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HOUSEHOLD CONSUMPTION AND LABOR SUPPLY RESPONSE TO
ECONOMIC SHOCKS IN RUSSIA

By

Ren Mu

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ABSTRACT

HOUSEHOLD CONSUMPTION AND LABOR SUPPLY RESPONSE TO ECONOMIC SHOCKS IN RUSSIA

By

Ren Mu

This dissertation consists of three chapters. The first two chapters are empirical studies on household consumption and labor supply response to economic shocks, using the data from the Russian Longitudinal Monitory Survey (RLMS). The third chapter studies the econometric estimation methods in an unevenly spaced panel data.

Chapter 1. "Risk, Consumption, Wealth and Human Capital: Evidence from Russia". This paper investigates Russian households' consumption response to the income shocks. In particular, this paper examines the effects of education and wealth on the ability of the households to smooth their consumption. A random coefficient model of average treatment effect that allows for endogenous variables is implemented in the estimation. After correcting for the possible sample attrition by the inverse probability-weighting method, this paper finds that consumption is only partially protected from idiosyncratic shocks. The analysis also provides evidence that households in the wealthier group can smooth their consumption better. In addition, education of the household members in the high asset group increases their consumption smoothing ability while no education effect is detected in the low asset group.

Chapter 2. "Multiple Job Holdings As a Way to Smooth Consumption: Labor Response to Wage Arrears Among Russian Couples". This paper tests the hypothesis that labor supply in the form of multiple job holdings was effective in the attempts of households to maintain consumption when their income was declining during the Russian economic transition period. The theoretical framework shows that the possibility of holding secondary job(s) for an individual increases with the possibility of getting wage arrears in their primary job. The paper applies the "Chamberlain" approach to a dynamic probit model of the decision to hold multiple jobs. It finds that both husbands and wives are more likely to take secondary informal jobs when they have wage arrears shocks in their primary jobs. The combined regression results from the reduced form and structural estimation of households consumption suggest that the insignificant effect of wage arrears on consumption reflect, to certain extent, the adjustment of secondary job holdings.

Chapter 3. "Estimation With or Without Straight Exogeneity Assumption in Unevenly Spaced Panel Data". This paper studies the econometric estimation methods for unevenly spaced data, which is very common in the survey data conducted in developing countries. Classic minimum distance, and one-step GMM estimators are used to impose the non-linear parameter restrictions in dynamic models. The paper also shows that these two methods also can be applied to estimations without strict exogeneity assumption.

To Xu and Chengcheng

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Chapter 1

Risk, Consumption, Wealth and Human Capital: Evidence From Russia

1.1 Introduction

Several years into the economic and social transition in Russia, many households have been in an environment of considerable economic uncertainty. The risk of wage nonpayment to working men and women is pervasive and the incidence of pension denial to retired people is high (Lokshin and Ravallion, 2000; Stillman 2001, Jensen and Richter 2002).¹ In 1998, when the Russian government abandoned its defense of a strong ruble exchange rate against the dollar and defaulted on the government domestic debt, one of the most serious financial crises hit the

¹Based on Russian Longitudinal Monetary Survey (RLMS), the wage nonpayment rate in 1994, 1995, 1996, 1998 and 2000 is 38.8%, 40.4%, 57%, 59% and 27% respectively. The rate of pension nonpayment in these years is 3.3%, 8.4%, 33.3%, 15.1% and 2.7% respectively.

economy.² Two years after that economic shock, there has been substantial increase in incomes, but the economic wellbeing of the households has not been fully recovered (Mroz, Henderson and Popkin 2002).

Using the data from the Russian Longitudinal Monitory Survey (RLMS), we can clearly see several features in the fluctuations of the households' income and consumption over the years (Table 1.1). Russian households have experienced several years of income decline since 1994.³ In November 1998, three months after the financial crisis, households income per capita dropped by 60% compared to 1994. In 2000, income per capita increased by 24% from 1998 and consumption increased by 19%, but consumption still remains the second lowest since 1994. Moreover, this trend holds true even after geographic variations are controlled (Column 2, 4 of Table 1.1).

This paper asks a simple question: in such a tumultuous transition period, how well have Russian households been dealing with their income shocks? Particularly, this paper investigates the consumption smoothing ability of the households. Previous research on consumption smoothing in Russia has found limited consumption smoothing among households (Stillman 2001). Most of the empirical tests for perfect consumption smoothing in developing countries find real and sig-

² Official Russian statistics estimate the Russian real GDP contracted 4.6% in 1998. The inflation rate, using the consumer price index, hit 84.4% and the interest rate on treasury bill rose from 27.8% in May 1998 to 135.3% in August 1998. Unemployment rate had reached close to 12% having increased from 7.0% in 1997. See Mroz and Popkin (1999), Cooper (1999).

³The panel data in RLMS has covered 1994, 1995, 1996 1998 and 2000. Russian GDP grew slightly only in 1997 (0.4%), the first case since 1992. See Lokshin and Ravallion (2000)

nificant consumption smoothing, that is, for many households consumption does not track household income particularly well regardless of the lack of efficient financial infrastructure and well-functioning social security, but the studies also reject the existence of full consumption insurance (Townsend 1995, Morduch 1995). At the same time, empirical studies have also found that households with different characteristics respond differently to income shocks. Wealthy households or households with more assets such as land are found to be better insured against income shocks (Townsend 1994, Morduch 1995, Jalan and Ravallion 1999). This paper looks at the potential effect of education on household consumption smoothing. The households with high-education members might, for instance, be able to better obtain information and plan their expenditure, thus shielding consumption from short-run fluctuations in individual income. This education effect is particularly interesting is because it provides one piece of empirical evidence to test the hypothesis that the ability of to deal successfully with economic disequilibria is enhanced by education.⁴ Schultz (1975) argues that educated individuals adapt more easily as economic circumstances change, using assets more efficiently, obtaining better credit arrangements and exploiting new income opportunities more quickly. Under this hypothesis, we expect to see that households with higher levels of human capital would have more allocative efficiency and thus do better in

⁴Welch (1970) stressed that the role of education in production may directly contribute to physical product, which is the “worker effect” of education. On the other hand, increased education may enhance a worker’s ability to acquire and decode information about costs and productive characteristics of the other inputs. This is “allocative effect” of education. Schultz (1975) contributes the enhanced ability of dealing with disequilibrium to the “allocative effect of” education.

smoothing their consumption against income shocks.⁵

The identification of this effect is complicated because education enhances the earning and thus the wealth of the households, and the wealth in turn enhances the consumption smoothing ability of the households. To separate the education effect, which might be over and above the wealth effect, I stratify the sample into two wealth groups. Further, in each wealth group, the impact of income change on consumption is allowed to depend on the maximum education level of adult household members. Due to the endogeneity of income change and the fact that the coefficient of income change on consumption change may differ across households with differing human capital, I implement a two-step method using a random coefficient model following Wooldridge (2002b). At the first step, income changes of the households are predicted by exogenous shocks. The second step involves using the predicted income change and the predicted income change interacted with education variable as instrumental variables to estimate the main effect of income change and the education effect on consumption smoothing.

The empirical work in this paper uses data from phase two of the Russian Longitudinal Monitoring Survey (RLMS), for the years 1994, 1995, 1996, 1998 and 2000 (Rounds IV-VIII).⁶ This survey is designed as a repeated sample of house-

⁵ Glewwe and Hall (1998) found that households with better educated heads are less vulnerable to macro-economic shocks in Peru. The vulnerability is measured by change in per capita consumption.

⁶ The regression analysis doesn't include the 1994 data because the information of years of education of the household members is not available.

hold dwellings, not of each household itself. Evidence is found that the households move out and thus attrition from the survey are intrinsically different from the households which remain in the survey. To address this problem, a predicted weight associated with attrition probability is assigned to each household. This inverse probability weighting scheme corrects sample attrition and leads to consistent estimators (Wooldridge 2002a; Wooldridge 2002c).

The paper proceeds as follows. Section 2 reviews the theory of full consumption insurance and its testable implications. Section 3 summarizes the data used to test the hypothesis. The evidence of a possible attrition problem is presented in Section 4 and the inverse probability weighting to correct for attrition is explained. Section 5 discusses the endogeneity of income change and the implementation of the random coefficient model of average treatment effect to estimate the main effect of income change, as well as the interaction of income change and education. Empirical results are discussed in section 6. We find that income changes matter to consumption change, so there is no perfect consumption smoothing. We also find evidence supporting the hypothesis that education of household members enhances the consumption smoothing in the high wealth group but not in the low wealth group. Section 7 concludes the paper.

1.2 Theoretical Framework and Empirical Implications

1.2.1 A Full Consumption Insurance Model

The full consumption insurance outcome can be obtained through a risk sharing model cast in the setting of a social planner, where the planner maximizes the sum of weighted utilities of individuals subject to an aggregated resource constraint (Mace 1991; Cochrane 1991; Townsend 1994; McCarthy 1995).⁷ Assume a single-good economy⁸ with N households and each of them lasts for T periods. Household i has state contingent time separable utility $U(C_{\tau t}^i(s_{\tau t}, \delta_{\tau t}^i))$, where $C_{\tau t}^i$ is the consumption per capita of household i in the state of τ at time t ; $s_{\tau t}$ is the state of the world at time t , $\tau = 1, 2, \dots, s$; and $\delta_{\tau t}^i$ is taste shifters of the household i . Let $\pi(s_{\tau t})$ denote the subjective prediction about state τ at time t with $\sum_{\tau=1}^s \pi(s_{\tau t}) = 1$, where $\pi(s_{\tau t})$ captures the expectation about the uncertainty. So the life time discounted expected utility of household i is: $U_i = \sum_{\tau=1}^S \sum_{t=1}^T \frac{1}{(1+\rho_i)^t} \pi(s_{\tau t}) U(C_{\tau t}^i(s_{\tau t}, \delta_{\tau t}^i))$, where ρ_i indicates the time discount rate of household i and $\delta_{\tau t}^i$ is the taste shifters of household i . If the households are to pool their resources together and insure each other against idiosyncratic shocks, this is equivalent to a social planner maximizing a weighted sum of

⁷Such optimal risk sharing allocation can also be achieved as a competitive equilibrium in a decentralized economy with complete contingent markets (Arrow 1964; Townsend 1994; Deaton 1997).

⁸The full consumption insurance implications continue to hold for the multiple good economy (Mace 1991).

household utilities subject to an overall constraint at each time and in each state of the world. Then the Pareto-optimal consumption allocations can be derived from the planning problem

$$\text{Max} \sum_{i=1}^N w_i \sum_{\tau=1}^S \sum_{t=1}^T \frac{1}{(1+\rho_i)^t} \pi(s_{\tau t}) U(C_{\tau t}^i(s_{\tau t}, \delta_{\tau t}^i)) \quad (1.1)$$

$$\text{s.t.} \quad \sum_{i=1}^N C_{\tau t}^i(s_{\tau t}, \delta_{\tau t}^i) = C^A(s_{\tau t}) \quad \tau = 1, 2, \dots, S; t = 1, 2, \dots, T. \quad (1.2)$$

where $C^A(s_{\tau t})$ is the total amount of the consumption good available at each time t in each state τ ; w_i is the weight assigned to household i with $w_i > 0$ and $\sum_{i=1}^N w_i = 1$ for $i = 1, 2, \dots, N$. The control variable for the social planner is $C_{\tau t}^i$, the consumption of household i at each time given the state of the world. Take the derivative with respect to $C_{\tau t}^i$, the first-order conditions for the problem maximizing (1.1) subject to (1.2) are:

$$w_i \pi(s_{\tau t}) \frac{1}{(1+\rho_i)^t} U'(C_{\tau t}^i(s_{\tau t}, \delta_{\tau t}^i)) = \lambda(s_{\tau t}) \quad (1.3)$$

where $\lambda(s_{\tau t})$ is the Lagrangian multiplier at time t in the state τ . Equation (1.3) says that in the optimal resource allocation in a given state of the world, the weighted marginal utilities are equalized across individual households. When the state of τ happens, the *ex-post* counterpart of (1.3) without any uncertainty is

$$w_i \frac{1}{(1+\rho_i)^t} U'(C_t^i(\delta_t^i)) = \lambda_t \quad (1.4)$$

To remove the fixed effect of each household associated with w_i , divide (1.4) at time $t + 1$ by (1.4) and we can get

$$\frac{U'(C_{t+1}^i(\delta_{t+1}^i))}{U'(C_t^i(\delta_t^i))} \frac{1}{1 + \rho_i} = \frac{\lambda_{t+1}}{\lambda_t} \quad (1.5)$$

The right-hand side of equation (1.5) consists only of aggregate variables and it is the same for all households. This equation has the full consumption insurance implication because it says that the growth of discounted marginal utility across all the households in community should be equal and be a function of growth in λ , which is a function of growth in total resources available to the community.

This model does not imply the reference group of consumption smoothing. The “community ” here can be a village (Towsend 1994), extended households (Altonji, Hayashi and Kotlikoff 1992), ethnic lines (Grimard 1997), and asset groups or stratifications of households according to their assets level (McCarthy 1995; Jalan and Ravallion 1999). The reference group used in this paper is asset groups within each primary survey unit (PSU).⁹

⁹A PSU is identified using the variable “site ” contained in the RLMS and the table made available by the Carolina Population Center. The number of households in each PSU varies from 37 to 172.

1.2.2 Empirical Implications and Test

To derive a testable form of (1.5), suppose the utility function is a power utility ¹⁰

$$U(C_t^i(\delta_t^i)) = \exp(\sigma \delta_t^i) \frac{1}{\sigma} (C_t^i)^\sigma \quad (1.6)$$

Strict concavity requires $\sigma < 1$. The households have the same constant relative risk aversion, $(1 - \sigma)$. So

$$\frac{U'(C_t^i)}{U'(C_{t+1}^i)} = \exp^{\sigma(\delta_{t+1}^i - \delta_t^i)} \left(\frac{C_{t+1}^i}{C_t^i} \right)^{(1-\sigma)} \quad (1.7)$$

Substituting (1.7) into (1.5) and taking the logarithms, we will get the following equation as the test for perfect insurance hypothesis:

$$\begin{aligned} \log C_{t+1}^i - \log C_t^i &= \frac{1}{1 - \sigma} [\sigma(\delta_{t+1}^i - \delta_t^i) \\ &\quad + \log(1 + \rho_i) + \log\left(\frac{\lambda_{t+1}}{\lambda_t}\right)] \end{aligned} \quad (1.8)$$

Conditional on the change in taste shifters $(\delta_{t+1}^i - \delta_t^i)$ and the time discount rate of ρ_i , equation (1.8) implies that in the optimal risk allocation, the consumption growth of each household i depend only on the aggregate resource availability variables through λ_t and λ_{t+1} , but doesn't depend on the individual income growth $\log Y_{t+1}^i - \log Y_t^i$ or initial assets level of the household A_1^i . Using the above equation to test for perfect consumption insurance, we make the following assumptions.

¹⁰The specification of power utility directly gives the relationship between growth rate of individual consumption and the aggregate variables. (Mace 1991)

First, the change of taste shifter δ_t^i is a function of the change of household characteristics X_t^i such as household size and household composition as well as the household characteristics in the initial period. Discount rate ρ_i is a function of household head characteristics H_t^i such as age and sex. If the full consumption insurance hypothesis is true within community r , we can include a set of community, year and the interactions of year and community dummies (D_r, D_t and D_{rt}) to control for the community average consumption.¹¹ Then the testable econometric model of equation (1.8) takes the following form

$$\Delta \log C_t^i = \alpha_0 + \alpha_1 \Delta \log Y_t^i + \alpha_2 A_1^i + \alpha_3 \Delta X_t^i + \alpha_4 H_1^i + \alpha_5 D_t + \alpha_6 D_r + \alpha_7 D_{tr} + \varepsilon_t^i \quad (1.9)$$

If the full consumption insurance exists, then $\alpha_1 = 0$ and $\alpha_2 = 0$.

The test based on (1.9) is under the null hypothesis that there is optimal consumption allocations within a complete risk sharing system. But because of moral hazard and incomplete information, such risk sharing systems, even in the village economy, may not be viable regardless of its advantage (Deaton, 1997). In a more realistic setting, the risk sharing among individuals can be obtained through informal social networks, the formal credit market, financial markets, and insurance markets. But because incomes covary, it may be that the group is inefficient in producing insurance especially if the shock is large, as was the one in Russia during this period. Maybe also participation in the risk-sharing system may incur

¹¹Using a set of dummies is preferred to using the changes in community mean consumption. (Deaton (1992), Jalan and Ravallion (1994))

costs and thus not every household is equally likely to participate in this system and thus is not equally insured against idiosyncratic income shocks. For example, liquidity constrained households may not have access to credit market. Likewise, information constrained households are unlikely to participate in the financial market or even insurance markets if the market entrance imposes information costs. But information costs are lower for better educated people if education helps people to obtain, process and use information (Welch 1970). Then we should expect that households whose members have high education are more likely to be covered by the risk-sharing systems than households with less-well educated people. This suggests that the coefficient on the income depends on the education level of the household members. If true, we can add in an interaction term of income change and maximum education level of the household members (E^i) into the equation (1.9) and expect to see a negative sign on this interaction term. I use demeaned maximum education ($E^i - \bar{E}$) in the interaction term. In this specification, the coefficient of the change in income can be interpreted as the average treatment effect of education on consumption smoothing, that is, the consumption smoothing of the households whose members have average education level.

But one problem with this procedure is that the coefficient on the interaction term also captures the wealth effect on consumption smoothing since households with high-educated people have higher income earning ability. One possible way to separate this wealth effect of education from the allocative effect of education is to

stratify the data by assets. Thus, we estimate the following equation for two asset groups separately:

$$\begin{aligned}\Delta \log C_t^i = & \beta_0 + \beta_1 \Delta \log Y_t^i + \beta_2 \Delta \log Y_t^i \times (E^i - \bar{E}) + \beta_3 E^i + \beta_4 A_1^i + \beta_5 \Delta X_t^i + \\ & + \beta_6 H_1^i + \beta_7 D_t + \beta_8 D_r + \beta_9 D_{tr} + \epsilon_t^i\end{aligned}\tag{1.10}$$

1.3 Data and Descriptive Statistics

The data used for this paper come from the Russian Longitudinal Monitory Survey (RLMS), which was conducted by the Population Center at the University of North Carolina. The RLMS is a household-based survey designed to measure the effects of Russian reform on the economic well-being of households and individuals starting from 1992. Beginning in 1994, RLMS was designed to provide a longitudinal study of populations of dwelling units. At each round, the RLMS interview was completed with the household and its members in the original sample dwelling unit. This sampling plan did not call for households to be followed if they moved from the sample dwelling unit. Consequently, the RLMS is not a true panel design. But unique household and individual identification numbers exist in the data and can be used as a link to form a pure panel of the households who remain in the original dwelling unit over time. The detailed information on household-level income and expenditures can then be used to study the economic welfare of households in a

dynamic setting. Data on individual wage earnings, pension earnings, complete years of education and employment status are also provided. The data used for analysis are for the years 1994-1996, 1998 and 2000. In the regression analysis containing the interaction term of income change and years of education, we drop the 1994 data because it does not have the information about years of education of the household members although it has information of level of schooling.¹²

The value of assets is the estimated worth of the non-financial households assets.¹³ It is used as a proxy for household wealth. The households then are divided into two groups according to their asset levels in 1994. Total household consumption of the household is the sum of expenditures on food consumption and non-food expenditures on clothing, fuel, transportation, repair service, laundry, postal service, medical service, marriage/funeral service, rent, child support, schooling, sanatorium, travel and clubs. The growth of consumption is calculated as the logarithmic difference in consumption. Total household income is the constructed income in RLMS, which is the sum of income from the workplace; fuel subsidies; child support; pensions; asset income and transfer payment from government, relatives or friends. But some components of total income may serve to smooth consumption. For example, transfers (both private and public) may increase after the shocks.

¹²Regression including the 1994 data is presented in the Appendix. 1994 data contains only the categorical level of education of the household members, so we include three education level dummies in that regression.

¹³The assets include (1) Refrigerator; (2) Freezer; (3) Washing Machine; (4) Black & White TV; (5) Color TV; (6) VCR; (7) Car or Truck; (8) Motorcycle; (9) Tractor; (10) Garden Cottage; (11) Dacha or Other House; (12) Other Apartment. Household survey respondent was asked to estimate the current value of their assets based on the age of assets. The missing value is replaced by the reported area-age specific asset.

Including endogenous components in the income measure will result in the volatility of income shock being systematically understated (Rosenzweig, 1988; Strauss and Thomas, 1995). Because of this concern, we construct a variable we call net income, which doesn't include the endogenous components such as unemployment benefits, transfers from relatives, friends, church, mosque, foreign and international organizations; and incomes from sales and rental of assets.

Table 1.2 provides an economic and demographic profile of the sample of 1412 households with 673 households in the low asset group and 739 in the high asset group. Total income is 40.3% higher than net income for the low asset group; for the high asset group, it is 30.21% higher than net income. This large proportion of endogenous components of income indicate that households smooth their income by public and private transfer or assets selling. This justifies our concern over the endogeneity of income change. Thus, we use net income we defined above as a measure of household income in the regression analysis.

Households on average have 3.72 members. The number of senior people in the low asset group is 0.786, significantly higher than 0.605 in the high asset group. But the number of children in the high asset group is 0.906, higher than 0.673 in the low asset group. These differences in the household composition between the two assets groups may be due to the fact that households with more senior people have older assets whose estimated values are usually not as high as the assets in the households composed of relatively younger people.

Descriptive statistics of the incidence of households that report unemployment, wage arrears and pension arrears are presented in Panel B of Table 1.2. More households in the high asset group report unemployment and wage arrears, but more households in low asset group report pension arrears. They correspond, not surprisingly, to the age differentials between the two groups. Panel C of Table 1.2 presents the proportion of households which experienced fresh spells of unemployment, wage arrears or pension arrears in the month of the survey. For example, about 8.1% of the households have reported at least one household member who was newly unemployed and 8.8% of the households have wage arrears for one month or less but have not experienced wage arrears in the previous year. More households in the low asset group experienced a pension shock than in the high asset group. This may simply be due to the fact that there are more seniors in the households in low assets group.

Table 1.3 presents information of the within-household coefficient of variation (CV) of total income, net income and consumption of the households in the analysis sample. The CV at the household level is calculated as the within-household standard deviation divided by the within-household mean. The CV at the group level is the average of CVs of the households in that group. The CV of total income for both assets groups is more than 0.5. Without controlling for endogenous income smoothing, as we expect, the CV for net income is higher and is over 0.6 for both groups. On average, consumption has tighter distribution than the total

income. The Kruskal-Wallis rank test confirms that CV of consumption for the lower assets group is significantly larger than that for the high asset group. This is not surprising since we expect that households with more assets experience less volatile changes in their consumption because they can draw on their assets to smooth their consumption. The simple correlation between consumption and net income is also lower for the high asset group although the magnitude is still as big as 0.42. It means that consumption follows income and therefore the ability to smooth consumption is very limited for households in both groups, if we assume that households prefer smooth consumption.

