	(0.544)	(0.569)	(0.666)	(0.554)
Non-State Sector	6.299	6.058	6.447	6.186	6.684	6.372
	(0.592)	(0.567)	(0.586)	(0.604)	(0.651)	(0.632)
Occupation:						
Professional or technician	6.480	6.398	6.806	6.644	6.945	6.781
	(0.504)	(0.495)	(0.528)	(0.549)	(0.608)	(0.537)
Director of government	6.664	6.619	6.890	6.792	7.077	6.861
	(0.497)	(0.645)	(0.530)	(0.632)	(0.537)	(0.632)
Office Stuff	6.444	6.238	6.644	6.501	6.814	6.635
	(0.676)	(0.632)	(0.530)	(0.587)	(0.587)	(0.596)
Labor	6.227	6.014	6.453	6.183	6.529	6.262
	(0.599)	(0.571)	(0.563)	(0.558)	(0.679)	(0.549)
Industry:						
Manufacturing	6.342	6.097	6.542	6.323	6.764	6.490
	(0.589)	(0.538)	(0.558)	(0.535)	(0.547)	(0.549)
Commerce and Retail	6.289	6.086	6.346	6.113	6.520	6.264
	(0.656)	(0.548)	(0.563)	(0.568)	(0.629)	(0.668)
Education, Culture and Art	6.543	6.394	6.979	6.642	6.996	6.742
	(0.520)	(0.523)	(0.514)	(0.587)	(0.484)	(0.487)
Public Service	6.570	6.386	6.830	6.701	6.893	6.765
	(0.541)	(0.860)	(0.527)	(0.547)	(0.600)	(0.524)
Financial and Other Service	6.532	6.344	6.661	6.403	6.725	6.485
	(0.591)	(0.646)	(0.563)	(0.643)	(0.762)	(0.637)

Summary Statistics of Log Earnings for High Privatized Region

	2002		2007	
	Male	Female	Male	Female
Age Groups:				
16-25	6.877	6.868	6.837	6.793
	(0.581)	(0.663)	(0.536)	(0.533)
26-35	7.191	6.978	7.227	6.985
	(0.615)	(0.590)	(0.661)	(0.621)
36-45	7.223	6.929	7.223	6.796
	(0.576)	(0.568)	(0.702)	(0.665)
46-60	7.174	7.045	7.031	6.619
	(0.526)	(0.553)	(0.676)	(0.648)
Marital Status:				
Married	7.212	6.976	7.156	6.822
	(0.545)	(0.558)	(0.683)	(0.659)
Others	6.953	6.922	6.947	6.873
	(0.613)	(0.675)	(0.670)	(0.590)
Nature of Jobs:				
Permanent	7.240	7.126	7.264	7.045
	(0.534)	(0.545)	(0.609)	(0.636)
Temporary	7.109	6.861	7.050	6.762
	(0.582)	(0.575)	(0.711)	(0.637)
Levels of Education:				
College and above	7.533	7.398	7.531	7.301
	(0.583)	(0.498)	(0.683)	(0.676)
Professional School	7.287	7.106	7.203	6.986
	(0.578)	(0.543)	(0.651)	(0.573)
High School and Below	7.022	6.799	6.928	6.556
	(0.493)	(0.555)	(0.631)	(0.556)
Ownership Sector:				
State Sector	7.209	7.047	7.223	6.990
	(0.540)	(0.543)	(0.653)	(0.647)
Non-State Sector	7.103	6.842	7.066	6.757
	(0.598)	(0.609)	(0.698)	(0.636)
Occupation:				
Professional or technician	7.390	7.209	7.307	7.140
	(0.530)	(0.544)	(0.636)	(0.666)
Director of government	7.489	7.383	7.563	7.186
	(0.539)	(0.553)	(0.655)	(0.583)
Office Stuff	7.248	7.031	7.156	6.940
	(0.497)	(0.484)	(0.675)	(0.609)
Labor	6.951	6.705	6.941	6.624
	(0.486)	(0.563)	(0.638)	(0.576)
Industry:				
Manufacturing	7.092	6.917	7.047	6.741
	(0.497)	(0.567)	(0.674)	(0.656)
Commerce and Retail	7.054	6.821	7.043	6.701
	(0.573)	(0.663)	(0.707)	(0.609)
Education, Culture and Art	7.333	7.170	7.252	7.011
	(0.480)	(0.531)	(0.587)	(0.633)
Public Service	7.342	7.027	7.362	6.996
	(0.566)	(0.495)	(0.677)	(0.608)
Financial and Other Service	7.197	7.005	7.156	6.883
	(0.611)	(0.569)	(0.686)	(0.655)