1.4 Sample Attrition: Evidence and Correction

Among 3548 households included in the 1995 survey, 2214 of them remain in the survey for four rounds, but 1334 of them dropped out during periods of before the 2000 survey. We call these households leavers. Are the households who remain in the survey (stayers) significantly different from the leavers? Table 1.4 presents the summary statistics by attrition using 1995 data. On average, the stayers are poorer, have a less educated household head, larger household size and more senior members. Fewer stayers live in Moscow and St. Petersburg, rather more of them live in non-urban areas. All these differences between the two samples are statistically significant at 5%. Apparently, the households in our analysis sample, namely the stayers, are not a random sample from the original sample in 1995.

Using the stayers in the analysis without correcting for any potential attrition bias may result in overestimating the consumption response to income change, since the stayers are poorer and may face more credit constraint because disproportionately more of them live in non-urban areas.

There are two other variables in the data which are closely related to household attrition but may not be correlated with consumption change. They are the assessments of the interviewer about the level of cooperation of the household respondent with the survey enumerators. That is, at the end of the survey, the interviewer was asked to assess the respondent's attitude toward the interview as well as the respondent's behavior during the interview. The attitude was listed as "friendly and interested"; "not particularly interested "; "impatient and worried "; and "hostile ". The behavior includes "comfortable"; "occasionally nervous "; and "nervous ". On a scale of 1 to 4 with 1 representing the highest degree of cooperation, the mean attitude of the movers is 1.28, while the mean attitude of the stayers is 1.23. The difference is small in magnitude, but statistically significant at 5% level. It means that the households which were more willing to cooperate in the interview were more likely to stay in the survey.

Significant differences between the stayers and the movers suggest that estimates that don't correct for potential attrition appropriately might be inconsistent. We use the inverse probability weighting (IPW) method (Wooldridge 2002a) to correct potential bias from sample attrition.

Under the key assumption that sample attrition is ignorable with respect to the consumption growth conditional on the observables in the attrition equation¹⁴, the IPW gives more weight to the households which are less likely to stay in the sample to make the analysis sample more representative of the original sample. The IPW procedure involves two stages of estimation. In the first stage, at time t ($t=2, 3, 4$) an attrition probit model is estimated, restricting attention to those households still in the sample at $t-1$. Out of this sample, some are lost to attrition at time t , and some are not. Let $\pi_{it}(s_{it} = 1[x_{it}\delta_t + v_{it}]|s_{it-1} = 1, s_{it-2} = 1, \dots, s_{i1} = 1)$, where $t=2, 3, 4$ and $v_{it}|x_{it} \sim \text{Normal}(0,1)$, be the probit estimation of the conditional probability of household i to stay in the survey at time t . These predicted conditional probabilities can not be used directly in the IPW procedure because the sample at each time period is not representative of the population that was originally sampled at $t=1$. However, Wooldridge (2002a) shows that the joint probabilities calculated from these predicted conditional probabilities can be used in the IPW procedure and lead to consistent estimators. The predicted conditional probabilities $\hat{\pi}_{it}$ ($t=2, 3, 4$) are used in the second stage to calculate the joint probability that the households stay in the survey for two, three and four rounds. We denote the unconditional probabilities by $\hat{p}_{i2}$, $\hat{p}_{i3}$, $\hat{p}_{i4}$ respectively. We ignore the initial condition and assume that all the households have the same probability of being in the original sample. Then $\hat{p}_{i1}(s_{i1} = 1) = \hat{\pi}_{i1} = 1$. So the joint probability, $\hat{p}_{i2}(s_{i1} = 1, s_{i2} = 1) = \hat{\pi}_{i1} \times \hat{\pi}_{i2}$, $\hat{p}_{i3}(s_{i1} = 1; s_{i2} = 1; s_{i3} = 1) =$

¹⁴In our case, this means that the selection is not related to the idiosyncratic errors in regression 1.9. Our test confirms this assumption and the coefficient of the lead selection indicator in a fixed effect regression of 1.9 is not significant with a t -statistic being -1.01.

$$\hat{\pi}_{i1} \times \hat{\pi}_{i2} \times \hat{\pi}_{i3}; \hat{p}_{i4}(s_{i1} = 1, s_{i2} = 1, s_{i3} = 1, s_{i4} = 1) = \hat{\pi}_{i1} \times \hat{\pi}_{i2} \times \hat{\pi}_{i3} \times \hat{\pi}_{i4}.$$

According to the estimated probability $\hat{p}_{it}$, each household i at time t is assigned a weight $w_{it} = 1/\hat{p}_{it}$.

Table 1.5 presents the probit estimation of the conditional probabilities of being in the survey for the years 1996, 1998 and 2000. Conditional on the household demographic characteristics, geographic locations as well as respondent's level of cooperation in the survey, we find that income is no longer significant in explaining probabilities of being in the survey. The age of household head affects the probability in an inverse U shape pattern. For example, *ceteris paribus*, households with household head at age 50 in 1998 are the most likely to remain in the survey in 2000. The more senior people a household has, the more likely that it is going to remain in the survey. Bigger households are more likely to stay in the survey continuously. Households in the Moscow and St. Petersburg region are more likely to drop out compared to any other region covered by the surveys. The level of cooperation of the household respondent in the oral survey is also positively associated with staying ¹⁵ For example, the least cooperative households in 1996 and 1998 are more likely to drop from later surveys. And if the respondent was nervous during 1995 or 1996 survey, then the household is more likely to remain in the survey in 1996 and 1998. The predicted probabilities ($\hat{\pi}_{it}$) from these probit

¹⁵Heckman's solution requires that there be at least one exogenous variable affecting selection that does not appear in the structure equation. By reasonable assumption, the attitude and behavior variables which measure the level of respondent's cooperation may well serve as such identifying variables. But in the IPW method, no such identifying variables are needed.

estimation are then used to calculate the joint probability for each year ($\hat{p}_{it}$) and each household is assigned a weight equal to the reciprocal of the joint probability ($w_{it} = 1/\hat{p}_{it}$).

1.5 Endogenous Income Change

Net income defined in section 3 is used as household income in our analysis in order to reduce the potential bias from endogenous income smoothing. But two empirical problems still remain. The first problem is the measurement error in income. The measurement error in income will lead to an attenuation bias in the estimate of the coefficient in income growth and thus we will be less likely to reject the complete consumption insurance hypothesis. The second problem is that net income change may still be endogenous. For example, unobservables that affect income change may also affect consumption change. A credit constraint level that the household faces may affect income change as well as the precautionary savings of the households, thus consumption of the households. Also income change may be correlated with unobserved preference shifts (Cochrane 1991). If income change leads to higher preference for leisure and if leisure/consumption are substitutes, then the estimate of the coefficient of income change on consumption change will be biased downward. In the case that leisure and consumption are complements, we might overestimate the response of the consumption change to income change.

In our model, the coefficient of income change on consumption change is also allowed to differ across the households with different human capital. We implement a new method following a random coefficient model of average treatment effect with endogenous variables (Wooldridge 2002b) to estimate equation (1.10). The traditional 2SLS estimator uses interactions of exogenous variables with $(E^i - \bar{E})$ as instrumental variables for $\log Y_t^i \times (E^i - \bar{E})$. This method may result in too many overidentifying restrictions and the 2SLS estimator may have poor finite sample properties (Wooldridge 2002b). The new method involves two steps. First, the change of income is predicted from the estimation of a linear reduced form by regressing income change on exogenous variables. Call this predicted income change $\widehat{\Delta \log Y_t^i}$. The second step is to use the predicted income change ($\widehat{\Delta \log Y_t^i}$), the interaction of predicted income change with education ($\widehat{\Delta \log Y_t^i} \times E^i$) as instrumental variables for $\Delta \log Y_t^i$ and $\Delta \log Y_t^i \times (E^i - \bar{E})$ in equation (1.10).

We use two sets of exogenous variables to predict the change of income. First the change of total household wage earnings is used as a predictor for the change in the household income¹⁶. The total wage earnings is constructed separately from individual questionnaires. Each adult in the household reports their total labor earnings in the individual questionnaires. These individual responses can be added up to the household level and form a separate measure of household income.

This measure of income also contains measurement error but this error may be

¹⁶Stillman(2001) used aggregated individual total income as instrumental variable for household income.

uncorrelated with the measurement error in the household total income reported by the household respondent. Household income comes from a separate household questionnaire and the respondent is asked to estimate total household income. Thus the change in this aggregated wage earning can be used as an instrumental variable to purge the measurement error from the total income. But the change of total wage earning can't account for the potential endogeneity associated with household income change. As an alternative to correct for the endogeneity of income change and also to capture the unexpected nature of idiosyncratic income shocks, a second set of exogenous variables are used. They are: whether there is a household member who is newly owed wage (for no more than one month) ¹⁷, whether there is a household member who is newly unemployed, whether there are retired household members who are newly owed pensions, and an interaction of pension arrears with a dummy variable for the year 1996, which was the year of the pension crisis.

Table 1.6 presents the estimation of income change in the first step. We can see that the change of wage income obtained from individual questionnaires are significant both statistically and economically in predicating household income change. When we use the shocks of unemployment, wage arrears and pension

¹⁷The following survey questions are used to construct this variable. First, "At the present time, does your place of work owe you any money which for some reason they didn't pay you on time? ". Second, "For how many months has your enterprise not paid this money to you? ". If the answer to the first question is "Yes " and the answer to the second question is "one month ", I take it as "owed wage for no more than one month ". The "newly owed wage for no more than one month " means that no household member is owed wage in the previous period but there is at least one household member is owed wage for no more than one month in this period. The variables, "newly unemployed " and "newly owed pension ", are defined in the same way.

arrears as instruments, we obtain the expected signs. They are jointly significant in low and the high asset groups and the $p - values$ for the $F - statistics$ are 0.002 and 0 respectively. Individually, three out of four predicting variables are significant for the low asset group and all of them are significant for high asset group.

1.6 Results

The estimated results of equation (1.10) for low and high asset groups are presented in Table 1.7 and 1.8 respectively. Columns (1) to (3) contain the estimation results without sample attrition correction. Columns (4) to (6) contain the estimation results with sample attrition correction. The first stage regression using predicted income change and the interaction of predicted income change and education as instrument variables for income change and the interaction of income change and demeaned education are presented in Table 1.10 in the Appendix.

Comparing the OLS estimator and the IV estimators for each of the two asset group, we can see that the coefficient of income change is significantly larger in the IV results when we use wage income change to predict the household income change (IV1). It confirms our concern of measurement error in the income variable. When we use the shocks of unemployment, wage arrears and pension arrears as predictors of income change (IV2), we find that the magnitude of coefficient lies

in between the OLS and IV1. It might be the case that IV1 overestimates the consumption response to income change because it doesn't correct for common unobservables between income change and consumption change. Sample attrition correction leads to smaller estimators of the coefficient on income change for both OLS and two IV estimations in the low asset group. In the high asset group, the coefficient of income change is bigger in IV2 after corrected for attrition. But the differences between the coefficients in the regressions with and without sample attrition correction are generally very small in magnitude. We are going to focus on the IV2 regression results with sample attrition correction in the following analysis.

Neither the low asset nor the high asset group can completely smooth their consumption. The coefficient on the income change means how consumption change responds to income change for the household whose member has average education level ¹⁸. For example, in the low asset group (Column 6 in Table 1.8, if income change 10%, consumption will change 1.74% for the household whose member has 11 years of education . In the high asset group (Column 6 in Table 1.9), 10% change in income will lead to 0.95% change in consumption for the household with 11 years of education. Education effect on consumption smoothing is found in high asset group but not in the low asset group. In the high asset group, the coefficient on the interaction term of income change and education is -0.0386, significantly different from 0 at 10% significant level. It means that if the household has a

¹⁸ The average years of education is 11 years for the low asset group and 13 years for the high asset group.

university graduate ¹⁹, for example , then a 10% change in income only causes a 0.58% change in consumption. The result is puzzling because we might expect that people in the low asset group would draw on their human capital more in times of income shock but the wealth effect in the high asset group might outweigh any education effect. What we find here, however, is that education and wealth are complements and that human capital can help people to better use their wealth in smoothing consumption against income shock.

Assets are significant in helping the households in the low asset group to smooth their consumption and not surprisingly, the asset effect is not significant in the high asset group. As we can see in the descriptive statistics (Table 1.2), net income per capita in the high asset group is about 32.8% higher than that in the low asset group. At the time of income shock, the households in the the high asset group do not necessarily need to sell or rent out their assets, but for the low asset group, drawing on their assets may be one of the main options to cope with the shock. For the low asset group, drawing down the assets by 10% can increase the consumption by 0.39%.

The coefficient on the number of children in the initial period has a different sign in the two groups and both of them are significant. It seems that children can help, in some way, the households in the low asset group to smooth consumption. One explanation for this result may be related to means-testing schemes in child benefits

¹⁹University graduate on average has 16.03 years of education in the sample.

in Russia.²⁰ The child benefits that low income households receive may serve to help the households to smooth their consumption. For the high asset group, the presence of children in the first period doesn't have any consumption smoothing effect. Instead, if there are more children in the first period, consumption will increase, possibly to meet the growth of the children.

For households in both groups, the change in the number of senior people has a negative and significant effect on consumption change. One more senior person in the household is related to a 0.37% and 0.16% decrease in consumption for the low asset and high asset groups respectively. It may just be due to the fact that seniors do not consume as much as younger people. Alternatively, living arrangements with a senior person might be related to whether the pension payment is fulfilled. If a household's members choose to live with seniors when they have pensions, then we can see a negative sign in the change of number of old people in the households because the households with more old people will have better means to cope with income shocks. But the causation could go other way from smoothing consumption to attracting seniors. If this is the case, then the coefficient on the change of senior people is not consistently estimated in this specification. Although we don't focus on the endogenous living arrangement here, caution should be taken in interpreting this result.

²⁰In 1991, the government introduced a special child support benefit to be paid to all families with children. In 1995 some regional governments decided to limit the payments of child support benefits to only the poor families. In 1997-1998, a federal law was adopted, which limited the payments to only the families with per capita income below the regional subsistence level. See Denisova, Kolenikov and Yudaeva (2000) on the child benefits policy in Russia.

The coefficients on the year dummies measure how consumption changes during 1996-1998 and 1998-2000 compared with the 1995-1996 period. For the households in low asset group, consumption decreased by 18.8% during 1996-1998 compared with the 1995-1996 period. For the households in high asset group, consumption decreased by 27.2% . These differences are not statistically significant. During the 1998-200 period, consumption increased by 43.7% for the low asset group and 24.4% for the high asset group, compared with 1995-1996 period. These are statistically different at 10% significance level²¹. This means that consumption recovered more during the 1998-2000 period for the low asset group than for the high asset group. This result is consistent with the findings that there is a decline in inequality during the 1998-2000 period and much of this decline is due to government transfers and pension payments (Mroz, Henderson and Popkin 2001).

To check whether dropping the 1994 data will lead to different estimation results, we include the 1994 data in the regression without the interaction term of income change and years of education (since 1994 data doesn't contain information on years of education). Instead we include three dummies to identify the four categorical education groups. The results are presented in Table 1.12 and Table 1.13 in the appendix. The inverse probability weights are calculated in the same way as Section 4 but using 1994 as the first period. Almost all the previous results hold in these regression with 1994 data. The coefficient of income change in the high asset group (Column 6 Table 1.12) is 0.1451 lower than 0.1679 (Column 6 Table

²¹The *p* – value is 0.053.

1.8) when 1994 data is not included. The regressions in Table 1.12 don't count for the differential consumption smoothing across households with different human capital while the coefficient of 0.1679 in Table 1.8 is the consumption response to income change for household whose members have average education level. The coefficient of income change in the low asset group (Column 6 Table 1.11) doesn't differ significantly from that in Column 6 of Table 1.7 when we exclude 1994 data (0.1657 vs. 0.1608). This is not surprising. Since no education effect is found in the low asset group, without including interaction term of income change and education in Table 1.11 shouldn't change the coefficient on income change.

Different regressions without education interaction term are also reported in Table 1.13 and Table 1.14. Without controlling for education effect, the coefficients of income change increase in both of the assets group. It is intriguing, especially for low asset group, where we do not find education effect on consumption smoothing. When we pool the asset group together (Table 1.15), the education effect is not significant. As we observe earlier, that the education effect exists in high asset group only, thus it might be the case that such effect is not dominant in the whole sample. The results of the regressions for the whole sample, but with income change interacting with asset group dummy variable is reported in Table 1.16. And the results for including the interaction terms for both asset group and education are included in Table 1.17. Those results yield insignificant coefficients on income change variable. Such results are likely to be caused by multicollinearity, due to

the interaction terms.

1.7 Conclusions

Using the Russian Longitudinal Monitory Survey (RLMS), we examine the differences of consumption insurance between two groups of households based on their initial asset level. In the econometric model, we corrected the potential attrition bias with the inverse probability weighting method and we use the random coefficient model for average treatment effect to estimate the endogenous income change and education effect. We reject the full consumption smoothing hypothesis in both wealthy and less wealthy group. We find that the education in the high asset group can increase the consumption smoothing while no education effect is detected in the low asset group. We also find that poor households may rely on their assets to smooth their consumption while assets effect is not significant in consumption equation for wealthy households. The number of children in the initial period has different impact on consumption smoothing for the poor and wealthy households. The change of policy in child support may cause this difference. The number of senior people in the households also helps to smooth consumption. And wealthy households recovered slowly from the financial shock. Several of the results needs more detailed work. For example, we found that income shocks have but small impact on households' consumption. A further study of how the Russian households managed to smooth their consumption would be necessary to understand how the

households adjust to different shocks in the transitional economy. Multiple job holdings and living arrangement would be some topics interesting to look at.

Table 1.1: Household Real Income and Consumption Change Over Years and Regions

Dependent Variable (log)	Income per capita		Consumption per capita	
	1	2	1	2
Year 1995	-0.314 (0.019)** ⁽³⁾	-0.253 (0.041)**	-0.176 (0.019)**	-0.140 (0.039)**
Year 1996	-0.476 (0.025)**	-0.388 (0.048)**	-0.351 (0.022)**	-0.355 (0.041)**
Year 1998	-0.580 (0.021)**	-0.615 (0.046)**	-0.718 (0.021)**	-0.741 (0.040)**
Year 2000	-0.388 (0.021)**	-0.375 (0.042)**	-0.573 (0.021)**	-0.554 (0.041)**
Moscow and St. Petersburg		0.466 (0.075)**		0.411 (0.078)**
Northern and North Western		0.141 (0.079)*		0.120 (0.078)
Volga-Vaytski and Volga Basin		-0.079 (0.051)		-0.141 (0.052)**
North Caucasian		-0.127 (0.070)*		0.002 (0.056)
Ural		0.012 (0.055)		-0.037 (0.058)
Western Siberian		0.069 (0.069)		0.106 (0.074)
Eastern Siberian and Far Eastern		0.253 (0.072)**		0.080 (0.068)
F-statistics for Year Dummies	207.39**	49.23**	380.98**	111.13**
F-statistics for Region/Year Dummies		3.42**		2.21**
Number of Obs	8928	8928	8928	8928
R-squared	0.044	0.079	0.091	0.115

(1) The omitted region is Central and Central Black Earth.

(2) Regressions with region dummies also include interactions between region dummies and year dummies.

(3) Standard errors (robust to correlation of residuals within households and heteroscedasticity) in parentheses

(4) ** indicates significance at 5% level and * 10% significant level.

Table 1.2: Descriptive Statistics

	ALL	Low Assets	High Assets
Panel A: Household Characteristics			
Net Income per Capita	1181.370 (1786.130)	889.796 (1098.702)	1436.404 (2187.700)
Total Income per Capita	1417.600 (1652.770)	1248.402 (1535.417)	1870.340 (2425.912)
Consumption per Capita	1578.230 (2079.450)	1141.678 (1278.420)	1658.942 (1888.691)
Total Assets	4794.190 (9139.080)	813.749 (450.440)	8768.132 (11623.610)
Household Size	3.716 (1.516)	3.471 (1.536)	3.929 (1.467)
Number of Seniors	0.689 (0.792)	0.786 (0.776)	0.605 (0.796)
Number of Children	0.7981 (0.987)	0.673 (1.022)	0.906 (0.942)
Age of Houshold Head	47.391 (14.825)	49.828 (16.293)	45.225 (13.011)
Gender of Houshold Head	0.776 (0.417)	0.663 (0.428)	0.876 (0.330)
Years of Education of Household Head	10.897 (3.746)	9.908 (3.814)	11.769 (3.558)
Maximum Education of Household Members	12.038 (3.724)	10.818 (3.919)	13.113 (3.176)
Panel B: Incidence of Unemployment, Wage Arrears and Pension Arrears			
Unemployment	0.120 (0.325)	0.111 (0.314)	0.127 (0.333)
Wage Arrears	0.415 (0.493)	0.353 (0.478)	0.471 (0.499)
Pension Arrears	0.098 (0.297)	0.115 (0.319)	0.082 (0.274)
Panel C: Change of Unemployment, Wage Arrears and Pension Arrears			
Change of Unemployment	0.081 (0.272)	0.071 (0.257)	0.089 (0.285)
Wage Arrears for One Month or Less	0.088 (0.284)	0.065 (0.247)	0.108 (0.311)
Change of Pension Arrears	0.076 (0.265)	0.089 (0.284)	0.065 (0.246)
Number of households	1412	673	739

(1) Net income is defined as total income net of public transfers,private transfers, unemployment benefits and incomes from sales and rental of assets.

(2) Standard deviations in parentheses.

Table 1.3: Coefficient of Variation (CV) in Income and Consumption (per capita)

	All	Low Assets	High Assets
CV for Total Income	0.562	0.549	0.575
	(0.287) ⁽¹⁾	(0.281)	(0.292)
<i>p</i> – value for Kruskal-Wallis test			0.037
CV for Net Income ⁽²⁾	0.632	0.614	0.649
	(0.430)	(0.444)	(0.416)
<i>p</i> – value for Kruskal-Wallis test			0.0001
CV for Consumption	0.625	0.650	0.602
	(0.305)	(0.324)	(0.285)
<i>p</i> – value for Kruskal-Wallis test			0.0001
Correlation of Net Income and Total Consumption	0.4412	0.4909	0.4192
Number of Households	1412	673	739

(1) Standard deviations in the parentheses.

(2) Net income is defined as the total income net of public transfer, private transfer; unemployment benefits and incomes from sales and rental of assets.

Table 1.4: Descriptive Statistics in 1995 by Attrition

	Stayers	Leavers	<i>p</i> -value
	(1)	(2)	(1)-(2)
Net Income per capita	1793.554 (38.002)	2555.519 (3906.432)	0.000
Consumption per capita	1264.867 (33.343)	1749.451 (68.078)	0.000
Years of Education of Household Head	10.899 (0.079)	11.212 (0.114)	0.024
Gender of Household Head	1.224 (0.008)	1.282 (0.012)	0.0001
Moscow & St.Petersburg	0.051 (0.004)	0.156 (0.009)	0.000
Household Size	3.715 (0.032)	3.211 (0.038)	0.000
Age of Household Head	47.170 (0.315)	46.947 (0.470)	0.693
Number of Seniors	0.690 (0.017)	0.537 (0.186)	0.000
Urban	0.607 (0.010)	0.729 (0.0116)	0.000
Attitude of Respond	1.231 (0.011)	1.280 (0.021)	0.035
Behavior of Respond	1.186 (0.010)	1.211 (0.018)	0.236
Number of Obs.	2214	1334	

(1) Stayers are households which stayed all 4 rounds since 1995 survey.

Leavers are households which were in 1995 survey but dropped out either in 1996,1998 or in 2000 survey.

(2) Attitude=1 if household survey respondent is friendly and interested;

Attitude=2 if respond is not particularly interested; Attitude=3 if respondent is impatient and worried; Attitude=4 if respondent is hostile.

(3) Behavior=1 if respondent is comfortable during the interview; Behavior=2 if respondent is occasionally nervous; Behavior=3 if respondent is nervous.

(4) Standard errors in parentheses.

(5)*p* – value is for testing the null hypothesis that the variable mean is not different across the two samples.

Table 1.5: Attrition Probability during 1995-2000

Dependent Variable:	1=Stay; 0=Leave		
	(96 95)	(98 96,95)	(2000 98,96,95)
Net Income per capita	0.034	0.016	0.026
(log)	(0.022)	(0.019)	(0.0167)
Education of	-0.001	0.006	0.0067
Household Head	(0.010)	(0.009)	(0.008)
Gender of Household	-0.055	-0.064	-0.056
Head	(0.081)	(0.069)	(0.058)
Age of Household	0.045	0.039	0.050
Head	(0.012)**	(0.010)**	(0.086)**
Age ² of Household	-0.0003	-0.0003	-0.0005
Head	(0.0001)**	(0.0001)**	(0.0001)**
Number of Seniors	0.134	0.181	0.172
	(0.067)**	(0.056)**	(0.047)**
Household Size	0.087	0.075	0.076
	(0.030)**	(0.026)**	(0.022)**
Moscow and	-0.405	-0.367	-0.577
St. Petersburg	(0.137)**	(0.127)**	(0.111)**
Northern and	0.037	0.035	0.0167
North Western	(0.104)	(0.092)	(0.079)
Volga-Vaytski and	-0.266	-0.353	-0.200
Volga Basin	(0.120)**	(0.105)**	(0.093)**
North Caucasian	-0.101	-0.094	-0.002
	(0.102)	(0.091)	(0.082)
Ural	-0.136	-0.161	-0.119
	(0.118)	(0.106)	(0.093)
Western Siberian	-0.216	-0.335	-0.318
	(0.119)*	(0.105)**	(0.095)**

Table 1.5 (cont'd).

Eastern Siberian and	-0.325	-0.312	-0.337
Far Eastern	(0.077)**	(0.067)**	(0.060)**
Attitude2	-0.244	-0.173	-0.197
	(0.074)**	(0.059)**	(0.049)**
Attitude3	-0.156	-0.249	-0.314
	(0.185)	(0.148)*	(0.125)**
Attitude4	-0.446	-0.512	-0.444
	(0.440)	(0.291)*	(0.239)*
Behavior2	-0.018	-0.014	-0.101
	(0.084)	(0.071)	(0.056)*
Behavior3	0.635	0.309	0.101
	(0.239)**	(0.167)*	(0.133)
Number of obs	2314	2129	2263

(1)The omitted region is Central and Central Black Earth.

(2)Standard errors (robust to correlation of residuals within households and heteroscedasticity)in parentheses

(3)**indicates significance at 5% level and* 10% significant level.

(4)Attitude2=not particularly interested; Attitude3=impatient,worried;Attitude4= hostile. The omitted attitude category is Attitude1=friendly interested.

Behavior2=occasionally nervous;Behavior3=nervous.The omitted behavior category is Behavior1=felt comfortable.

Table 1.6: Predicting the Change of Income

OLS regressions with inverse probability weight				
Dependent Variable: Change of Income	Whole Sample	Low Asset Group	High Asset Group	
Change of Wage Income	0.572	0.564	0.581	
Obtained from Individual Survey	(0.053)**	(0.069)**	(0.080)**	
Wage Arrears for One Month or Less	-0.207	-0.068	-0.259	
Change of Unemployment	(0.063)**	(0.111)	(0.089)**	
	-0.501	-0.660	-0.489	
	(0.140)**	(0.247)**	(0.219)**	
Change of Pension Arrears	-0.649	-0.704	-0.536	
	(0.126)**	(0.186)**	(0.202)**	
Change of Pension Arrears	-0.638	-0.751	-0.566	
× Year 1996	(0.139)**	(0.228)**	(0.180)**	
$p - value$ for F -statistics		0.002	0.000	
Control Variables:				
Household Characteristics Variables	Yes	Yes	Yes	Yes
Household Total Assets	Yes	Yes	Yes	Yes
Region/Year Dummies	Yes	Yes	Yes	Yes
Number of Obs	4236	2020	2216	2216

(1) Standard errors (robust to correlation of residuals within households and heteroscedasticity) in parentheses

** significant 5%significance level and * significant 10%significance level.

(2) Household characteristics variables: years of maximum education of adult household members; change in the number of children; seniors and household size; the number of children, seniors and household size in the first period; age, age squared and gender of the household head in the first period.

Table 1.7: Consumption Smoothing for the Whole Sample

Dependent Variables:	Consumption Change					
	Without Attrition Correction			With Attrition Correction		
	OLS	IV1	IV2	OLS	IV1	IV2
Income Change	0.062 (0.015)**	0.241 (0.040)**	0.188 (0.055)**	0.053 (0.016)**	0.232 (0.039)**	0.158 (0.057)**
Maximum Education Of Household Members	0.002 (0.003)	0.003 (0.003)	0.003 (0.005)	-0.0001 (0.003)	0.0002 (0.003)	0.0002 (0.003)
Total Assets	0.007 (0.011)	0.003 (0.008)	0.003 (0.011)	0.002 (0.011)	0.007 (0.012)	0.005 (0.012)
Change in the Number of Children	-0.033 (0.042)	-0.026 (0.044)	-0.028 (0.040)	-0.033 (0.042)	-0.027 (0.044)	-0.030 (0.043)
Change in the Number of Seniors	-0.227 (0.059)**	-0.194 (0.061)**	-0.205 (0.056)**	-0.239 (0.057)**	-0.206 (0.059)**	-0.222 (0.058)**
Change in Household Size	-0.041 (0.026)	-0.033 (0.026)	-0.035 (0.024)	-0.045 (0.027)*	-0.038 (0.027)	-0.040 (0.027)
Number of Children In the 1st Period	0.005 (0.019)	0.002 (0.019)	0.002 (0.027)	0.0002 (0.019)	-0.003 (0.020)	-0.002 (0.019)
Number of Seniors In the 1st Period	-0.059 (0.026)**	-0.048 (0.027)*	-0.052 (0.039)	-0.061 (0.030)**	-0.055 (0.030)*	-0.059 (0.030)**
Household Size in the 1st Period	0.022 (0.014)	0.020 (0.014)	0.021 (0.020)	0.025 (0.015)*	0.024 (0.015)*	0.025 (0.015)*

Table 1.7 (cont'd).

Age of Household Head	-0.016 (0.005)**	-0.015 (0.005)**	-0.016 (0.007)**	-0.015 (0.006)**	-0.016 (0.006)**	-0.016 (0.006)**
Age2 of Household Head	0.0018 (0.0005)**	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**
Gender of Household Head	-0.028 (0.025)	-0.023 (0.026)	-0.025 (0.042)	-0.025 (0.026)	-0.021 (0.027)	-0.023 (0.027)
Year 1998	-0.296 (0.049)**	-0.228 (0.052)**	-0.248 (0.044)**	-0.302 (0.048)**	-0.233 (0.051)**	-0.261 (0.051)**
Year 2000	0.314 (0.036)**	0.281 (0.039)**	0.290 (0.038)**	0.303 (0.036)**	0.272 (0.039)**	0.285 (0.038)**
Region/Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs.	4236	4236	4236	4236	4236	4236

(1) Standard errors (robust to correlation of residuals within households and heteroscedasticity) in parentheses;

** significant 5%significance level and * 10%significance level.

(2) IV1 uses change of total wage income obtained from individual questionnaire as instrument for household income change. IV2 uses change of unemployment, wage arrears no more than one month, change in pension arrears as the instrument variables for household income change

Table 1.8: Consumption Smoothing for the Low Asset Group

Dependent Variable:	Consumption Change					
	Without Attrition Correction			With Attrition Correction		
	OLS	IV1	IV2	OLS	IV1	IV2
Income Change	0.066 (0.028)**	0.337 (0.082)**	0.166 (0.082)**	0.061 (0.027)**	0.330 (0.076)**	0.161 (0.087)*
Income Change $\times$ Demeaned	-0.002 (0.009)	-0.017 (0.019)	-0.010 (0.024)	-0.001 (0.009)	-0.019 (0.017)	-0.006 (0.027)
Maximum Education	-0.001 (0.005)	-0.001 (0.005)	-0.001 (0.008)	-0.004 (0.005)	-0.003 (0.005)	-0.003 (0.005)
Maximum Education of Household Members	-0.037 (0.021)*	-0.032 (0.022)	-0.035 (0.030)	-0.042 (0.021)**	-0.036 (0.023)	-0.040 (0.022)*
Total Assets	-0.057 (0.065)	-0.098 (0.074)	-0.072 (0.069)	-0.057 (0.065)	-0.100 (0.080)	-0.071 (0.070)
Change in Number of Children	-0.381 (0.089)**	-0.372 (0.094)**	-0.379 (0.088)**	-0.369 (0.090)**	-0.362 (0.096)**	-0.366 (0.091)**
Change in Number of Seniors	-0.012 (0.043)	0.012 (0.043)	-0.003 (0.044)	-0.021 (0.044)	0.001 (0.046)	-0.015 (0.045)
Change in Household Size	-0.081 (0.034)**	-0.084 (0.035)**	-0.083 (0.050)*	-0.083 (0.037)**	-0.090 (0.038)**	-0.086 (0.036)**
Number of Children in 1st Period	-0.171 (0.049)**	-0.168 (0.049)**	-0.171 (0.071)**	-0.178 (0.054)**	-0.181 (0.054)**	-0.180 (0.053)**
Number of Seniors in 1st Period	0.077 (0.027)**	0.070 (0.027)**	0.075 (0.038)**	0.075 (0.029)**	0.070 (0.029)**	0.073 (0.029)**
Household Size in the 1st Period						

Table 1.8 (cont'd).

Age of Household	-0.015	-0.018	-0.016	-0.014	-0.017	-0.015
Head	(0.009)*	(0.009)*	(0.012)	(0.009)	(0.010)*	(0.009)
Age ² of Household	0.0002	0.0001	0.0002	0.0001	0.0002	0.0002
Head	(0.0001)**	(0.0001)	(0.0001)**	(0.0001)	(0.0001)**	(0.0001)**
Gender of Household	-0.062	-0.055	-0.060	-0.053	-0.044	-0.049
Head	(0.038)	(0.038)	(0.064)	(0.039)	(0.039)	(0.039)
Year 1998	-0.228	-0.144	-0.197	-0.240	-0.157	-0.209
	(0.088)**	(0.092)	(0.070)**	(0.085)**	(0.090)*	(0.085)**
Year 2000	0.387	0.324	0.364	0.384	0.325	0.362
	(0.059)**	(0.069)**	(0.064)**	(0.059)**	(0.068)**	(0.062)**
Region/Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs	2020	2020	2020	2020	2020	2020

(1) Standard errors (robust to correlation of residuals within households and heteroscedasticity) in parentheses;

** significant 5%significance level and * 10%significance level.

(2) IV1 uses change of total wage income obtained from individual questionnaire as instrument for household income change. IV2 uses change of unemployment, wage arrears no more than one month; change in pension arrears as the instrument variables for household income change

Table 1.9: Consumption Smoothing for the High Asset Group

Dependent Variable	Consumption Change					
	Without Attrition Correction			With Attrition Correction		
	OLS	IV1	IV2	OLS	IV1	IV2
Income Change	0.087 (0.027)**	0.216 (0.042)**	0.158 (0.077)**	0.075 (0.030)**	0.211 (0.042)**	0.168 (0.081)**
Income Change $\times$ Demeaned	-0.015 (0.006)**	-0.040 (0.019)**	-0.017 (0.015)	-0.013 (0.006)**	-0.038 (0.019)**	-0.039 (0.022)*
Maximum Education	0.0001 (0.004)	-0.0006 (0.004)	-0.0001 (0.006)	-0.0008 (0.004)	-0.002 (0.004)	-0.002 (0.004)
Maximum Education of Household Members	0.013 (0.012)	0.014 (0.012)	0.014 (0.013)	0.011 (0.012)	0.013 (0.013)	0.013 (0.012)
Total Assets	-0.032 (0.058)	-0.019 (0.058)	-0.020 (0.053)	-0.031 (0.057)	-0.018 (0.057)	-0.026 (0.059)
Change in Number of Children	-0.160 (0.076)**	-0.135 (0.076)*	-0.144 (0.070)**	-0.173 (0.077)**	-0.145 (0.076)*	-0.159 (0.079)**
Change in Number of Seniors	-0.057 (0.033)*	-0.055 (0.033)*	-0.054 (0.029)*	-0.058 (0.033)*	-0.056 (0.033)*	-0.055 (0.034)
Change in Household Size	0.042 (0.022)*	0.041 (0.022)*	0.040 (0.033)	0.040 (0.022)*	0.039 (0.022)*	0.039 (0.022)*
Number of Children In 1st Period	-0.002 (0.028)	0.002 (0.029)	0.002 (0.046)	-0.011 (0.029)	-0.005 (0.029)	-0.010 (0.030)
Number of Seniors In 1st Period	-0.002 (0.015)	-0.0004 (0.015)	-0.001 (0.024)	0.004 (0.015)	0.005 (0.015)	0.006 (0.015)
Household Size in the 1st Period						

Table 1.9 (cont'd).

Age of Household Head	-0.015 (0.006)**	-0.015 (0.006)**	-0.015 (0.010)	-0.017 (0.007)**	-0.017 (0.007)**	-0.017 (0.007)**
Age ² of Household Head	0.0002 (0.0001)**	0.0001 (0.0001)	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0001 (0.0001)
Gender of Household Head	-0.004 (0.031)	0.001 (0.032)	-0.001 (0.055)	-0.008 (0.033)	-0.003 (0.033)	-0.007 (0.033)
Year 1998	-0.345 (0.052)**	-0.300 (0.057)**	-0.314 (0.054)**	-0.346 (0.051)**	-0.297 (0.056)**	-0.317 (0.061)**
Year 2000	0.233 (0.045)**	0.222 (0.046)**	0.223 (0.044)**	0.225 (0.044)**	0.213 (0.045)**	0.218 (0.047)**
Region/Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs	2216	2216	2216	2216	2216	2216

(1) Standard errors (robust to correlation of residuals within households and heteroscedasticity) in parentheses;

** significant 5%significance level and * 10%significance level.

(2) IV1 uses change of total wage income obtained from individual questionnaire as instrument for household income change. IV2 uses change of unemployment, wage arrears no more than one month; change in pension arrears as the instrument variables for household income change

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APPENDIX

Table 1.10: First Stage Regression

Dependent Variable:	Income Change		Income Change × Demeaned Maximum Education	
	IV1	IV2	IV1	IV2
Panel A: Whole Sample				
Predicted Income Change 1	1.000 (0.088)**			
Predicted Income Change 2		1.000 (0.138)**		
Control Variables:				
Household Characteristics	Yes	Yes	Yes	Yes
Household Total Assets	Yes	Yes	Yes	Yes
Region/Year Dummy	Yes	Yes	Yes	Yes
Number of Obs	4236	4236	4236	4236
Panel B: Low Asset Group				
Predicted Income Change 1	0.327 (0.293)		-11.914 (1.559)**	
Predicted Income Change 1 × Maximum Education	0.058 (0.024)**		1.027 (0.121)**	
Predicted Income Change 2		0.539 (0.281)*		-8.306 (1.192)**
Predicted Income Change 2 × Maximum Education		0.043 (0.038)		0.766 (0.121)**
Control Variables:				
Household Characteristics	Yes	Yes	Yes	Yes
Household Total Assets	Yes	Yes	Yes	Yes
Region/Year Dummy	Yes	Yes	Yes	Yes
Number of Obs	2020	2020	2020	2020

Table 1.10 (cont'd).

Panel C: High Asset Group

Predicted Income Change 1	1.752 (0.358)**		-3.054 (2.453)	
Predicted Income Change 1 × Maximum Education	-0.053 (0.025)**		0.313 (0.195)	
Predicted Income Change 2		1.165 (0.277)**		-5.778 (0.962)**
Predicted Income Change 2 × Maximum Education		-0.014 (0.023)		0.553 (0.090)**
Control Variables:				
Household Characteristics	Yes	Yes	Yes	Yes
Household Total Assets	Yes	Yes	Yes	Yes
Region/Year Dummy	Yes	Yes	Yes	Yes
Number of Obs	2216	2216	2216	2216

(1) Predicted Income Change 1 is fitted value of income change using change of wage earnings obtained from individual survey as predictor. Predicted income change 2 is fitted value of income change using unemployment shock, wage arrears shock and pension shock as predictors. (2) Standard errors (robust to correlation of residuals within households and heteroscedasticity) in parentheses ** significant 5% significance level and * significant 10% significance level. (3) Household characteristics variables: years of maximum education of the household members; change in the number of children; seniors and household size; the number of children, seniors and household size in the first period; age, age squared and gender of the household head in the first period.

Table 1.11: Regression Results With vs Without 1994 Data— Low Asset Group

Dept. Var: Consumption Change							
With 94 Data				Without 94 Data			
	OLS	IV1	IV2	OLS	IV1	IV2	
Income Change	0.059 (0.020)**	0.311 (0.112)**	0.182 (0.075)**	0.065 (0.027)**	0.337 (0.083)**	0.166 (0.089)*	
Total Assets	-0.038 (0.020)*	-0.033 (0.021)	-0.035 (0.019)*	-0.037 (0.020)*	-0.031 (0.022)	-0.035 (0.020)*	
Maximum Education in 2nd Category	-0.066 (0.059)	-0.058 (0.061)	-0.062 (0.058)	-0.019 (0.054)	-0.030 (0.054)	-0.017 (0.054)	
Maximum Education in 3rd Category	-0.021 (0.044)	-0.026 (0.046)	-0.024 (0.043)	0.019 (0.050)	0.008 (0.049)	0.008 (0.049)	
Maximum Education in 4th Category	0.021 (0.048)	0.022 (0.050)	0.021 (0.047)	0.056 (0.052)	0.058 (0.053)	0.048 (0.050)	
Change in Number of Children	-0.050 (0.066)	-0.042 (0.075)	-0.046 (0.066)	-0.056 (0.065)	-0.093 (0.074)	-0.069 (0.066)	
Change in Number of Seniors	-0.328 (0.113)**	-0.287 (0.120)**	-0.309 (0.111)**	-0.380 (0.089)**	-0.364 (0.095)**	-0.374 (0.086)**	
Change in Household Size	-0.028 (0.051)	-0.017 (0.052)	-0.023 (0.050)	-0.013 (0.043)	0.006 (0.044)	-0.007 (0.042)	
Number of Children In 1st Period	-0.016 (0.044)	-0.004 (0.046)	-0.011 (0.043)	-0.079 (0.035)**	-0.081 (0.035)**	-0.081 (0.033)**	
Number of Seniors In 1st Period	-0.060 (0.052)	-0.042 (0.057)	-0.052 (0.051)	-0.169 (0.049)**	-0.165 (0.049)**	-0.168 (0.047)**	

Table 1.11 (cont'd).

Household Size in the 1st Period	0.020 (0.033)	0.007 (0.036)	0.014 (0.033)	0.076** (0.027)**	0.067 (0.027)**	0.073 (0.026)**
Age of Household Head	-0.010 (0.009)	-0.013 (0.010)	-0.012 (0.009)	-0.015 (0.009)*	-0.017 (0.010)*	-0.016 (0.009)*
Age ² of Household Head	0.0001 (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**
Gender of Household Head	-0.021 (0.046)	0.001 (0.050)	-0.011 (0.046)	-0.062 (0.037)*	-0.052 (0.037)	-0.058 (0.036)
Year 1996	-0.125 (0.076)	-0.187 (0.072)**	-0.155 (0.076)**			
Year 1998	-0.383 (0.071)**	-0.372 (0.076)**	-0.377 (0.070)**	-0.229 (0.089)**	-0.149 (0.093)	-0.199 (0.088)**
Year 2000	0.269 (0.063)**	0.145 (0.076)*	0.208 (0.071)**	0.387 (0.059)**	0.324 (0.069)**	0.364 (0.061)**
Region/Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs	2743	2743	2743	2020	2020	2020

(1) Standard errors (robust to correlation of residuals within households and heteroscedasticity) in parentheses

** significant 5%significance level and * significant 10%significance level.

(2) IV1 uses change of total wage income obtained from individual questionnaire as instrument for household income change.

IV2 uses change of unemployment, wage arrears no more than one month; change in pension arrears as the instrument variables

(3)First education level is below general secondary education (< 10 grades). Second level is general secondary education .

(=10 grades). Third level is vocational school. Fourth level is university and above.

Table 1.12: Regression Results With vs Without 1994 Data— High Asset Group

Dept. Var: Consumption Change	With 94 Data				Without 94 Data			
	OLS	IV1	IV2	OLS	IV1	IV2	OLS	IV2
Income Change	0.058 (0.016)**	0.143 (0.031)**	0.150 (0.074)**	0.053 (0.018)**	0.163 (0.039)**	0.145 (0.080)*		
Total Assets	0.007 (0.009)	0.005 (0.009)	0.005 (0.009)	0.013 (0.012)	0.014 (0.012)	0.014 (0.011)		
Maximum Education in 2nd Category	0.067 (0.044)	0.066 (0.044)	0.066 (0.043)	-0.087 (0.054)	-0.079 (0.056)	-0.088 (0.054)		
Maximum Education in 3rd Category	0.033 (0.039)	0.024 (0.039)	0.023 (0.039)	-0.031 (0.045)	-0.043 (0.047)	-0.044 (0.045)		
Maximum Education in 4th Category	0.047 (0.038)	0.043 (0.038)	0.043 (0.038)	0.001 (0.045)	-0.008 (0.046)	-0.009 (0.045)		
Change in Number of Children	-0.035 (0.045)	-0.019 (0.046)	-0.018 (0.047)	-0.032 (0.058)	-0.013 (0.058)	-0.016 (0.057)		
Change in Number of Seniors	-0.163 (0.0635)**	-0.139 (0.0642)**	-0.138 (0.0653)**	-0.164 (0.076)**	-0.136 (0.076)*	-0.142 (0.076)*		
Change in Household Size	-0.074 (0.027)**	-0.074 (0.027)**	-0.073 (0.026)**	-0.057 (0.033)*	-0.054 (0.032)*	-0.054 (0.032)*		
Number of Children In 1st Period	0.043 (0.018)**	0.048 (0.019)**	0.048 (0.019)**	0.041 (0.022)*	0.039 (0.022)*	0.039 (0.021)*		
Number of Seniors In 1st Period	0.008 (0.027)	0.018 (0.027)	0.019 (0.028)	-0.002 (0.028)	0.005 (0.028)	0.003 (0.027)		
Household Size in the 1st Period	-0.014 (0.015)	-0.017 (0.015)	-0.017 (0.015)	-0.002 (0.015)	-0.001 (0.015)	-0.001 (0.015)		

Table 1.12 (cont'd).

Age of Household	-0.007	-0.006	-0.006	-0.015	-0.014	-0.014
Head	(0.006)	(0.006)	(0.006)	(0.006)**	(0.006)**	(0.006)**
Age of Household	0.0001	0.0001	0.0001	0.0002	0.0001	0.0002
Head	(0.0001)	(0.0001)	(0.0001)	(0.0001)**	(0.0001)**	(0.0001)**
Gender of Household	-0.001	0.004	0.004	-0.004	0.002	-0.0001
Head	(0.033)	(0.033)	(0.032)	(0.031)	(0.032)	(0.031)
Year 1996	0.024	-0.009	-0.012			
	(0.054)	(0.056)	(0.059)			
Year 1998	-0.311	-0.308	-0.307	-0.353	-0.305	-0.312
	(0.041)**	(0.042)**	(0.041)**	(0.052)**	(0.058)**	(0.062)**
Year 2000	0.264	0.221	0.216	0.234	0.219	0.221
	(0.041)**	(0.044)**	(0.056)**	(0.046)**	(0.046)**	(0.047)**
Region/Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs	3312	3312	3312	2216	2216	2216

(1) Standard errors (robust to correlation of residuals within households and heteroscedasticity) in parentheses

** significant 5% significance level and * significant 10% significance level.

(2) IV1 uses change of total wage income obtained from individual questionnaire as instrument for household income change.

IV2 uses change of unemployment, wage arrears no more than one month; change in pension arrears as the instrument variables

(3) First education level is below general secondary education (< 10 grades). Second level is general secondary education . (=10 grades). Third level is vocational school. Fourth level is university and above.

Table 1.13: Consumption Smoothing for Low Asset Group (Without Education Interaction)

Dependent Variables:	Consumption Change					
	Without Attrition Correction			With Attrition Correction		
	OLS	IV1	IV2	OLS	IV1	IV2
Income Change	0.062 (0.025)**	0.371 (0.090)**	0.194 (0.101)*	0.058 (0.025)**	0.350 (0.090)**	0.174 (0.101)*
Maximum Education	0.006 (0.005)	0.008 (0.005)	0.006 (0.008)	0.002 (0.005)	0.002 (0.005)	0.001 (0.005)
Of Household Members	-0.032 (0.025)	-0.029 (0.026)	-0.033 (0.034)	-0.048 (0.023)**	-0.031 (0.027)	-0.041 (0.024)*
Total Assets	-0.026 (0.065)	-0.059 (0.077)	-0.050 (0.068)	-0.018 (0.065)	-0.049 (0.076)	-0.039 (0.069)
Change in the Number of Children	-0.321 (0.106)**	-0.292 (0.114)**	-0.307 (0.108)**	-0.356 (0.097)**	-0.340 (0.105)**	-0.349 (0.099)**
Change in the Number of Seniors	-0.040 (0.046)	-0.021 (0.049)	-0.028 (0.047)	-0.041 (0.046)	-0.021 (0.049)	-0.031 (0.048)
Change in Household Size	-0.065 (0.035)*	-0.059 (0.037)	-0.070 (0.046)	-0.068 (0.035)*	-0.066 (0.038)*	-0.078 (0.037)**
Number of Children	-0.201 (0.048)**	-0.184 (0.052)**	-0.201 (0.067)**	-0.206 (0.052)**	-0.201 (0.054)**	-0.213 (0.054)**
In the 1st Period	0.070 (0.027)**	0.055 (0.030)*	0.070 (0.038)*	0.074 (0.028)**	0.062 (0.030)**	0.077 (0.030)**
Household Size in the 1st Period						

Table 1.13 (cont'd).

Age of Household Head	-0.022 (0.009)**	-0.023 (0.010)**	-0.023 (0.011)**	-0.021 (0.010)**	-0.025 (0.011)**	-0.023 (0.010)**
Age2 of Household Head	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0003 (0.0001)**
Gender of Household Head	-0.095 (0.040)**	-0.073 (0.042)*	-0.091 (0.065)	-0.092 (0.041)**	-0.075 (0.043)*	-0.093 (0.044)**
Year 1998	-0.206 (0.077)**	-0.212 (0.092)**	-0.197 (0.070)**	-0.254 (0.094)**	-0.209 (0.097)**	-0.321 (0.108)**
Year 2000	0.470 (0.189)**	0.377 (0.195)*	0.433 (0.196)**	0.540 (0.186)**	0.454 (0.192)**	0.508 (0.192)**
Region/Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs.	2020	2020	2020	2020	2020	2020

(1) Standard errors (robust to correlation of residuals within households and heteroscedasticity) in parentheses

** significant 5%significance level and * significant 10%significance level.

(2) IV1 uses change of total wage income obtained from individual questionnaire as instrument for household income change.

IV2 uses change of unemployment, wage arrears no more than one month; change in pension arrears as the instrument variables

(3)First education level is below general secondary education (< 10 grades). Second level is general secondary education .

(=10 grades). Third level is vocational school. Fourth level is university and above.

Table 1.14: Consumption Smoothing for High Asset Group (Without Education Interaction)

Dependent Variables:	Consumption Change					
	Without Attrition Correction			With Attrition Correction		
	OLS	IV1	IV2	OLS	IV1	IV2
Income Change	0.056 (0.018)**	0.192 (0.037)**	0.162 (0.074)**	0.047 (0.019)**	0.203 (0.037)**	0.172 (0.079)**
Maximum Education Of Household Members	-0.0006 (0.004)	-0.0006 (0.004)	-0.0006 (0.006)	-0.0006 (0.004)	-0.001 (0.004)	-0.001 (0.004)
Total Assets	0.019 (0.012)	0.020 (0.012)*	0.020 (0.019)	0.010 (0.012)	0.012 (0.012)	0.012 (0.012)
Change in the Number of Children	-0.030 (0.057)	-0.011 (0.057)	-0.011 (0.052)	-0.031 (0.057)	-0.012 (0.057)	-0.016 (0.058)
Change in the Number of Seniors	-0.182 (0.075)**	-0.154 (0.075)**	-0.156 (0.069)**	-0.176 (0.077)**	-0.146 (0.077)*	-0.155 (0.079)**
Change in Household Size	-0.055 (0.032)*	-0.052 (0.032)	-0.051 (0.029)*	-0.058 (0.033)*	-0.055 (0.033)*	-0.054 (0.033)
Number of Children In the 1st Period	0.042 (0.022)*	0.040 (0.022)*	0.040 (0.033)	0.040 (0.022)*	0.038 (0.022)*	0.038 (0.022)*
Number of Seniors In the 1st Period	-0.009 (0.029)	-0.002 (0.029)	-0.002 (0.046)	-0.010 (0.029)	-0.001 (0.029)	-0.005 (0.029)
Household Size in the 1st Period	-0.002 (0.015)	-0.001 (0.015)	-0.001 (0.024)	0.003 (0.015)	0.004 (0.015)	0.005 (0.015)

Table 1.14 (cont'd).

Age of Household Head	-0.015 (0.006)**	-0.014 (0.007)**	-0.014 (0.010)	-0.016 (0.007)**	-0.015 (0.007)**	-0.016 (0.007)**
Age2 of Household Head	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0003 (0.0001)**
Gender of Household Head	-0.014 (0.032)	-0.008 (0.032)	-0.009 (0.055)	-0.008 (0.032)	-0.002 (0.033)	-0.004 (0.033)
Year 1998	-0.360 (0.051)**	-0.313 (0.057)**	-0.313 (0.054)**	-0.352 (0.051)**	-0.301 (0.057)**	-0.311 (0.061)**
Year 2000	0.232 (0.045)**	0.218 (0.045)**	0.217 (0.044)**	0.226 (0.045)**	0.210 (0.045)**	0.213 (0.047)**
Region/Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs.	2216	2216	2216	2216	2216	2216

(1) Standard errors (robust to correlation of residuals within households and heteroscedasticity) in parentheses

** significant 5%significance level and * significant 10%significance level.

(2) IV1 uses change of total wage income obtained from individual questionnaire as instrument for household income change.

IV2 uses change of unemployment, wage arrears no more than one month; change in pension arrears as the instrument variables

(3)First education level is below general secondary education (< 10 grades). Second level is general secondary education .

(=10 grades). Third level is vocational school. Fourth level is university and above.

Table 1.15: Consumption Smoothing for Pooled Asset Group (With Education Interaction; With Attrition Correction)

Dependent Variables:	Consumption Change		
	OLS	IV1	IV2
Income Change	0.062 (0.020)**	0.257 (0.044)**	0.169 (0.058)**
Income Change× Demeaned	-0.007 (0.005)	-0.031 (0.014)**	-0.024 (0.021)
Maximum Education	-0.0002 (0.003)	-0.0003 (0.003)	-0.0004 (0.003)
Of Household Members	-0.003 (0.008)	-0.001 (0.008)	-0.002 (0.008)
Total Assets	-0.035 (0.042)	-0.035 (0.045)	-0.036 (0.043)
Change in the Number of Children	-0.239 (0.057)**	-0.214 (0.059)**	-0.229 (0.059)**
Change in the Number of Seniors	-0.044 (0.027)*	-0.034 (0.027)	-0.037 (0.027)
Change in Household Size	-0.0002 (0.019)	-0.004 (0.020)	-0.003 (0.019)
Number of Children In the 1st Period	-0.062 (0.030)**	-0.059 (0.030)*	-0.062 (0.031)**
Number of Seniors In the 1st Period	0.025 (0.015)*	0.026 (0.015)*	0.026 (0.015)*
Household Size in the 1st Period	-0.015 (0.006)**	-0.016 (0.006)**	-0.016 (0.006)**
Age of Household Head	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**
Age2 of Household Head	-0.028 (0.026)	-0.028 (0.027)	-0.029 (0.027)
Gender of Household Head	-0.300 (0.048)**	-0.229 (0.050)**	-0.261 (0.051)**
Year 1998	0.302 (0.036)**	0.271 (0.039)**	0.285 (0.038)**
Year 2000	Yes	4395	Yes
Region/Year Dummies	4236	4236	4236
Number of Obs.			

See notes in Table 1.14

Table 1.16: Consumption Smoothing for Pooled Asset Group (With Asset Interaction; With Attrition Correction)

Dependent Variables:	Consumption Change		
	OLS	IV1	IV2
Income Change	0.006 (0.075)	0.511 (0.170)**	0.342 (0.262)
Income Change×Asset Group	0.006 (0.009)	-0.036 (0.020)*	-0.025 (0.033)
Maximum Education Of Household Members	0.0001 (0.003)	-0.0001 (0.003)	-0.0002 (0.003)
Total Assets	-0.003 (0.008)	-0.0013 (0.008)	-0.001 (0.008)
Change in the Number of Children	-0.032 (0.042)	-0.034 (0.045)	-0.035 (0.043)
Change in the Number of Seniors	-0.237 (0.057)**	-0.211 (0.059)**	-0.226 (0.059)**
Change in Household Size	-0.045 (0.027)*	-0.038 (0.027)	-0.040 (0.027)
Number of Children In the 1st Period	-0.005 (0.019)	-0.005 (0.020)	-0.004 (0.020)
Number of Seniors In the 1st Period	-0.061 (0.030)**	-0.058 (0.030)*	-0.061 (0.030)**
Household Size in the 1st Period	0.025 (0.015)*	0.025 (0.015)*	0.025 (0.015)*
Age of Household Head	-0.015 (0.006)**	-0.016 (0.006)**	-0.016 (0.006)**
Age2 of Household Head	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**
Gender of Household Head	-0.026 (0.026)	-0.025 (0.027)	-0.027 (0.027)
Year 1998	-0.302 (0.048)**	-0.231 (0.051)**	-0.263 (0.052)**
Year 2000	0.303 (0.036)**	0.270 (0.039)**	0.285 (0.038)**
Region/Year Dummies	Yes	Yes	Yes
Number of Obs.	4236	4236	4236

See notes in Table 1.14

Table 1.17: Consumption Smoothing for Pooled Asset Group(With Education/Assets Interaction; With Attrition Correction)

Dependent Variables:	Consumption Change		
	OLS	IV1	IV2
Income Change	-0.097 (0.097)	0.367 (0.176)**	0.239 (0.272)
Income Change $\times$ Asset Group	0.064 (0.060)	0.022 (0.116)	-0.007 (0.205)
Income Change $\times$ Demeaned Maximum Education	0.015 (0.032)	-0.008 (0.062)	-0.022 (0.124)
Income Change $\times$ Asset Group $\times$ Demeaned Maximum Education	-0.003 (0.004)	-0.003 (0.008)	-0.0002 (0.015)
Maximum Education Of Household Members	-0.0004 (0.003)	-0.0004 (0.003)	-0.0004 (0.003)
Total Assets	-0.003 (0.008)	-0.0005 (0.008)	-0.002 (0.008)
Change in the Number of Children	-0.033 (0.042)	-0.039 (0.045)	-0.038 (0.044)
Change in the Number of Seniors	-0.234 (0.058)**	-0.215 (0.059)**	-0.231 (0.060)**
Change in Household Size	-0.045 (0.027)*	-0.035 (0.027)	-0.037 (0.027)
Number of Children In the 1st Period	0.001 (0.019)	-0.005 (0.020)	-0.003 (0.020)
Number of Seniors In the 1st Period	-0.061 (0.030)**	-0.060 (0.030)**	-0.063 (0.031)**
Household Size in the 1st Period	0.025 (0.015)*	0.026 (0.015)*	0.026 (0.015)*
Age of Household Head	-0.015 (0.006)**	-0.017 (0.006)**	-0.016 (0.006)**
Age2 of Household Head	0.0002 (0.0001)**	0.0002 (0.0001)**	0.0002 (0.0001)**
Gender of Household Head	-0.026 (0.026)	-0.029 (0.027)	-0.030 (0.027)
Year 1998	-0.299 (0.048)**	-0.228 (0.050)**	-0.262 (0.051)**
Year 2000	0.302 (0.036)**	0.271 (0.039)**	0.285 (0.038)**
<i>F</i> -test of Interaction Terms	3.02	2.00	0.71
<i>p</i> - value of <i>F</i> statistics	0.0286	0.112	0.548
Region/Year Dummies	Yes	Yes	Yes
Number of Obs.	4236	4236	4236

See notes in Table 1.14

Chapter 2

Multiple Job Holdings As a Way to Smooth Consumption: Labor Response to Wage Arrears Among Russian Couples

2.1 Introduction

During ten years of economic and social transition, Russia has witnessed a weak correlation between employment change and output change: the declines in total employment were substantially below the steep declines in GDP ¹. Instead of mass layoffs, wage arrears, unpaid administrative leave and short-time work were common practices adopted by the employers as adjustment mechanisms. Among these practices, wage arrears were the dominant form of labor market adjustment and the main source of insecurity for Russian workers (Lehmann, Wadsworth and

¹Between 1990 and 1998, GDP fell by about 45%, while aggregate employment declined by about 16%. OECD (2001)

Acquisti (1999)). At the end of 1998, nominal wage arrears reached 77 billion roubles, which was equivalent of 200 percent of the monthly wage bill. After three years of recovery from the 1998 financial crisis, by the end of 2001, the stock of wage arrears was reduced to 29.9 billion roubles but was still higher than the level of 17.5 billion roubles in 1995.² Wage nonpayment was also pervasive in terms of the percentage of working people affected: about 64% of working age men and women were owed wages in 1998 and this number was still over 25% in 2001 (Mroz, Osmolovskii and Popkin, 2002).

Various studies have shown that workers respond actively in one way or another to wage arrears. For example, using nationally representative household survey data together with matched firm-individual data, Earle and Sabirianova (2002) found that wage arrears have a positive impact on workers' quits in the regions where wage arrears level are less than average. Lehmann, Wadsworth and Acquisti (1999) also found that wage arrears positively affect the incidence of job-to-job movement and such effect is strengthened by the viability of the outside labor market. Foley (1997) looked at the individual pattern of transitions between labor market states from 1992 to 1996 in a pooled cross section data set and found that wage arrears had no effect on propensity to switch jobs; however, wage arrears increased the probability of taking on additional work (Foley 1997b). Desai and Idson (2001) detected worker-initiated turnover among workers subjected to wage nonpayment. Moreover, they found that although wage arrears had no effect on

²Russian Economic Trends, June 1999, vol.8, no.4 ; December 2002, vol 11, no.4

the tendency of workers to hold more than one formal job, wage arrears did have distinct labor supply effects with respect to less formal supplemental work.

Given that labor markets are flexible, any labor response, particularly an increase in household labor supply in secondary jobs, might mitigate the negative impact of wage arrears in the primary job on household consumption. It has been well known that labor supply is an alternative to dissaving, asset decumulation, or increasing debt in the attempts of households to maintain consumption in the face of declining income (Mincer 1962). Various studies have focused on the labor market responses, such as hours worked, self-employment and household labor supply to economic shocks ³. Empirical evidence also shows that shift of labor from farm to off-farm employment can explain the observed lack of correlation between consumption and idiosyncratic crop shocks in rural India (Kochar 1999). To test the hypothesis that in Russian economy the labor response helps to mitigate the impact of wage arrears on household consumption, we focus on multiple job holdings by household members. ⁴ Applying a test proposed by earlier research (Kochar 1999), our reduced-form regression of consumption on wage arrears reveals no significant effect of wage arrears in the primary job on household consumption. ⁵

³Smith, Thomas, Frankenberg, Beegle, and Teruel (2002) on Indonesia; McKenzie (2003a) on Mexico and McKenzie (2003b) on Argentina.

⁴The impact of wage arrears on total working hours is ambiguous because it might reflect job changes. Furthermore, changing primary jobs need not reflect the desire of the household to smooth their consumption because with well-functioned labor market, job-specific shocks would result in a shift to new jobs, even if households have access to insurance market (Kochar 1999).

⁵This result is consistent with the result in our previous findings that the consumption of Russian households was relatively well protected from shocks such as wage arrears, pension arrears and unemployment.

Conditional on multiple job holdings, however, wage arrears have a negative effect on consumption. This result confirms that the ability to smooth consumption in times of wage arrears reflects, in some part, multiple job holdings of the male and female household heads.

The experience of wage arrears by one individual can trigger the change of worker's labor allocation from one job to another job or from single job holding to multiple job holding, as documented in the previous literature. At the same time, it may also affect the consumption-leisure decision within his/ her household and change the labor supply of other household members. Previous theoretical analysis highlights the implications of income shocks on spousal labor supply in a household life-cycle model in which individual's labor supply increases when exogenous shocks experienced by their spouse causes a *transitory* reduction in their household income.⁶ In the case of wage arrears, if individual worker responds to their own wage arrears by increasing labor supply, then the cross effect of wage nonpayment on spouse labor supply might be subdued. In our estimation of household labor supply responses to wage arrears shocks, we analyze how individual labor supply responds to wage arrears experienced by the spouse. Unlike previous studies of "the added worker effect", which focus on the wife's labor supply response to the husband's labor market shock, we examine the labor supply response of both wife and husband to the wage nonpayment experienced by their spouse. It is necessary

⁶The effect of a husband's job loss on the labor supply of his wife is known as the "added worker" effect (Mincer 1962; Heckman and MaCurdy 1980; Lundberg 1985; Stephens 2001; ect.)

in the context of the Russian labor market to include both women and men in the analysis because the labor force participation rate of women is comparable to that of men.⁷

In our estimation of multiple job holdings as well as job-to-job movement, we apply the “Chamberlain ” approach to a dynamic probit model. This model explicitly allows individual fixed effects to be correlated with time varying variables including the incidence of wage nonpayment. It is especially useful because the unobserved time-invariant individual characteristics may very well be correlated with both the labor supply decisions and the experience of wage arrears. We also allow the effect of first time wage arrears on the labor supply to be different from wage arrears in general. Such difference is important because it allows us to learn how people respond to repeated shocks such as wage arrears.

We find that both husband and wife are more likely to take secondary informal job when they have wage arrears shocks in their primary jobs. Moreover, they are more likely to change their primary job after they experience wage arrears in their primary jobs. In the reduced form regression of household’s consumption on wage arrears, we find that the household consumption is very well protected from wage arrears shock. But the results in the structural equation shows that household consumption falls with the wage arrears shocks experienced by the wife.

⁷Labor force participation rate of women was 83.3%, 84.1%, 82.3%, 80.7% 78.7% and 78.9% in year 1994, 1995, 1996, 1998, 2000 and 2001 respectively. The labor force participation rate of men in the same period was 87.9%, 88.2%, 86.6%, 84.4%, 85.9% and 86.1%. (Mroz, Henderson, Bontch-Osmolovskii and Popkin, 2001)

The results suggest that overall insignificant effect of wage arrears on consumption reflects adjustment of secondary job holdings.

The remainder of this paper proceeds as follows. Section 2 reviews the literatures on the causes of wage nonpayment in Russia and describe the features of wage arrears with descriptive statistics from RLMS. Section 3 presents the theoretical model of household labor supply with uncertainty and discusses the empirical specification strategy. Section 4 discusses the dataset used in the analysis. Section 5 presents the central results. Section 6 concludes.

2.2 Wage Arrears In Russia

2.2.1 The Causes of Wage Arrears

Wage arrears in Russia are not an independent and isolated phenomenon. They were rather a part of more general and pervasive payment arrears, which included nonpayment from government to its suppliers in industries; nonpayment of tax from enterprise to government and nonpayment from enterprise to enterprise. All these arrears were to some extent inter-correlated in a vicious circle (Gimpelson and Lippoldt 2001; Ivanova and Wyplosz 1999). The causes of wage arrears and nonpayment in general have been the focus of many economic studies. At a macro level, tight monetary policy in the mid-1990s targeted at inflation is often cited as one possible root of nonpayment, because it induced economic depression and

cash shortages. Two features of fiscal policies during this period, high tax rates and budgetary cuts are also believed to have caused the wage arrears. High tax rates created incentives for firms to hide cash, while the budget cuts resulting from the budget deficit targets specified by the International Monetary Fund by the end of 1995 caused persistent underfinancing of the army as well as other public sectors and generated mass late wages and pensions. Absence of regulatory control also contributed to the widespread wage arrears, because it left firms managers with unchecked powers to manage money and unscrupulous managers were not held responsible for delaying or withholding wage payment to workers (Earle and Sabirianova 2002; Desai and Idson 2001; Gimpelson and Lippoldt 2001).

In terms of firms' decision regarding wage arrears at micro level, one interpretation is that wage arrears reflects an implicit contract between firms and employees. According to this theory, the firm proposes a contract that includes a low monetary wage and access to social service. The most productive workers leave the firm and concentrate in the most productive firms; the less adequate workers remain in their initial firm. In this framework, wage arrears can be viewed as an element of implicit contract between firms and less productive workers (Grosfeld et. 2001). Another view treats arrears as the outcome of generally poor economic performance of firms. Unprofitable firms lacking cash and run up arrears as a way for them to cut costs and stay afloat (Lehmann, Wadsworth and Acquisti 1999). This response may be especially attractive when firms face the political and bureaucratic obstacles to

layoffs, such as costly regulations and approvals that have to be met. Or managers may not want to create conflicts with local governments unwilling to allow large open unemployment (Commander et al. 1996). Wage arrears could also be a device used by managers to extract subsidies from the government, especially by firms with close ties to federal or local governments or those with greater bargaining power (Alfandari and Schaffer 1996).

Given the decisions of firms with respect to wage arrears, Russian workers seem to have been very tolerant of such practices. Fear of unemployment might explain why workers accept deteriorating employment conditions. It is particularly aggravated by the low level of unemployment benefits, which was also subject to arrears (Clarke 1998). At the same time, keeping an “old” job could provide at least some in-kind compensation, particularly enterprise-related social benefits, which include housing, nursery, health care and recreation benefits, and added about 5 percent to total labor costs in general⁸. The larger the fringe benefit portion of compensation was, the stronger the incentives for workers to accept a backlog in wages (Gimpelson and Lippoldt 2001). Weak union is also cited as a factor leading to more wage arrears (Connor 1995). More importantly, when other firms in the region also pay late, the employees of a late-paying firm become less likely to quit, reduce effort or to strike. Such a self-propagation feature of the wage-arrear prac-

⁸The composition of fringe benefits in the Russian system is different than in the U.S. system. The fringe benefits in the U.S. include payments to private retirement systems as well as to life insurance, health benefits and other agreed-upon plans. Legally required payments such as Social Security and unemployment insurance contributions are normally not counted as the fringe benefits. Fringe benefits in the U.S. accounted for about 9.2%-16.1% of total compensation in the 1980s (Woodbury 1983).

tice makes it difficult for workers not to accept wage arrears (Earle and Sabirianova 2000).

2.2.2 The Distributions of Wage Arrears on the Primary Jobs

Official information on wage arrears in Russia is limited to aggregate levels of cumulative overdue wage debts. We use Russian Longitudinal Monitory Survey (RLMS) (1994-1996, 1998, 2000, 2001) micro level data to describe the magnitude, persistence and the distribution patterns of wage arrears on the primary jobs of the respondents. The incidence of wage arrears could be measured separately by two survey questions. The first one is “At the present time, does your primary place of work owe you any money which for some reasons they didn’t pay you on time?” This question measures the incidence of all wage arrears, which in Table 1 we call “owed wage ”. Since wage payment is very uncertain and workers got paid periodically, we also use the second question to measure the “flow ” of wage arrears. The respondent was asked “Tell me please, at your primary place of work in the last 30 days, did you get a sum of money as wages, bonuses, benefits, revenues, profits ? ” This question measures the incidence of wage arrears in the survey month and we name it “working without payment at current month ”.

As we can see from Table 2.6, wage arrears have been prevalent over the years since early in the 1990’s. About 40% of respondents reported that they were owed

overdue wage at the survey dates in 1994 and 1995, with higher proportion for men than for women. The wage nonpayment rate rose to about 60% in 1996 and 64% at the time of financial crisis in 1998. During the period in which the economy was recovering from the financial crisis after 1998, the rate of wage nonpayment dropped to 33.2% for men and 26% for women in 2000. It further decreased to 26.3% for men and 21.7% for women in 2001. Under the concept of wage arrears on the current month (3rd and 4th row of Table 2.6), the rate of wage nonpayment is lower than the rate measured by “whether currently owed money by the employer”, because people who have wage arrears might choose to quit working or change jobs. Moreover, workers irregularly got repayment of back wages. The magnitude of arrears can be measured by “months of wages not paid”. The average months of wage nonpayment was about 2.8 months in 1994 and rose to 6.0 months for men and 4.7 months for women in 1998. In 2000 and 2001, even though the incidence of wage arrears was much lower than previous years, the magnitude of wage nonpayment was not getting much better, with an average of 3 months in 2001.

Variation of wage nonpayment across a number of individual characteristics was also large. Figure 1.1-Figure 4.2 depict the patterns of wage arrears by age, education, tenure and relative monthly wage of individuals. The age effect (Figure 2.1 and 2.2) changes over the years, but for both men and women, young workers (age 18-29) are less likely to have wage arrears than older workers. Arrears

are generally negatively related to the level of education completed, especially for male workers (Figure 2.3 and 2.4). More educated workers are likely to have more alternative job prospects and thus less likely to continue working without payment at primary jobs. Workers with primary or less education were the most vulnerable to wage arrears, especially during the period of financial crisis in 1998. Tenure is generally positively related to the incidence of wage nonpayment (Figure 2.5 and 2.6). It might be explained by the fact that workers with long tenure might have less outside opportunity because of their specialized skills. New employees with tenure less than 1 year are far less likely to have wage arrears. The mobility cost for a new employee might be lower thus they are more likely to change job after nonpayment. Another explanation might be the fact that they were exposed to less incidence of wage arrears because of their short tenure with the employees. Figure 2.7 and 2.8 shows the relation between incidence of wage arrears and relative real monthly earnings⁹. They imply that people in the lower earning quartile have a higher incidence of wage arrears. The causality of wage arrears and wage earnings can go either way. Wage nonpayment may affect people at the bottom of wage distribution most if the managerial decision is to allocate wage arrears to the lower-paid, less-skilled employees (Desai and Idson 2001). On the other hand, wage arrears have negative effect on people's earning and thus people who have wage nonpayment may be more likely to be in the bottom of the earning distribution.

⁹The survey doesn't have the information on actual wage, instead it asked the respondent "How much money in the last 30 days did you receive from your workplace after taxes? ".

Table 2.6 lists the wage arrears by occupation. In order to have enough observation numbers in each occupation-gender-year cell, we look at the distribution of wage nonpayment at the aggregate level, particularly before and after 1998. Consistent with the data in Table 2.6, there is a substantial drop in wage arrears in most of the occupations after 1998. Within each period there exists considerable variance, with rates ranging from 76.2% for men who are “agricultural and fishery laborers” to 14.8% for “models, salespersons and demonstrators”. The rate of wage nonpayment is high in the semi-skilled job such as “machine operators and assemblers”; or “drivers and mobile-plant operators”. It is relatively low among professionals like “general managers”. This is consistent with the wage arrears distribution among different education categories displayed in Figure 2.1 and 2.2. Some fields such as “teaching professionals” and “physical mathematical, engineering science professionals” also experienced a high rate of wage arrears regardless of the high-level education of the employees. This phenomenon might be explained the fact that these jobs would fall under the budget sectors and government retrenchment in the late 1990’s increased the rate of wage nonpayment in these areas. Within each occupation, women are not necessarily less likely to get wage arrears although in general women have less incidence of wage arrears as showed in Table 2.6.

2.3 Theoretical Framework and Empirical Issues

2.3.1 Theoretical Framework

This section examines how one might expect the likelihood of taking multiple job to vary with the experience of wage arrears in the primary job. Further, we explore the implication of multiple job holdings on household consumption decision.

Households' Choice of Multiple Job Holdings

We begin by considering a simple theoretical model of a household's choice of leisure and consumption. An analysis of households' choice of multiple job holdings involves the specification of a model under uncertainty whereby observed choice depends on households' wage payment in primary jobs, thus the realization of the wage arrears shock. Assume households exist until time T and their utility function depends on household total consumption C as well as the leisure of male and female household head. The leisure is represented by discrete choice variable i_m and i_f , each of which stands for male and female member's choice on multiple job holding. Let the wage of male and female household head in primary job be W_m^M and W_f^M . The realization of their wage arrears shock in the primary job is represented by P_m^M and P_f^M . And we denote the nonpecuniary benefits that are associated with having the primary job by $\bar{B}$. If male or female household head chooses to take multiple jobs ($i_m = 1$ or $i_f = 1$), we assume they can get wage payment

W^S_m and W^S_f at the non-primary job(s) without risk. The households' objective function at any point of the life cycle is then described by the maximization of the expected utility subject to the budget constraint:

$$\text{Max}U_t = E_t \sum_{\tau=t}^T \frac{1}{(1+\rho)^\tau} U(C_\tau, l_{m\tau}, l_{hf\tau}) \quad (2.1)$$

$$\begin{aligned} A_t &= (1+r)A_{t-1} - C_{t-1} + W^M_{mt}\mathbf{1}(P^M_{mt} = 1) + W^M_{ft}\mathbf{1}(P^M_{ft} = 1) + \\ &\quad + W^S_{mt}\mathbf{1}(i_{mt} = 1) + W^S_{ft}\mathbf{1}(i_{ft} = 1) + \bar{B} \\ c_T &= A_T \end{aligned} \quad (2.2)$$

where $\mathbf{1}(\cdot)$ is the indicator function of the event between brackets—for instance, “male household head taking multiple jobs period t ” is $\mathbf{1}(i_{mt} = 1) = 1$

Because $P^M_{mt} = 1$ and $P^M_{ft} = 1$ refer to the male and female household head getting full wage payment at primary job in period t , we can write the probability of full wage payment as the following:

$$Pr(P^M_{mt} = 1) = E_t[\mathbf{1}(P^M_{mt} = 1)] = p_{mt}; \quad (p_{mt} \in [0, 1]) \quad (2.3)$$

and

$$Pr(P^M_{ft} = 1) = E_t[\mathbf{1}(P^M_{ft} = 1)] = p_{ft}; \quad (p_{ft} \in [0, 1]) \quad (2.4)$$

In order to explicitly derive how households' choice of taking multiple jobs and the wage arrears at the primary job are correlated, we take two-period case ($T - 1$, T) as an example. In this finite-horizon discrete case, if the solution exists, this maximization problem is equivalent to solving the Bellman (1957) equation. We

denote the value function of household h by V^h and the discount factor by ρ , the Bellman equation is written as:

$$\begin{aligned} V^h(A_{T-1}) = & \text{Max}U(C_{T-1}, i_{mT-1}, i_{fT-1}) + \rho E_T \text{Max}U[Z_T + W_{mT}^M(P_{mT}^M = 1) + \\ & W_{fT}^M(P_{fT}^M = 1) + W_{mt}^S \mathbf{1}(i_{mt} = 1) + W_{ft}^S \mathbf{1}(i_{ft} = 1), i_{mT}, i_{fT}] \end{aligned} \quad (2.5)$$

where $Z_T = (1 + r)A_{T-1} - C_{T-1} + \bar{B}$. By the iterated expectation, we have:

$$\begin{aligned} & E_T U[Z_T + W_{mT}^M \mathbf{1}(P_{mT}^M = 1) + W_{fT}^M \mathbf{1}(P_{fT}^M = 1) + W_{mt}^S \mathbf{1}(i_{mT} = 1) + \\ & W_{fT}^S \mathbf{1}(i_{fT} = 1), i_{mT}, i_{fT}] \\ & = E_T E_p U[Z_T + W_{mT}^M \mathbf{1}(P_{mT}^M = 1) + W_{fT}^M \mathbf{1}(P_{fT}^M = 1) + W_{mT}^S \mathbf{1}(i_{mT} = 1) + \\ & W_{fT}^S \mathbf{1}(i_{fT} = 1), i_{mT}, i_{fT} | p_{mT}, p_{fT}] \\ & = p_{mT} p_{fT} E_t U[Z_T + W_{mT}^M + W_{fT}^M + W_{mT}^S \mathbf{1}(i_{mT} = 1) + \\ & W_{fT}^S \mathbf{1}(i_{fT} = 1), i_{mT}, i_{fT}] + [1 - p_{mT}][1 - p_{fT}] E_T U[Z_T + \\ & W_{mT}^S \mathbf{1}(i_{mT} = 1) + W_{fT}^S \mathbf{1}(i_{fT} = 1), i_{mT}, i_{fT}] + p_{mT}[1 - p_{fT}] E_T U[Z_T + \\ & W_{mT}^M + W_{mT}^S \mathbf{1}(i_{mT} = 1) + W_{fT}^S \mathbf{1}(i_{fT} = 1), i_{mT}, i_{fT}] + \\ & p_{fT}[1 - p_{mT}] E_T U[Z_T + W_{fT}^M + W_{mT}^S \mathbf{1}(i_{mT} = 1) + W_{fT}^S \mathbf{1}(i_{fT} = 1), i_{mT}, i_{fT}] \end{aligned} \quad (2.6)$$

We treat the leisure of male and female household members equally in the household utility function. And also we assume that leisure is a normal good. Let $U_1 = U(\bar{C}, 0, 0)$; $U_2 = U(\bar{C}, 1, 0) = U(\bar{C}, 0, 1)$ and $U_3 = U(\bar{C}, 1, 1)$. The assumption implies, given the consumption level, household's utility will have the following

relationship :

$$\text{Assumption 1. } U_1 < U_2 < U_3 \quad (2.7)$$

Another assumption we make in this model is based on Blundell, Magnac and Meghir (1997)'s result that if leisure is normal good, there will exist a reservation asset level; if assets are below the reservation level then the probability of accepting the job offer will be close to 1. Consequently, a lower level of wealth increases the probability of taking secondary jobs. Based on this result, we can assume that the utility gain from taking secondary jobs, is biggest when both of the household members get wage arrears in their primary jobs. At the same time, the utility gain from taking secondary jobs is smallest when none of the households head have wage arrears in their primary jobs:

$$\begin{aligned} \text{Assumption 2. } \exists \bar{Z} \text{ s.t. } \forall Z < \bar{Z}, \\ \Delta U_T^1 < \Delta U_T^3 < \Delta U_T^2 \quad \text{or} \quad \Delta U_T^1 < \Delta U_T^4 < \Delta U_T^2 \\ \text{and } \Delta U_T' < \Delta U_T''' < \Delta U_T'' \quad \text{or} \quad \Delta U_T' < \Delta U_T'''' < \Delta U_T'' \end{aligned} \quad (2.8)$$

where $\Delta U_T^1 = U[Z_T + W_{mt}^M + W_{ft}^M + W_{mT}^S + W_{fT}^S, 1, 1] - U[Z_T + W_{mT}^M + W_{fT}^M + W_{iT}^S, 1, 0]$ ($i = m, f$), which is the household utility gain from both male and female household head taking secondary job(s) over one of them taking secondary job(s) when both of them get wage payment in their primary jobs. Accordingly, $\Delta U_T^2 = U[Z_T + W_{mT}^S + W_{fT}^S, 1, 1] - U[Z_T + W_{iT}^S, 1, 0]$, which is the utility gain from both male and female household head taking secondary job(s) over one of them taking secondary job(s) when both of them get wage arrears in their primary

jobs. And $\Delta U_T^3 = U[Z_T + W_{mT}^M + W_{mT}^S + W_{fT}^S, 1, 1] - U[Z_T + W_{mT}^M + W_{iT}^S, 1, 0]$, which is utility gain from both male and female household head taking secondary job(s) over one of them taking a secondary job when the female gets wage arrears in her primary job. ΔU_T^4 , accordingly, is the utility gain in this case when the male gets wage arrears. Similarly, $\Delta U_T' = U[Z_T + W_{mT}^M + W_{fT}^M + W_{iT}^S, 1, 0] - U[Z_T + W_{mT}^M + W_{fT}^M, 0, 0]$ and is the household utility gain from one of the household members taking a secondary job(s) over none of the household members taking a secondary job when both of the households get wage payment in their primary jobs. $\Delta U_T'' = U[Z_T + W_{iT}^S, 1, 0] - U[Z_T, 0, 0]$; and it is utility gain from one of the household head taking secondary job(s) over none of the household heads taking secondary job(s) when both of the households get wage arrears on their primary jobs. Lastly, $\Delta U_T''' = U[Z_T + W_{mT}^M + W_{iT}^S, 1, 0] - U[Z_T + W_{mT}^M, 0, 0]$ and it stands for the household utility gain from one of the household members taking a secondary job compared to none of the household heads taking secondary job(s) when the female household head gets wage arrears in their primary jobs. And $\Delta U_T''''$ is the utility gain in this case when the male gets wage arrears.

There are three possible cases: both of the household members taking secondary job(s); one of the household members taking secondary job(s) and none of the household members taking secondary job(s). Both of the household members take secondary job(s) if and only if their expected utility is higher than when only one of them chooses to take secondary job(s). The difference in the expected utility

between two households members taking secondary job(s) and only one household is:

$$\begin{aligned}\Delta EU_T = & p_{mT}p_{fT}\Delta U_T^1 + (1 - p_{mT})(1 - p_{fT})\Delta U_T^2 + p_{mT}(1 - p_{fT})\Delta U_T^3 + \\ & + p_{fT}(1 - p_{mT})\Delta U_T^4\end{aligned}\quad (2.9)$$

The comparative statics of ΔEU_T with respect of the probability of wage arrears can be written as:

$$\frac{\partial \Delta EU_T}{\partial p_{mT}} = p_{fT}(\Delta U_T^1 - \Delta U_T^4) + (1 - p_{fT})(\Delta U_T^3 - \Delta U_T^2) \quad (2.10)$$

$$\frac{\partial \Delta EU_T}{\partial p_{fT}} = p_{mT}(\Delta U_T^1 - \Delta U_T^3) + (1 - p_{mT})(\Delta U_T^4 - \Delta U_T^2) \quad (2.11)$$

Following assumption 2 that $\Delta U_T^1 < \Delta U_T^4 < \Delta U_T^2$ and $\Delta U_T^1 < \Delta U_T^3 < \Delta U_T^2$, we know that $\frac{\partial \Delta EU_T}{\partial p_{iT}} < 0$. This shows that both male and female household head are more likely to take secondary job when the probability of getting wage payment in the primary job is lower.

Similarly, one of the household head will choose to take secondary job if and only if their expected utility is higher than when none of them chooses to take secondary job(s). This difference in expected utility between one household head taking secondary job(s) and none of the household head taking secondary job(s) is:

$$\begin{aligned}\Delta EU_T' = & p_{mT}p_{fT}\Delta U_T' + (1 - p_{mT})(1 - p_{fT})\Delta U_T'' + p_{mT}(1 - p_{fT})\Delta U_T''' + \\ & + p_{fT}(1 - p_{mT})\Delta U_T'''\end{aligned}\quad (2.12)$$

The relationship between the likelihood for one household head to take the secondary job and the probability of wage arrears can be shown as the following:

$$\frac{\partial \Delta EU_T'}{\partial p_{mT}} = p_{fT}(\Delta U_T' - \Delta U_T''''') + (1 - p_{fT})(\Delta U_T''' - \Delta U_T'') < 0 \quad (2.13)$$

and

$$\frac{\partial \Delta EU_T'}{\partial p_{fT}} = p_{mT}(\Delta U_T' - \Delta U_T''''') + (1 - p_{mT})(\Delta U_T''' - \Delta U_T'') < 0 \quad (2.14)$$

which means that one of the household head is more likely to take secondary job(s) if the probability of getting wage payment in the primary job is lower.

The model above identifies the relationship between the likelihood of taking secondary jobs and the probability of getting wage arrears, which reflects the household's expectation of wage payment. We cannot explicitly estimate such expectations on wage arrears because the firm-level information necessary for such estimation is not available. Instead we can use the real incidence of wage arrears and thus estimate the labor supply response to the realization of wage arrears shocks.

Households Consumption and Labor Supply

To further analyze the effects of wage nonpayment and secondary job holdings on households' consumption, we take the first order condition of the maximization problem outlined in equation (2.1) and (2.2), we can have:

$$U(C_t, i_{mt}, i_{ft}) = \lambda_t(1 + r) \quad (2.15)$$

$$\lambda_t = \frac{1+r}{1+\rho} E_t(\lambda_{t+1}) \quad (2.16)$$

According to MaCurdy (1985), the realization of past variables, the forecast errors at each period as well as the change of expectations about future wage enter the decisions of households as shock to λ_t . Households form expectations and update their expectations about future variables including the possibility that one or both of the household heads will get wage nonpayment. The marginal utility of wealth at time t is a function of initial assets, the expectation of future wages, the interest rate, the rate of time preference and other unobservables. Condition (2.16) describes the time path of the change in λ : households under uncertainty set their savings so that the expectation of next period's marginal utility of wealth is updated by the realized forecast errors.

For a given household, wage arrears in time t brings a low wage realization in time t , moreover it also changes the value of λ . Its impact on λ depends on how early the household learns of the wage arrears. If the household has information about wage arrears in advance, then λ increases before wage arrears actually occur. In this case, wage arrears at time t will not affect the consumption at time t in the structural model specified by equation (2.15). If wage arrears in the primary job come as a shock to the household at time t , the impact of such a shock will be embodied in the change of λ in equation (2.15). The wage effect of wage nonpayment affects household labor supply only at time t , but the wealth effect of wage nonpayment, which comes from the reduction in expected lifetime wealth, will lead to an increase

in household labor supply once they know of wage nonpayment ¹⁰. But in both of these cases, if the household uses secondary jobs to buffer the consumption against wage arrears in their primary jobs, then the overall impact of wage arrears on consumption will be low as reflected in the “reduced-form ” regression specified by equation (2.15) where the labor supply decision is not included. On the other hand, conditioning on secondary job holdings should yield a significant negative effect of wage arrears in primary job consumption.

2.3.2 Empirical Specification

Analyzing the Impact of Wage Arrears in Primary Job on Secondary Job Holdings

Estimation of secondary job holdings requires a specification of wage arrears shock as shown by p_{mt} and p_{ft} in equation (2.9) and (2.12). Also the estimation of consumption equation (equation (2.15)) requires the specification of the time-variant marginal utility of wealth for household h : λ_{ht} . Following the approach of MaCurdy (1985), $\log \lambda_{ht}$ can be expressed as:

$$\log \lambda_t = \log \lambda_0 + e + \sum_{\tau=0}^t \varepsilon_t \quad (2.17)$$

where ε_t represents the forecast errors at each time t . e is a household fixed effect. Since changes in $\log \lambda_t$ reflect both the realization of past variables and the changes in the expectation of future wealth, we include dummy variables S_{mt} and

¹⁰For the discussion of cross-wage effect and wealth effect in the family life-cycle labor supply model with uncertainty, see Blundell (1999) and Stephens (2002)

S_{ft} to capture the changes in $\log \lambda_t$ which are correlated with wage nonpayment shocks experienced by male and female household members at time t . We use two different measures of wage arrears “shocks” for S_{mt} and S_{ft} . One is “the first-time wage arrears”, which is defined to be a dummy variable equal to 1 if wage arrears happen for the first time between the survey years. The other is “the general wage arrears”, which is also a dummy variable but equal to 1 whenever a wage arrears occurs. The impact of “the first-time wage arrears” and “the general wage arrears” might be different because of the difference in households’ ability to predict the occurrence of wage arrears. For example, if “the first-time wage arrears” comes as a shock to households, then p_{mt} and p_{ft} have low values at time t . By equations (2.9) and (2.12), we know that households will be less likely to take secondary job(s) in the case of “the first-time wage arrears”. Similarly, households update their information on wage payment in the primary jobs and are more likely to take secondary job(s) in the case of “the general wage arrears”.

Another issue in estimating secondary job(s) holding is that the realizations of wage rates in the primary job and secondary job W_{mt}^M , W_{ft}^M , W_{mt}^S and W_{ft}^S might be correlated with the shocks at local labor markets such as wage nonpayment, unemployment, short-time work and other forms of shocks, which in turn are correlated with individual’s decision on secondary job holding. Moreover the change in wage rates may be also correlated with the wealth shock across the families. Thus including these wage variables in the regression may pick up the heterogeneity in

the local market shock and wealth losses. This would lead to biased estimates of the wage-effect.

The objectives of this paper, however, do not require an explicit estimation of wage effect and so we accordingly circumvent the problems by estimating a reduced-form regression that omits wages but includes the exogenous determinants of wage rates. These are individual characteristics X_{mt} and X_{ft} such as age and education; community labor market characteristics such as the presence of employment service center; closed government factory and the presence of bank in the community; the interacted terms in individual characteristics with community labor market characteristics R_{ct} ; and region, year and region/year dummies (D_r ; D_t and D_{rt}) ¹¹. The employment service centers were established to help people find work, conduct retraining in new specialization and pay unemployment benefits. The presence of employment service center in the population center would signal the existence of a relative accessibility of information on the labor market. The presence of a closed government factory, on the other hand, captures the demand side factor of local labor market. We also include a dummy variable on whether there is a bank in the community because of it might explain some differences in the likelihood of credit constraints.

Given the specification of $\log \lambda_t$, W_{mt} and W_{ft} explained above, the estimation

¹¹RLMS provides extensive infrastructure information on 160 population centers, which can be aggregated to 38 state level primary sampling units (PSUs). The "community "refers to population centers, while the "region "refers to PSUs.

of the effect of wage arrears on the probability of husband/wife taking secondary job(s)¹² can be specified. In order to account for the potential correlation between regressors and unobserved individual fixed heterogeneity, we implement Mundlak's (1978) random effects probit model¹³. In this model, we allow unobserved individual fixed effect (ν_f, ν_m) to be explicitly correlated with the mean of time-variant regressors. Following Mundlak (1978), the fixed effect of individual i ($i = m$ if male household head; $i = f$ if female household head) can be expressed as:

$$v_i = \psi + \psi_1 \bar{X}_m + \psi_2 \bar{X}_{hf} + \psi_3 \bar{Z} + \psi_4 \bar{S}_f + \psi_5 \bar{S}_m + a_i \quad (i = m, f) \quad (2.18)$$

where the conditional distribution of a_i follows normal distribution, that is:

$a_i | (X_{mt}, X_{ft}, Z_t, S_{ft}, S_{mt}) \sim \text{Normal}(0, \sigma_a^2)$. Assume that the estimating equation of secondary job or incidental work holding, in linearized form, is:

$$P_{it}^* = \gamma_1 X_{it} + \gamma_2 X_{it} + \gamma_3' Z_t + \gamma_4 S_{ft} + \gamma_5 S_{mt} + \gamma_6 R_{ct} \\ + \gamma_7 D_r + \gamma_8 D_t + \gamma_9 D_{rt} + v_i + \varepsilon_{it} \quad (i=m, f) \quad (2.19)$$

where P^* is the continuous latent variable associated with the outcome that household member i supplies a positive amount of labor to secondary job or incidental work. The random fixed effect estimation can be obtained after substituting (2.18) into (2.19).

¹²Information about two different forms of multiple jobs is available in RLMS. One is about formal secondary job, which is based on the question, "Tell me please, do you have some other kind of work ". followed by the questions about tenure, occupation and ownership of the employer. We define this type of secondary job as "secondary formal job ". The other is informal economic activity: "Tell me please, in the last thirty days did you engage in some additional kind of work for which you got paid? Maybe you sewed someone a dress, gave someone a ride in a car, assisted someone with apartment or car repairs, purchased and delivered food, looked after a sick person, or did something else that you were paid for ". We define this type of secondary job as "secondary informal job."

¹³The more general form of this model is later called "Chamberlain's method ".

We can also use specification (2.18) and (2.19) to estimate the impact of wage arrears in primary jobs on job turnovers since the change of primary job(s) is another possible labor response to wage arrears in primary jobs and it can be modelled similarly as secondary job holding as outlined in the theory section.

Analyzing the Effects of Wage Arrears in Primary Job on Household Consumption

To assess if secondary job holdings serve an insurance function, we also analyze the effect of secondary job holdings on the correlation between consumption and wage arrears shocks. Following Kochar (1999), we first estimate the overall effect of wage arrears shocks on household consumption by running a reduced-form regression of consumption on a set of covariates that include wage arrears shocks:

$$\begin{aligned} \log C_{ht} = & \alpha_0 + \alpha_1 H_{ht} + \alpha_2 S_{mt} + \alpha_3 S_{ft} + \alpha_4 D_r + \alpha_5 D_t + \alpha_6 D_{rt} + \\ & + v_h + \varepsilon_{ht} \end{aligned} \quad (2.20)$$

where H_{ht} stands for household h characteristics, including age, sex and education of household head, the number of household members in different age/sex categories, non-labor assets of the households. To estimate the wage arrears impact α_2 and α_3 , we use household fixed effect estimation and it allows the unobserved time-invariant household characteristics to be correlated with wage arrears. If the secondary job(s) helps the household to smooth consumption in the face of wage arrears in the primary job, we expect the coefficient of α_2 and α_3 to be insignificant

or small in magnitude.

The role of secondary job holding is examined through a structural regression that conditions on secondary job holdings of the male and female head of the household h , J_{hmt} and J_{hft} :

$$\begin{aligned} \log C_{ht} = & \alpha_0' + \alpha_1' H_{ht} + \alpha_2' S_{hmt} + \alpha_3' S_{hft} + \alpha_4' D_r + \alpha_5' D_t + \alpha_6' D_{rt} + \\ & + \alpha_7' J_{hmt} + \alpha_8' J_{hft} + \mu_h + \epsilon_{ht} \end{aligned} \quad (2.21)$$

Secondary job holdings are clearly endogenous variables; and hence, the structural regression (2.21) is estimated using instrumental variable procedures. We use the presence of employment service center in the community as well as the interaction term of this variable with the education level of female and male household member as the instrument for secondary job holdings. The identifying assumption is that the household preference is not affected by the presence of employment service and the interaction terms once the household characteristics and the regional level aggregated shocks are controlled for.

In the empirical estimation, instead of using the instrumental variables directly in the second stage regression, we first use the instrument variables as well as the exogenous explanatory variables to predict the secondary job holdings in a probit model and then use the predicted values of secondary job holdings in the second stage regression. Such procedure can take into account the nature of bivariate variables and efficiently estimate the coefficient of endogenous variables without

the need of correcting for standard errors (Wooldridge 2001).

2.4 Data and Summary Statistics

2.4.1 Sample Creation

The data comes from the Russian Longitudinal Monitory Survey (RLMS), which was conducted by the Population Center at the University of North Carolina. The RLMS is a household-based survey designed to measure the effects of Russian reform on the economic well-being of households and individuals starting from 1992. Beginning in 1994, RLMS was designed to provide a longitudinal study of populations of dwelling units. The data used for analysis are for the years 1994-1996, 1998, 2000 and 2001 (Round IV-X).

The sample of couples used in the estimation has been created in three steps. First, data from the RLMS household file is merged to the individual dataset. The information from the household file include the identification numbers of the household head and the spouse of the household head. Second, every individual who is a household head or a spouse of the head is extracted from the merged data in step one. Men between ages of 21 to 60 and women between ages of 21 to 55 are kept in the sample. Third, couples are created by merging together individuals with the same family identification number in each year. This results in a sample of 8008 couple-year observations.

The final data set is created by deleting observations with missing data or logically wrong information. With the definition of “shock ”to be wage arrears for the first time ¹⁴, observations in 1994 are not used in the regression analysis because it is treated as the initial year. Couples with at least two observations are used in the final data set. The number of observations deleted and the reason for deleting them are as follows:

1. 170 observations are deleted because not both of husband and wife are older than 21 years old.
2. 387 observations are deleted due to missing data in assets variables.
3. 27 observations are deleted because the reported total working hours per month are greater than 450 hours.
4. 35 observations are deleted because the reported main occupation is farmers.
5. 25 observations are deleted because the reported total years of schooling are greater than 50.

¹⁴Wage arrears for the first time is defined in the following steps. First, the individual was paid at their work in the previous survey. If the answer to the question in the previous period, “Did you work at your primary place of employment in the last 30 days?” is “Yes ”, then this person must also have answered “Yes ” to the question “Tell me, please, at your primary place of work in the last 30 days did you receive some amount of money in the form of wages, bonuses, grants, benefits, revenues, profits? ”. Second, the individual had no wage nonpayment at the time of last survey. That means their answer to the question, “At the present time, does your place of work owe you any money, which for various reasons was not paid on time? ” is “No ”. Third, at the first time of survey, this individual is working but not paid wage at work.

6. 597 observations are deleted because working hours is missing for the respondents who reported to work.
7. 513 observations are deleted because wage arrears variable is missing for the respondents who reported working at a primary job.
8. 658 observations are deleted because wage arrears variable is missing for respondents who reported being involved in other economic activities than formal jobs.
9. 189 observations are deleted due to missing data in community information on closure of government factory, presence of employment services and banks.
10. 1250 observations in 1994 are deleted.¹⁵
11. 513 observations are deleted from couples that don't have at least two years of observations.
12. 74 observations are deleted because wage arrears occurred after not working in the previous year.

The resulting sample contains 3570 observations on 1605 couples with 584 of them having two years of observations; 399 of them having three years of

¹⁵Since "the first time wage arrears" is defined by getting wage arrears for the first time during the survey period, we treat the year of 1994 as initial year. As a result the 1994 data is not included in our estimation.

observations; 267 of them having four years of observations and 266 of them having five years of observations.

2.4.2 Summary Statistics

Table 2.3 reports the distribution of employment states of the married couples in our analysis sample. During 1995-2001, on average 83% of husbands and 75% wives were employed in the formal sector. Conditional on being employed in formal sectors, 87.7% of men and 92.5% of women have had only one job; 4.5% of men and 3.8% of women had secondary formal job. 7.7% of men and 3.1% of women had incidental work besides their first job in the formal sectors. During the financial crisis in 1998, more women held secondary informal jobs and the rate of secondary informal job holding increased to 6.6%. Over the years, less than 1% of the people in formal sector had three jobs simultaneously.¹⁶ Exclusive employment in the informal sector on average accounted for 5.2% for men and 3.3% for women. The rates were rising over the years: it rose from 4.5% in 1995 to about 6% in 2000's for men and from 3% to almost 5% for women in the same period.

The last row of Table 2.3 presents the rate of job change during the survey period. Since job change is defined as any change in job compared to the last

¹⁶Paxson and Sicherman(1996) reported that using PSID, dual job holding rates in U.S. are 21% for men and 12% for women. While by CPS, the rates are 7% and 6% respectively.

survey ¹⁷, the job change rate is much higher in 1998 and 2000 when there were two year gaps from the last survey. Especially during 1998-2000 period, when the economy experienced financial crisis first and then recovery, as high as 66.4% of men and 61.9% of women changed their original jobs. Overall, women are less likely to change job than men. From 1995 to 1996 ¹⁸, 15.3% of men and 10.7% of women reported having changed their jobs.

In Table 2.6, we present the comparison of individual characteristics and household characteristics by whether the husband or wife or both is still owed wage by their primary working place. Average age for husband who never had wage arrears is 37.24, compared to 38.2 for husband who had wage arrears. As expected, the education is higher for husband without any wage nonpayment. It is also not surprising to find that the employment rate for husbands with the experience of wage arrears (92.5%) is much higher than that for husbands without (72.9%), since people are subject to wage arrears only when they have jobs. Moreover, husbands who had wage arrears are more likely to take secondary formal or informal job than husbands who had no wage nonpayment, and the difference in holding secondary informal jobs is statistically significant.

Wives were younger and more educated if the husband had never had wage nonpayment. Not surprisingly, the incidence of wage arrears of wives and

¹⁷The job change is identified by the answer to the question, for example, in 1998: "Tell me, please did you change your place of work or profession by comparison with December 1996 or has everything remained the same? "

¹⁸No question was asked in the survey of 1995 about the job change

]

husbands is highly correlated. 67.2% of the wives had wage nonpayment when their husbands had wage nonpayment, whereas 42.2% of the wives had wage arrears when their husband had never experienced wage arrears.¹⁹ Consistent with the younger age of the wife, the number of the younger children is higher and the number of children older than 7 is lower in the no wage arrears group. Although family nonlabor income is not significantly different among the households with or without wage nonpayment,²⁰ household wealth, measured by assets value in the base year (1994) is significantly higher for household which had never had wage nonpayment.

When comparing between households whose female head had wage arrears to households whose female head had no wage arrears, we find a similar pattern to the comparison we made to the male household head. One striking difference is that wife's education is higher in the wage arrears group than in the no wage arrears group. This finding, though, is consistent with Figure 2.4 where we saw that women with primary and less education were far less likely than others to have wage arrears in 1995. Four percent of the wives in the wage arrears group hold secondary formal jobs and 3.8% hold secondary informal jobs. These rates are 1.6% and 1.5% respectively in the no wage arrears group. The last two columns reports the comparisons between the household without any wage

¹⁹Such high correlation might possibly be caused by marriage matching in the jobs. The correlation of wife and husband's occupations, according to International Labor Organization Coding (four digits), is 0.22. But we can not identify the working place of the individuals.

²⁰Family nonlabor income includes total household pension income, personal property sales, rental income, capital investment income, insurance payment, alimony received, help from organizations and help from relatives.

arrears and the households with wage arrears. The findings are consistent with the previous results. Husbands are more likely to take secondary informal jobs and wives are more likely to take secondary formal jobs in the wage arrears group. Such differences might be caused by increased labor supply from the wives to their wage nonpayment.

2.5 Empirical Results

This paper presents three sets of results. We first consider the effects of first time wage arrears, first own effects, and, second, cross effects and, separately, the effects of general wage arrears on secondary job holdings, which include both formal secondary job holdings and the informal secondary job holdings. We then look at the response of changing jobs to wage arrears. The last set of results involves the consumption regressions.

2.5.1 Labor Supply Response to Wage Arrears—Secondary Job Holdings and Job Changes

Tables 2.5 to 2.8 report the estimated effect of wage arrears on the likelihood of holding a secondary formal job or informal job using Chamberlain's method of random effects probit model.

First, wage nonpayment for the first time had no effect on the tendency of husbands or wives to hold more than one formal job (Table 2.5). It is not surprising since it might be difficult to locate another formal job within one month after the wage arrears occurred. But we do find that wife's tendency to take secondary job takes a quadratic form: it increases with husband's age and reaches the maximum when the age of husband is about 52. Also wife's tendency to take secondary job when husband has wage arrears for the first time increases with her education. So here we find a cross-effect of husband's wage nonpayment on the wife's tendency to have secondary job. Wife's age impact on this cross-effect might be explained by experience increasing the opportunity for women to find a secondary job and so does education. The findings for the impact of wage arrears in general on holding secondary job are similar (Table 2.8). Husbands are not more likely to hold secondary job if they have wage arrears or if their wives have wage arrears. One different result reported in Table 2.8 is that wives are found to be significantly more likely to take secondary job when they themselves have wage arrears and the likelihood of having secondary job also increases with education when their husband has wage arrears.

In terms of the tendency to hold secondary informal job (Table 2.7 and 2.8), we find that it increases when husband was hit by wage nonpayment for the first time. Although wives are not found to be more likely to take the informal jobs when they got wage nonpayment for the first time, we do find that they are more

likely to take informal jobs when we use any owed wage arrears as the measurement of wage arrears shocks.

Table 2.9 and 2.10 report the results on change of primary jobs after wage arrears shock. The ideal data for estimating the effect of wage arrears on changing jobs is monthly or quarterly data, where we could have complete information on individual's jobs and thus be able to more precisely detect the effect of wage arrears. Unfortunately, we only have one observation of job information for each year of the survey. So we won't be able to tell how many times individual change their jobs between two survey years, although we know if he or she changes his or her job from the pervious survey. Moreover, some households were missing in some of the surveys, which left us with an unbalanced panel. Given the data structure we have, we can only estimate the job change one year or two years after wage arrears.

If husbands have their first wage arrears in previous survey, they are not necessarily more likely to change their job. The response of changing job varies by education of husbands. Husbands with higher education are more likely to report changing their jobs in the survey right after they have wage arrears for the first time in the previous survey.²¹ This might be explain by the fact that individuals with more education have more outside opportunities. When we use wage arrears in general, instead of using first time wage arrears, we find that

²¹The coefficient of the interaction term of first time wage arrears and husband's education (column 2 of Table 2.10) is 0.0852 and significant at 10% confidence level.

both husband and wives are more likely to change their previous jobs where they have wage nonpayment.

We can not interpret the difference in the impacts on job changes of wage arrears in general and first time wage arrears as an adjusting process to wage nonpayment since, as we emphasized earlier, that there is one year or two years gap between two surveys and even for the first time wage arrears, we are looking at the job change response to wage arrears that happened one or two years ago. The difference might just be caused by the fact that there are more observations having wage arrears in general than having first time wage arrears.

2.5.2 Effects of Wage Arrears on Household Consumption

The overall impact of wage arrears is first estimated in the reduced form regression as shown in the first column of Table 2.11 and 2.12. The results show that the time profile of household consumption is relatively smooth; much of the sample variation in consumption is explained by the region-year dummy variables and a set of demographic preference shifters. In particular, male household head's wage arrears shock, measured either by first-time wage arrears or wage arrears in general has no significant effect on consumption at all. The only exception is that female household head's wage arrears in general is estimated to reduce the household consumption by about 0.05% and the coefficient is

marginally significant at 10% level. This suggests that household consumption is protected from wage arrears shocks.

Secondary job holdings, which is included in the structural equation, includes both formal secondary jobs and incidental jobs. In predicting the secondary job holdings with instrument variables and other exogenous regressors, the F test of the significance of the instrumental variables of community employment service center and interaction term of employment center and education variable is 4.89 and 5.20 for male and female secondary job holdings respectively , which are significant at 7% and 8% level (Appendix Table 2.13).

Similar to the results from the reduced-form regression on first-time wage arrears on consumption, the results from structural equation (column 2 in Table 2.11) shows that household consumption is very well protected from wage arrears shocks. Although men taking secondary jobs (as shown in Table 2.11) helps to increase the household consumption by over 60%, the result still implies that conditioning on such big effect of secondary job holdings, first-time wage arrears don't significantly reduce the household consumption. As we mentioned earlier, labor supply is one of the many mechanisms that households can fall upon in the time of income shocks. Although it is puzzling that the big effect of secondary job holdings by male household head doesn't seem to explain the smoothness of consumption at first time wage arrears, we can't rule out that households use dissaving, borrowing, and selling assets to smooth consumptions when they first

experience wage arrears shocks. In contrast to the results from the reduced-form regression on general wage arrears on consumption, the results from structural equation (column 2 in Table 2.12) shows that household consumption falls with the experience of wage arrears shocks. The results from the structural regression imply that wage arrears experienced by the female household head reduce household consumption by about 10%. This decline in consumption in the absence of adjustments secondary job holdings is consistent with the positive and significant effects of male and female secondary job holding on consumption. This result suggests that overall insignificant effect of wage arrears on consumption reflects adjustment of secondary job holdings.

2.6 Conclusion

This paper documents the features of wage nonpayment in Russia during economic transition since 1994. In particular, it examines the labor supply response, including multiple job holdings as well as job changes, of married couples to their wage arrears for the first time and the wage arrears in general. Wage arrears apparently affect the economy, among other things, by inducing more labor supply response from working men and women in terms of secondary job holdings and job changes. Such labor responses, especially secondary job holdings, are found to help to smooth household consumption in the presence of general wage arrears in primary jobs; but they don't seem to explain the

smoothness of household consumption at first wage arrears. The results of this paper suggests that different households consumption smoothing mechanism might function simultaneously in Russia, but the development of the labor market may well help the households to smooth income directly. The latter finding is particularly important given the frequent income shocks that households in the transition economy are facing. Public policies which directly or indirectly improve the labor market conditions, such as lessening or eliminate the control of population migration and increase in education investment, programs that can enhance the ability of individuals to engage in labor markets, may help households to better cope with uncertainties.

Table 2.1: Incidence and Level of Wage Arrears

	1994	1995	1996	1998	2000	2001
Owed Wage						
–Men	0.443 (0.010)	0.453 (0.011)	0.629 (0.011)	0.655 (0.011)	0.332 (0.011)	0.263 (0.008)
–Women	0.369 (0.010)	0.387 (0.010)	0.574 (0.011)	0.621 (0.011)	0.259 (0.009)	0.217 (0.008)
Working Without Payment at Current Month						
–Men	0.267 (0.009)	0.301 (0.009)	0.389 (0.011)	0.321 (0.010)	0.199 (0.009)	0.162 (0.008)
–Women	0.199 (0.008)	0.241 (0.009)	0.340 (0.010)	0.300 (0.010)	0.180 (0.008)	0.156 (0.007)
Wage Not Paid (Months)¹						
–Men	2.846 (0.084)	3.164 (0.115)	3.982 (0.136)	6.027 (0.263)	5.408 (0.378)	3.332 (0.269)
–Women	2.653 (0.082)	2.683 (0.108)	3.108 (0.083)	4.729 (0.191)	4.350 (0.361)	2.857 (0.276)

1. This average number of months not paid is conditional on wage nonpayment. Standard errors are in parenthesis.

Source: Russian Longitudinal Monitory Survey 1994,1995,1996,1998,2000,2001

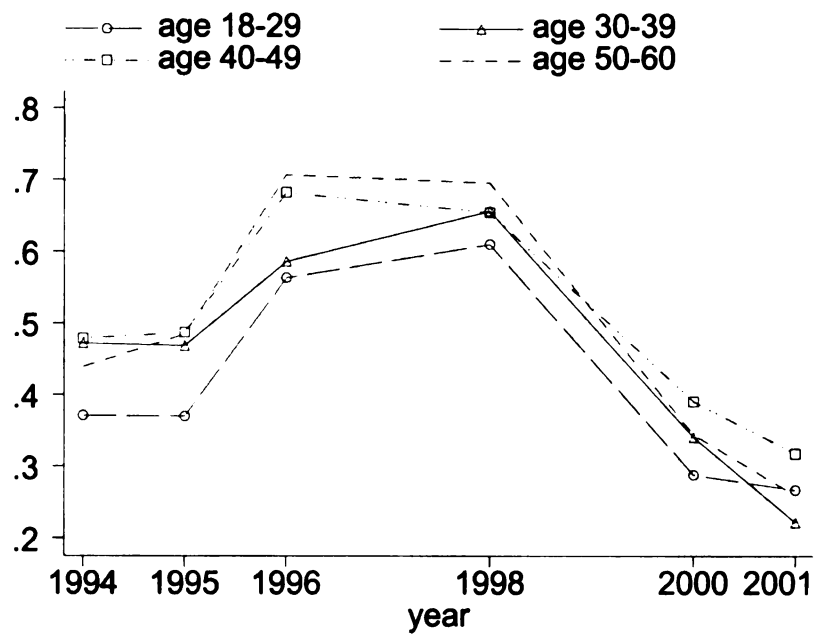


Figure 2.1: Currently Owed Wage by Age (Men)

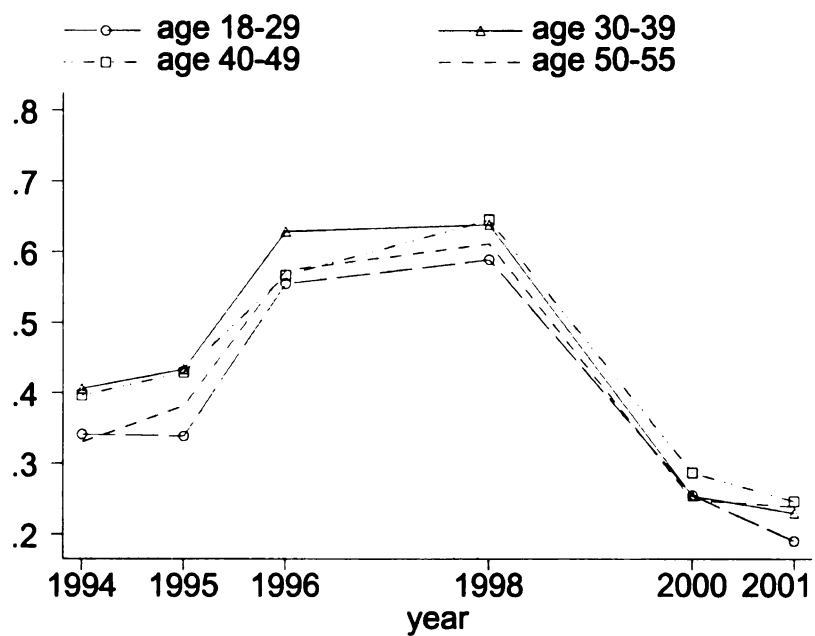


Figure 2.2: Currently Owed Wage by Age (Women)

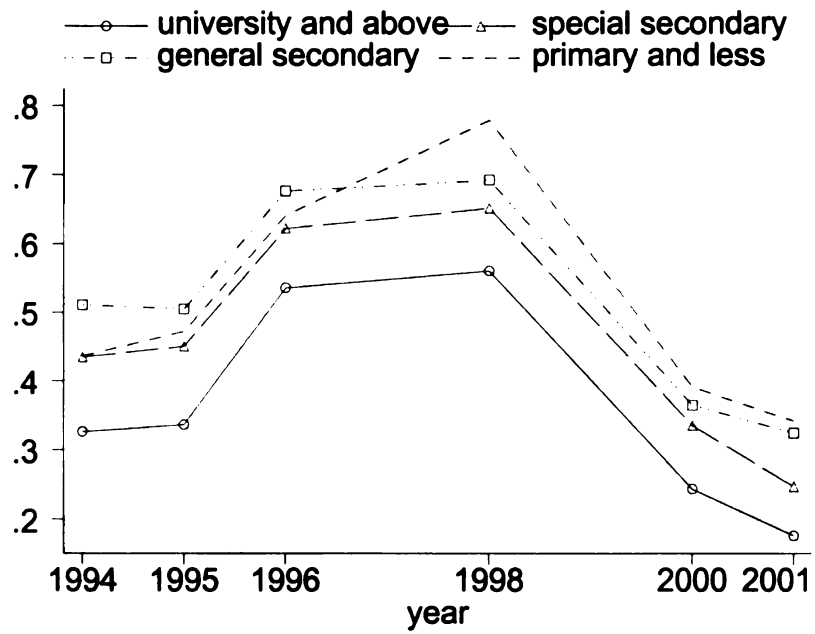


Figure 2.3: Currently Owed Wage by Education (Men)

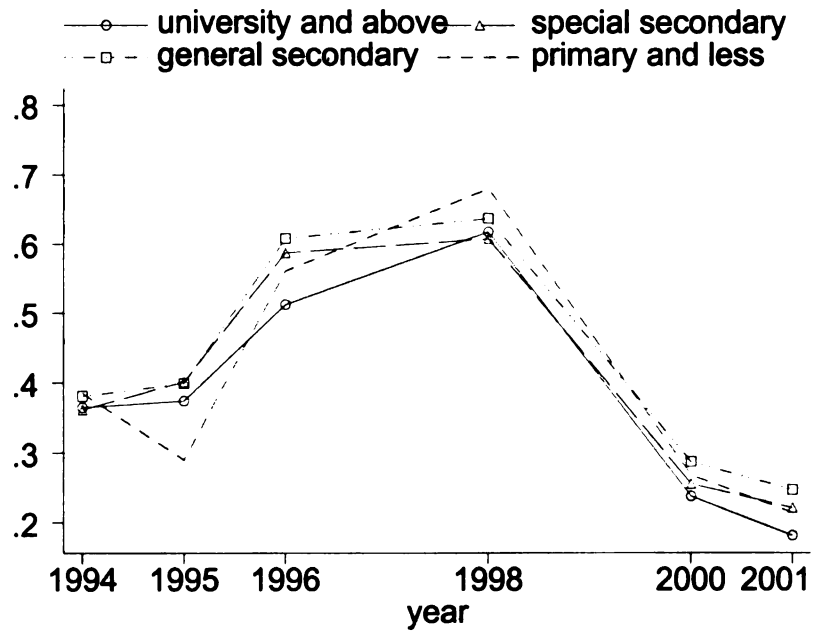


Figure 2.4: Currently Owed Wage by Education (Women)

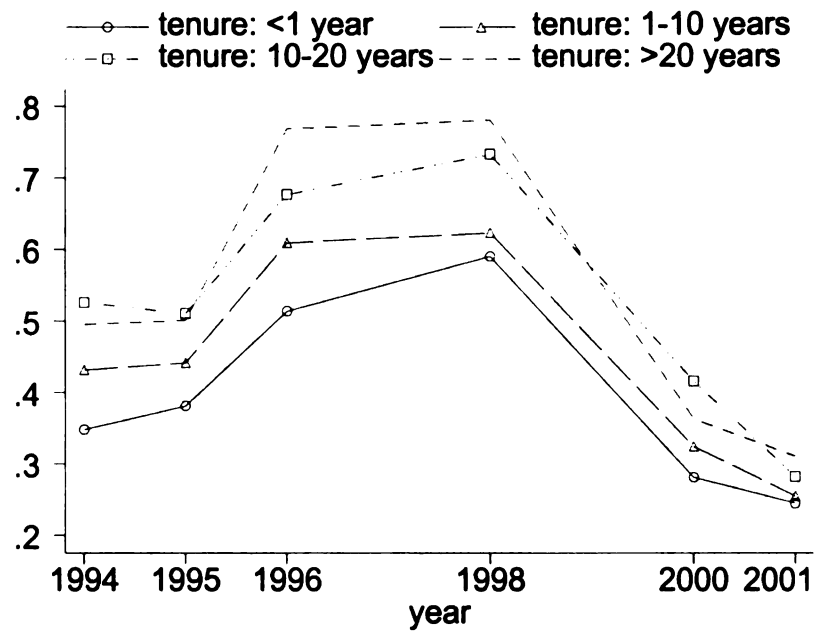


Figure 2.5: Currently Owed Wage by Tenure (Men)

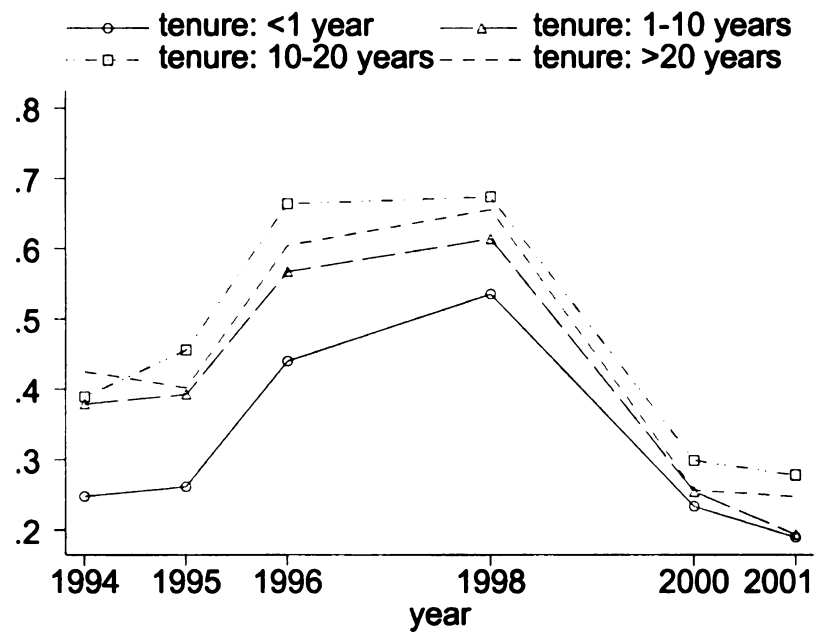


Figure 2.6: Currently Owed Wage by Tenure (Women)

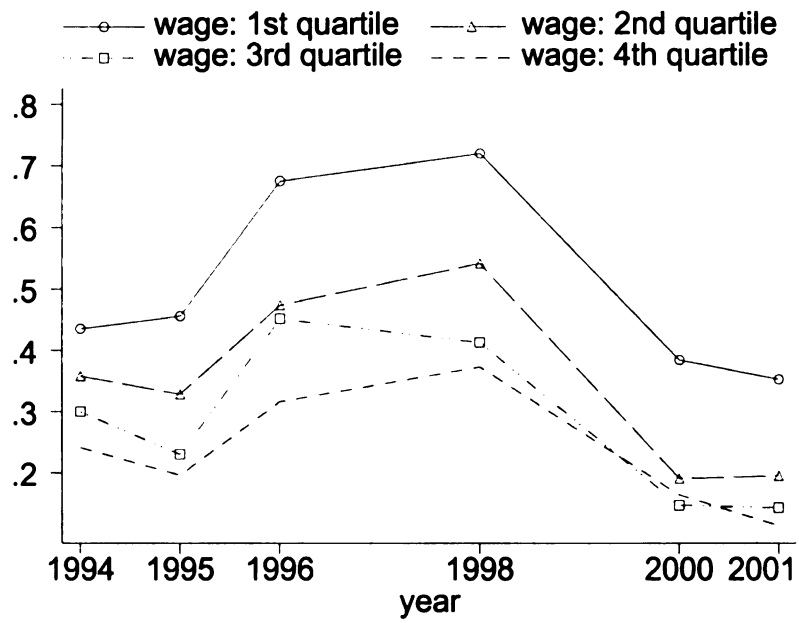


Figure 2.7: Currently Owed Wage by Wage (Men)

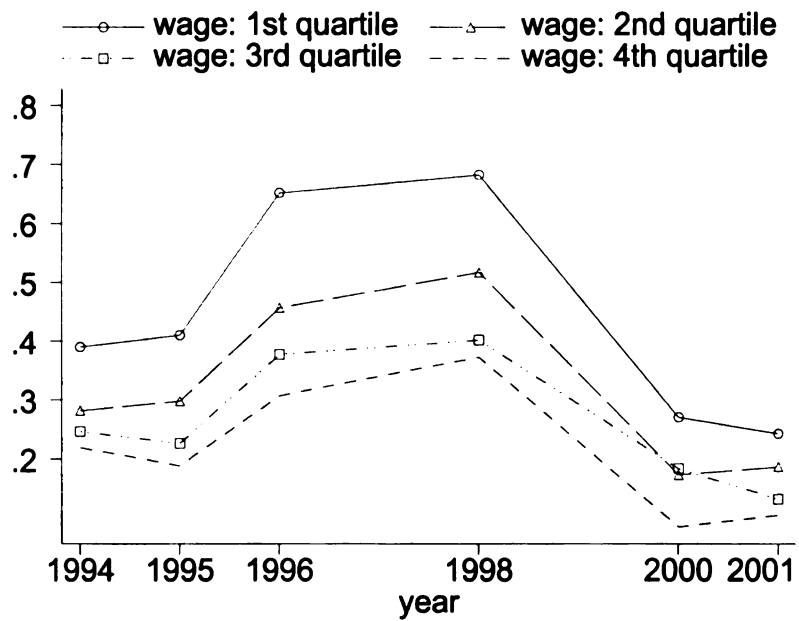


Figure 2.8: Currently Owed Wage by Tenure (Women)

Table 2.2: Wage Arrears by Occupation (before/after 1998)

Occupational Category (2-digit ILO occupation code)	Before 1998		After 1998	
	Men	Women	Men	Women
Armed Forces (01)	0.682 (135)	0.526 (19)	0.485 (66)	0.111 (9)
Legislations, Senior Officials, Corporate Managers (11,12)	0.385 (13)	0.563 (16)	0.227 (198)	0.257 (140)
General Managers (13)	0.326 (221)	0.358 (106)	0.115 (96)	0.262 (103)
Physical Mathematical, Engineering Science Professionals (21)	0.450 (535)	0.576 (420)	0.227 (198)	0.264 (178)
Life Science and Health Professionals (22)	0.456 (136)	0.435 (301)	0.20 (70)	0.209 (163)
Teaching Professionals (23)	0.611 (180)	0.573 (799)	0.238 (80)	0.286 (514)
Other Professionals (24)	0.378 (156)	0.408 (574)	0.176 (68)	0.206 (296)
[business, legal,archivist, writer, religious] Physical and Engineering Science Associate Professionals (31)	0.528 (235)	0.502 (309)	0.229 (183)	0.216 (167)
Life Science and Health Associate Professionals (32)	0.435 (39)	0.568 (722)	0.125 (8)	0.246 (321)
Teaching Associate Professionals (33)	0.333 (6)	0.536 (265)	0.5 (2)	0.333 (42)
Other Associate Professionals (34)	0.381 (265)	0.423 (860)	0.190 (142)	0.162 (493)

Table 2.2 (cont'd).

Office Clerks (41)	0.411 (95)	0.429 (770)	0.178 (45)	0.217 (368)
Customer Service Clerks (42)	0.22 (9)	0.382 (272)	0 (6)	0.184 (103)
Personal and Protective Service Workers(51)	0.479 (294)	0.425 (285)	0.282 (149)	0.214 (257)
Models,Salespersons and Demonstrators (52)	0.148 (81)	0.260 (539)	0.152 (33)	0.104 (316)
Skilled Agricultural and Fishery Workers (61,62)	0.537 (67)	0.182 (11)	0.319 (47)	0.167 (6)
Extraction and Building Trades Workers (71)	0.538 (699)	0.629 (170)	0.300 (373)	0.351 (57)
Metal and Machinery Workers (72)	0.577 (1599)	0.504 (123)	0.284 (623)	0.235 (34)
	Men	Women	Men	Women
Occupational Category (2-digit ILO occupation code)				
Precision, Handcraft and Printing Workers (73)	0.233 (30)	0.209 (43)	0.421 (19)	0.20 (25)
Other Craft and Related Trades Workers [food processing, wood treaters,textile](74,70)	0.50 (66)	0.408 (184)	0.348 (23)	0.278 (79)
Stationary-Plant Operators [metal,wood,chemical processing](81)	0.598 (336)	0.568 (227)	0.269 (189)	0.305 (128)
Machine Operators and Assemblers (82)	0.645 (276)	0.470 (251)	0.268 (190)	0.173 (150)

Table 2.2 (cont'd).

Drivers and Mobil-Plant Operators [motor vehicle,ship crews](83)	0.607 (1967)	0.550 (151)	0.389 (885)	0.311 (74)
Sales and Services Elementary Occupations [street vendor,domestic cleaning](91)	0.489 (362)	0.516 (950)	0.256 (254)	0.244 (422)
Agricultural and Fishery Laborers(92)	0.762 (181)	0.766 (274)	0.810 (79)	0.683 (123)
Laborers in Mining, Construction, Manufacturing, Transport (93)	0.399 (281)	0.458 (153)	0.236 (140)	0.25 (60)

Source: Russian Longitudinal Monitory Survey 1994,1995,1996,1998,2000,2001.

Number of observations in parenthesis.

Table 2.3: Distribution of Employment States of Husband and Wife

	All		1995		1996		1998		2000		2001	
	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife
Employment States												
Employed in Primary Job (1)	0.830 (0.004)	0.757 (0.004)	0.863 (0.009)	0.793 (0.011)	0.818 (0.010)	0.756 (0.011)	0.789 (0.011)	0.727 (0.012)	0.807 (0.010)	0.729 (0.011)	0.829 (0.010)	0.745 (0.011)
— Primary Job only	0.877 (0.004)	0.925 (0.003)	0.879 (0.009)	0.926 (0.008)	0.888 (0.009)	0.930 (0.008)	0.888 (0.009)	0.932 (0.008)	0.879 (0.009)	0.924 (0.008)	0.923 (0.009)	0.916 (0.008)
— Primary & Secondary Formal Job	0.045 (0.002)	0.038 (0.002)	0.046 (0.006)	0.036 (0.005)	0.044 (0.006)	0.033 (0.005)	0.042 (0.006)	0.038 (0.006)	0.044 (0.006)	0.044 (0.006)	0.047 (0.006)	0.044 (0.006)
— Primary & Secondary Formal Job & Secondary Informal Job	0.004 (0.001)	0.004 (0.001)	0.002 (0.001)	0.002 (0.001)	0.004 (0.002)	0.005 (0.002)	0.005 (0.001)	0.005 (0.002)	0.007 (0.002)	0.004 (0.002)	0.002 (0.002)	0.005 (0.002)
— Primary & Secondary Informal Job	0.077 (0.003)	0.031 (0.002)	0.076 (0.007)	0.045 (0.005)	0.068 (0.007)	0.055 (0.005)	0.071 (0.008)	0.066 (0.005)	0.077 (0.007)	0.064 (0.005)	0.069 (0.007)	0.034 (0.005)
Engaged in Informal Job Only (2)	0.052 (0.002)	0.033 (0.002)	0.045 (0.005)	0.029 (0.004)	0.052 (0.006)	0.026 (0.004)	0.055 (0.006)	0.028 (0.004)	0.066 (0.006)	0.046 (0.005)	0.064 (0.006)	0.048 (0.006)
Employed (1)+(2)	0.883 (0.003)	0.791 (0.004)	0.909 (0.008)	0.823 (0.010)	0.871 (0.009)	0.783 (0.011)	0.847 (0.009)	0.758 (0.011)	0.873 (0.008)	0.775 (0.010)	0.893 (0.008)	0.793 (0.011)
Not Employed	0.131 (0.003)	0.207 (0.004)	0.092 (0.008)	0.178 (0.010)	0.129 (0.009)	0.217 (0.011)	0.154 (0.009)	0.242 (0.011)	0.127 (0.008)	0.225 (0.010)	0.107 (0.008)	0.207 (0.011)
Change Jobs Since Previous Survey	0.216 (0.004)	0.178 (0.004)	—	—	0.153 (0.010)	0.107 (0.008)	0.241 (0.011)	0.173 (0.010)	0.242 (0.013)	0.169 (0.011)	0.196 (0.010)	0.126 (0.009)

Standard errors are in parenthesis.

The lien with “—” are conditional distribution.

Table 2.4: Individual and Household Characteristics by Wage Arrears

	Husband Never Had Wage Arrears	Husband Had Wage Arrears	Wife Never Had Wage Arrears	Wife Had Wage Arrears	Husband & Wife Had Wage Arrears	Husband Or Wife Had Wage Arrears
Husband's Age	37.239 (0.383)**	38.171 (0.263)**	37.732 (0.373)	38.368 (0.285)	37.038 (0.249)**	38.357 (0.547)**
Husband's Education	12.469 (0.106)**	12.093 (0.078)**	12.328 (0.105)	12.196 (0.087)	12.206 (0.074)	12.438 (0.154)
Husband Had Wage Arrears	—	—	0.538 (0.020)**	0.766 (0.014)**	—	0.817 (0.010)
Husband's Employment Rate	0.729 (0.018)**	0.925 (0.005)**	0.842 (0.012)**	0.875 (0.009)**	0.769 (0.022)**	0.883 (0.007)**
Husband's Total Working Hours	123.053 (3.572)**	158.631 (1.804)**	146.133 (2.780)	147.561 (2.225)	131.436 (4.528)**	150.60 (1.851)**
Husband Had Secondary Formal Job	0.035 (0.006)	0.043 (0.004)	0.041 (0.006)	0.040 (0.005)	0.042 (0.009)	0.040 (0.004)
Husband Had Secondary Informal Job	0.040 (0.006)**	0.074 (0.005)**	0.053 (0.006)**	0.068 (0.005)**	0.039 (0.008)**	0.067 (0.005)**
Wife's Age	35.434 (0.406)**	36.425 (0.259)**	35.459 (0.369)**	36.546 (0.269)**	34.797 (0.547)**	36.405 (0.238)**
Wife's Education	12.626 (0.107)	12.461 (0.074)	12.347 (0.094)**	12.631 (0.080)**	12.509 (0.068)	12.540 (0.137)
Wife Had Wage Arrears	0.422 (0.022)**	0.672 (0.015)**	—	—	—	0.719 (0.012)
Wife's Employment Rate	0.768 (0.165)	0.780 (0.011)	0.580 (0.018)**	0.913 (0.006)**	0.649 (0.025)**	0.806 (0.009)**

Table 2.4 (cont'd).

Wife's Total Working Hours	107.681 (3.134)	109.579 (2.085)	82.28 (3.028)**	127.48 (1.820)**	92.597 (4.415)**	112.78 (1.863)**
Wife Had Secondary Formal Job	0.033 (0.006)	0.029 (0.004)	0.016 (0.004)**	0.040 (0.005)**	0.011 (0.004)**	0.034 (0.004)**
Wife Had Secondary Informal Job	0.037 (0.006)**	0.025 (0.003)**	0.015 (0.004)**	0.038 (0.004)**	0.030 (0.003)	0.023 (0.007)
Number of Children ⁷	0.411 (0.025)**	0.354 (0.016)**	0.438 (0.024)**	0.328 (0.016)**	0.433 (0.034)**	0.359 (0.015)**
Number of Children between age 7 and 18	0.706 (0.034)**	0.840 (0.025)**	0.690 (0.032)**	0.869 (0.026)**	0.634 (0.023)**	0.834 (0.044)**
Number of Working Age Men	1.172 (0.016)	1.188 (0.011)	1.188 (0.016)	1.179 (0.011)	1.176 (0.022)	1.184 (0.010)
Number of Working Age Women	1.185 (0.017)	1.184 (0.011)	1.188 (0.016)	1.181 (0.012)	1.198 (0.024)	1.181 (0.010)
Number of Elder Men	0.043 (0.008)	0.041 (0.005)	0.045 (0.008)	0.040 (0.006)	0.039 (0.011)	0.042 (0.005)
Number of Elder Women	0.129 (0.014)	0.129 (0.009)	0.134 (0.013)	0.126 (0.010)	0.123 (0.018)	0.135 (0.009)
Family Nonlabor Income	1591.245 (115.265)	1735.428 (485.021)	1413.65 (164.35)	1312.59 (85.28)	1412.7 (100.29)	1340.29 (112.71)
Family Initial Assets	103946.9 (8977.02)	88769.38 (5264.53)	104510.6 (7807.62)**	86268.29 (5599.84)**	119118.4 (13880.98)**	87816.76 (4650.74)**

Note: Standard errors in parenthesis. ** and *: significantly different from adjacent column at 5% and 10% significant level.

Table 2.5: Random Probit Estimation of Labor Response (Holding Secondary Job) to First Time Wage Arrears

	Husband's Holding Secondary Job			Wife's Holding Secondary Job		
	1	2	3	1	2	3
First Wage Arrears	-0.0696 (0.4048)	-0.0972 (0.4116)	-0.1927 (0.5181)	0.1403 (0.3670)	0.2194 (0.3752)	-0.8281 (0.7588)
—Husband						
First Wage Arrears	-0.2265 (0.4306)	-0.2782 (0.4505)	-0.0648 (0.4384)	0.2625 (0.4018)	0.2501 (0.4507)	0.0163 (0.4925)
—Wife						
Education of Husband	0.0127 (0.1130)	0.0126 (0.1122)	0.0113 (0.1120)	-0.0197 (0.1209)	-0.0284 (0.1232)	-0.0351 (0.1242)
Education of Wife	0.0035 (0.1174)	0.0053 (0.1164)	0.0043 (0.1165)	0.0839 (0.1269)	0.0992 (0.1291)	0.0443 (0.1316)
Age of Husband	0.1613 (0.5673)	0.1250 (0.5677)	0.1567 (0.5667)	1.3960 (0.7765)**	1.4742 (0.7742)**	1.3609 (0.7811)**
Age2 of Husband	-0.0013 (0.0060)	-0.0009 (0.0060)	-0.0012 (0.0060)	-0.0135 (0.0078)**	-0.0144 (0.0078)**	-0.0134 (0.0078)**
Age of Wife	0.0554 (0.6646)	0.1159 (0.6636)	0.0789 (0.6656)	-0.7357 (0.8353)	-0.7704 (0.8442)	-0.7090 (0.8475)
Age2 of Wife	-0.0011 (0.0076)	-0.0017 (0.0076)	-0.0013 (0.0076)	0.0069 (0.0091)	0.0075 (0.0092)	0.0069 (0.0092)
(log) Non-labor Income	-0.0086 (0.0237)	-0.0104 (0.0237)	-0.0096 (0.0237)	-0.0103 (0.0264)	-0.0099 (0.0266)	-0.0076 (0.0269)

Table 2.5 (cont'd).

Interaction Term						
Assets×Wage	0.0857					-0.2277
Arrears—Husband	(0.1469)					(0.1573)
Assets×Wage	-0.1583					0.0206
Arrears—Wife	(0.1323)					(0.2935)
Husband's Education						
×Wage Arrears—Husband			0.0564			
			(0.1200)			
Husband's Education			-0.1716			
×Wage Arrears—Wife			(0.1489)			
Wife's Education						
×Wage Arrears—Husband						0.4542
						(0.2279)**
Wife's Education						0.1975
×Wage Arrears—Wife						(0.1755)
Joint Significance						
Average of Time-Variant	12.81	12.92	13.12	13.88	13.59	13.31
Independent Variables						
p-value	0.463	0.454	0.439	0.382	0.403	0.425
Number of obs	3570	3570	3570	3570	3570	3570

1. Robust standard errors are in parenthesis. **significant at 5% level; * significant at 10% level.

2. Other variables included in the regressions are the average of time-variant independent variables number of children at age of 0-6 in the household; the number of children at age of 7-17 in the household; the number of working age men/women in the household; the number of elderly women/men in the household; employment service at the community; government factory closed at the community, bank at the community and these community variables interacted with education and age of husband and wife respectively; year and year/region dummies

Table 2.6: Random Probit Estimation of Labor Response (Holding Secondary Job) to Wage Arrears

	Husband's Holding Secondary Job			Wife's Holding Secondary Job		
	1	2	3	1	2	3
Wage Arrears						
—Husband	0.2020 (0.1810)	0.204 (0.183)	0.273 (0.198)	0.1794 (0.1851)	0.130 (0.199)	-0.004 (0.201)
Wage Arrears	-0.0441	-0.043	-0.065	0.4694	0.442	0.570
—Wife	(0.1821)	(0.183)	(0.196)	(0.1882)**	(0.198)**	(0.199)**
Education of Husband	-0.0064	-0.006	0.017	-0.0243	-0.035	-0.023
	(0.1114)	(0.111)	(0.117)	(0.1214)	(0.125)	(0.123)
Education of Wife	0.0206	0.021	0.025	0.0656	0.058	0.028
	(0.1161)	(0.116)	(0.117)	(0.1270)	(0.129)	(0.135)
Age of Husband	0.1527	0.154	0.162	1.3290	1.299	1.319
	(0.5654)	(0.565)	(0.572)	(0.7625)**	(0.766)**	(0.761)**
Age2 of Husband	-0.0012	-0.001	-0.001	-0.0116	-0.011	-0.012
	(0.0061)	(0.006)	(0.006)	(0.0077)	(0.008)	(0.008)
Age of Wife	0.0579	0.061	0.039	-0.6781	-0.666	-0.704
	(0.6640)	(0.664)	(0.671)	(0.8324)	(0.836)	(0.831)
Age2 of Wife	-0.0013	-0.001	-0.001	0.0054	0.005	0.006
	(0.0077)	(0.008)	(0.008)	(0.0091)	(0.009)	(0.009)
(log) Non-labor Income	-0.0085	-0.008	-0.006	-0.0068	-0.008	-0.015
	(0.0237)	(0.024)	(0.024)	(0.0267)	(0.027)	(0.027)

Table 2.6 (cont'd).

Interaction Term									
Assets×Wage		-0.003						0.075	
Arrears—Husband		(0.057)						(0.099)	
Assets×Wage		-0.005						0.060	
Arrears—Wife		(0.061)						(0.092)	
Husband's Education									
× Wage Arrears—Husband									
Husband's Education									
× Wage Arrears—Wife									
Wife's Education									
× Wage Arrears—Husband									
Wife's Education									
× Wage Arrears—Wife									
Joint Significance:									
Average of Time-Variant	12.89	12.92							
Independent Variables									
p-value	0.456	0.454							
Number of obs	3570	3570							

1. Robust standard errors are in parenthesis. **significant at 5% level; * significant at 10% level.

2. Other variables included in the regressions are the average of time-variant independent variables number of children at age of 0-6 in the household; the number of children at age of 7-17 in the household; the number of working age men/women in the household; the number of elderly women/men in the household; employment service at the community; government factory closed at the community, bank at the community and these community variables interacted with education and age of husband and wife respectively; year and year/region dummies

Table 2.7: Random Probit Estimation of Labor Response (Holding incidental work) to First Time Wage Arrears

	Husband's Holding incidental work			Wife's Holding incidental work		
	1	2	3	1	2	3
First Wage Arrears	0.7293	0.7169	0.7104	-0.1257	-0.1378	-0.1078
—Husband	(0.2383)**	(0.2431)**	(0.2424)**	(0.3805)	(0.3933)	(0.3891)
First Wage Arrears	0.0128	-0.00005	-0.0110	0.3320	0.3286	0.3414
—Wife	(0.2594)	(0.2683)	(0.2656)	(0.3845)	(0.3932)	(0.3857)
Education of Husband	0.0262	0.0259	0.0208	0.0015	0.0015	0.0016
	(0.0748)	(0.0748)	(0.0753)	(0.1082)	(0.1082)	(0.1083)
Education of Wife	0.0102	0.0097	0.0103	0.0741	0.0737	0.0747
	(0.0771)	(0.0771)	(0.0771)	(0.1115)	(0.1115)	(0.1120)
Age of Husband	-0.2056	-0.2115	-0.2041	1.0440	1.0455	1.0435
	(0.3577)	(0.3588)	(0.3581)	(0.7135)	(0.7144)	(0.7151)
Age2 of Husband	-0.0017	-0.0016	-0.0017	-0.0129	-0.0129	-0.0129
	(0.0039)	(0.0039)	(0.0039)	(0.0073)**	(0.0073)**	(0.0073)**
Age of Wife	0.3075	0.3071	0.3035	-0.2312	-0.2342	-0.2258
	(0.3831)	(0.3837)	(0.3835)	(0.7395)	(0.7400)	(0.7410)
Age2 of Wife	0.0001	0.0001	0.0001	0.0021	0.0022	0.0021
	(0.0045)	(0.0045)	(0.0045)	(0.0081)	(0.0081)	(0.0081)
(log) Non-labor Income	-0.0131	-0.0131	-0.0127	0.0213	0.0213	0.0213
	(0.0162)	(0.0162)	(0.0163)	(0.0256)	(0.0256)	(0.0257)

Table 2.7 (cont'd).

Interaction Terms:					
Assets×Wage		0.0257		0.0279	
Arrears—Husband		(0.1032)		(0.2325)	
Assets×Wage		0.0280		0.0047	
Arrears—Wife		(0.1506)		(0.2362)	
Husband's Education			0.0364		
× Wage Arrears—Husband			(0.0646)		
Husband's Education			0.0523		
× Wage Arrears—Wife			(0.0838)		
Wife's Education					-0.0095
× Wage Arrears—Husband					(0.1454)
Wife's Education					-0.0539
× Wage Arrears—Wife					(0.1613)
Joint Significance:					
Average of Time-Variant	19.67	19.72	19.40	11.07	11.06
Independent Variables					
p-value	0.103	0.103	0.111	0.605	0.606
Number of obs	3570	3570	3570	3570	3570

1. Robust standard errors are in parenthesis. **significant at 5% level; * significant at 10% level.

2. Other variables included in the regressions are the average of time-variant independent variables number of children at age of 0-6 in the household; the number of children at age of 7-17 in the household; the number of working age men/women in the household; the number of elderly women/men in the household; employment service at the community; government factory closed at the community, bank at the community and these community variables interacted with education and age of husband and wife respectively; year and year/region dummies

Table 2.8: Random Probit Estimation of Labor Response (Holding incidental work) to Wage Arrears

	Husband's Holding incidental work			Wife's Holding incidental work		
	1	2	3	1	2	3
Wage Arrears	0.1769	0.198	0.181	0.1589	-0.114	0.157
—Husband	(0.1170)	(0.119)**	(0.118)	(0.1936)	(0.150)	(0.198)
Wage Arrears	0.1316	0.105	0.130	0.4393	0.595	0.452
—Wife	(0.1195)	(0.121)	(0.120)	(0.1815)**	(0.150)**	(0.184)**
Education of Husband	0.0214	0.019	0.028	-0.0284	-0.020	-0.027
	(0.0736)	(0.074)	(0.077)	(0.1118)	(0.109)	(0.112)
Education of Wife	0.0169	0.019	0.018	0.0635	0.074	0.082
	(0.0767)	(0.077)	(0.077)	(0.1122)	(0.112)	(0.119)
Age of Husband	-0.1778	-0.170	-0.172	1.1412	1.134	1.123
	(0.3597)	(0.360)	(0.360)	(0.7187)	(0.725)	(0.720)
Age2 of Husband	-0.0019	-0.002	-0.002	-0.0131	-0.013	-0.013
	(0.0039)	(0.004)	(0.004)	(0.0074)**	(0.007)**	(0.007)**
Age of Wife	0.2503	0.253	0.243	-0.2910	-0.330	-0.269
	(0.3836)	(0.384)	(0.384)	(0.7460)	(0.750)	(0.748)
Age2 of Wife	0.0004	0.0003	0.0004	0.0021	0.003	0.002
	(0.0045)	(0.004)	(0.004)	(0.0082)	(0.008)	(0.008)
(log) Non-labor Income	-0.0117	-0.011	-0.011	0.0257	0.025	0.025
	(0.0162)	(0.016)	(0.016)	(0.0262)	(0.026)	(0.026)

(Table 2.8 (cont'd)).

Interaction Terms:				
Assets×Wage	-0.038			-0.017
Arrears—Husband	(0.037)			(0.068)
Assets×Wage	0.062			-0.028
Arrears—Wife	(0.047)			(0.059)
Husband's Education				
× Wage Arrears—Husband			-0.014	
Husband's Education			(0.035)	
× Wage Arrears—Wife			0.004	
Wife's Education			(0.034)	
× Wage Arrears—Husband				0.001
Wife's Education				(0.061)
× Wage Arrears—Wife				-0.030
				(0.060)
Joint Significance:				
Average of Time-Variant	13.49	13.24	13.46	11.66
Independent Variables				15.33
p-value	0.411	0.429	0.413	0.287
Number of obs	3570	3570	3570	3570

1. Robust standard errors are in parenthesis. **significant at 5% level; * significant at 10% level.

2. Other variables included in the regressions are the average of time-variant independent variables number of children at age of 0-6 in the household; the number of children at age of 7-17 in the household; the number of working age men/women in the household; the number of elderly women/men in the household; employment service at the community; government factory closed at the community, bank at the community and these community variables interacted with education and age of husband and wife respectively; year and year/region dummies

Table 2.9: Random Probit Estimation of Labor Response (Change of Job) to First Wage Arrears

	Husband's Change of Job		Wife's Change of Job	
	1	2	1	2
First Time Wage Arrears in Previous Period—Husband	0.029 (0.166)	0.029 (0.167)	0.045 (0.187)	0.050 (0.188)
First Time Wage Arrears in Previous Period—Wife	-0.021 (0.163)	-0.021 (0.173)	0.241 (0.174)	0.244 (0.173)
Education of Husband	0.025 (0.055)	0.027 (0.057)	0.003 (0.059)	0.005 (0.080)
Education of Wife	0.023 (0.057)	0.021 (0.054)	-0.023 (0.063)	-0.014 (0.066)
Age of Husband	-0.313 (0.344)	-0.341 (0.344)	0.271 (0.373)	-0.271 (0.374)
Age2 of Husband	-0.001 (0.004)	-0.001 (0.004)	0.002 (0.004)	0.002 (0.004)
Age of Wife	0.326 (0.366)	-0.316 (0.363)	0.374 (0.405)	0.371 (0.405)
Age2 of Wife	-0.001 (0.004)	-0.002 (0.007)	-0.005 (0.004)	-0.005 (0.005)
(log) Non-labor Income	-0.016 (0.014)	-0.023 (0.012)*	-0.032 (0.015)**	-0.031 (0.014)**

Table 2.9 (cont'd).

Interaction Terms:				
Husband's Education×		0.023		
First Time Wage Arrears—Husband		(0.012)*		
Husband's Education×		-0.003		
First Time Wage Arrears—Wife		(0.026)		
Wife's Education×				0.024
First Time Wage Arrears—Husband				(0.033)
Wife's Education×				-0.039
First Time Wage Arrears—Wife				(0.034)
Joint Significance:				
Average of Time-Variant Independent Variables	120.82	120.71	69.54	69.33
p-value	0.000	0.000	0.000	0.000
Number of obs.	2617	2617	2617	2617

1. Robust standard errors are in parenthesis. **significant at 5% level; * significant at 10% level.

2. Other variables included in the regressions are the average of time-variant independent variables number of children at age of 0-6 in the household; the number of children at age of 7-17 in the household; the number of working age men/women in the household; the number of elderly women/men in the household; employment service at the community; government factory closed at the community, bank at the community, and these community variables interacted with education and age of husband and wife respectively; year and year/region dummies.

Table 2.10: Random Probit Estimation of Labor Response (Change of Job) to Wage Arrears

	Husband's Change of Job		Wife's Change of Job	
	1	2	1	2
Wage Arrears in Previous Period	0.270	0.271	-0.063	-0.070
—Husband	(0.096)**	(0.091)**	(0.109)	(0.109)
Wage Arrears in Previous Period	-0.082	-0.082	-0.096	-0.087
—Wife	(0.098)	(0.098)	(0.111)	(0.111)
Education of Husband	0.022	0.024	0.003	0.005
	(0.055)	(0.057)	(0.060)	(0.059)
Education of Wife	0.027	0.027	-0.024	-0.015
	(0.057)	(0.058)	(0.063)	(0.066)
Age of Husband	-0.346	-0.346	-0.291	-0.291
	(0.345)	(0.345)	(0.371)	(0.371)
Age2 of Husband	-0.0004	-0.0004	0.002	0.002
	(0.004)	(0.004)	(0.004)	(0.004)
Age of Wife	0.334	0.334	0.411	0.408
	(0.368)	(0.368)	(0.403)	(0.404)
Age2 of Wife	-0.0002	-0.0002	-0.005	-0.005
	(0.004)	(0.004)	(0.004)	(0.004)
(log) Non-labor Income	-0.017	-0.017	-0.032	-0.039
	(0.014)	(0.014)	(0.015)**	(0.015)**

Table 2.10 (cont'd).

Interaction Terms:				
Husband's Education ×		0.024		
Wage Arrears—Husband		(0.057)		
Husband's Education ×		0.027		
Wage Arrears—Wife		(0.058)		
Wife's Education ×				0.022
Wage Arrears—Husband				(0.033)
Wife's Education ×				-0.039
Wage Arrears—Wife				(0.034)
Joint Significance:				
Average of Time-Variant	120.63	120.54	69.01	68.66
Independent Variables				
p-value	0.000	0.000	0.000	0.000
Number of obs	2617	2617	2617	2617

1. Robust standard errors are in parenthesis. **significant at 5% level; * significant at 10% level.

2. Other variables included in the regressions are the average of time-variant independent variables number of children at age of 0-6 in the household; the number of children at age of 7-17 in the household; the number of working age men/women in the household; the number of elderly women/men in the household; employment service at the community; government factory closed at the community, bank at the community, and these community variables interacted with education and age of husband and wife respectively; year and year/region dummies.

Table 2.11: Consumption Regression (First Time Arrears)

	Reduced Form Fixed Ef- fect Estimation	Structure Equation Fixed Ef- fect IV Esti- mation
First Time Wage Arrears	-0.051	-0.026
—Husband	(0.039)	(0.042)
First Time Wage Arrears	-0.035	-0.048
—Wife	(0.041)	(0.045)
Secondary Job Holding		0.699
—Husband		(0.251)**
Secondary Job Holding		0.336
—Wife		(0.215)
Age of Household Head	-0.048	-0.050
	(0.032)	(0.034)
Number of Male Children (<18 years old)	-0.200	-0.190
	(0.027)**	(0.029)**
Number of Female Children (<18 years old)	-0.124	-0.126
	(0.022)**	(0.024)**
Number of Working Age Male (age 18-60)	-0.107	-0.097
	(0.030)**	(0.032)**
Number of Working Age Female (age 18-55)	-0.101	-0.118
	(0.031)**	(0.033)**
Number of Senior Male (≥60 years old)	0.033	0.070
	(0.089)	(0.095)
Number of Senior Female (≥55 years old)	-0.216	-0.214
	(0.051)**	(0.057)**
No-Labor Income	0.009	0.009
	(0.003)**	(0.003)**
Number of obs	3570	3570
F(78,2510)	7.16	
Wald chi2(80)		936246.45

1. Standard errors are in parenthesis. **significant at 5% level; * significant at 10% level.

2. Other variables included in the regressions are the year and year/region dummies

Table 2.12: Consumption Regression (Wage Arrears)

	Reduced Form Fixed Effect Estimation	Structure Equation Fixed Effect IV Estimation
Wage Arrears	0.025	-0.028
—Husband	(0.029)	(0.034)
Wage Arrears	-0.047	-0.088
—Wife	(0.029)*	(0.032)**
Secondary Job Holding		0.726
—Husband		(0.383)*
Secondary Job Holding		0.725
—Wife		(0.323)**
Age of Household Head	-0.107	-0.119
	(0.051)**	(0.054)**
Number of Male Children	-0.257	-0.264
(<18 years old)	(0.038)**	(0.041)**
Number of Female Children	-0.135	-0.152
(<18 years old)	(0.029)**	(0.032)**
Number of Working Age Male	-0.126	-0.108
(age 18-60)	(0.037)**	(0.041)**
Number of Working Age Female	-0.109	-0.163
(age 18-55)	(0.038)**	(0.044)**
Number of Senior Male	0.025	-0.008
(≥60 years old)	(0.114)	(0.126)
Number of Senior Female	-0.170	-0.158
(≥55 years old)	(0.062)**	(0.076)**
No-Labor Income	0.011	0.009
	(0.004)**	(0.004)**
Number of obs	3570	3570
F(78,2510)	4.87	
Wald chi2(80)		675238.84

1. Standard errors are in parenthesis. **significant at 5% level; * significant at 10% level.

2. Other variables included in the regressions are the year and year/region dummies

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1

APPENDIX

Table 2.13: First Stage Regression of Multiple Job Holdings

	Husband Taking Secondary Job	Wife Taking Secondary Job
Presence of Community Employment Service Center	-0.071 (0.210)	-0.116 (0.252)
Employment Service Center Interacted with Husband's Education	0.029 (0.014)**	
Employment Service Center Interacted with Wife's Education		0.036 (0.018)**
Age of Household Head	-0.019 (0.003)**	-0.011 (0.004)**
Number of Male Children (≤ 18 years old)	-0.043 (0.128)	-0.259 (0.159)
Number of Female Children (≤ 18 years old)	-0.158 (0.074)**	-0.042 (0.100)
Number of Working Age Male (age 18-60)	0.034 (0.045)	-0.088 (0.052)*
Number of Working Age Female (age 18-55)	0.053 (0.029)*	0.064 (0.033)*
Number of Senior Male (≥ 60 years old)	-0.040 (0.059)	0.008 (0.067)
Number of Senior Female (≥ 55 years old)	0.046 (0.058)	0.034 (0.067)
Non-labor Income	0.014 (0.007)**	0.005 (0.007)
Statistics for Joint Test of Instrumental Variables Chi2(2)	4.89	5.2
Prob>chi2	0.0867	0.0744

1. Standard errors are in parenthesis. **significant at 5% level; * significant at 10% level.

2. Other variables included in the regressions are the year and year/region dummies

Chapter 3

Estimation With or Without Strict Exogeneity Assumption in Unequally Spaced Panel Data

3.1 Introduction

In unequally spaced panel data, observations are missing entirely in certain periods and they are only available on non-consecutive basis.¹ Unequally spaced panel data are normal rather than exceptions in many surveys carried out in developing countries where the survey was interrupted because of funding issues or other reasons. McKenzie (2001) documented some examples of unequally spaced surveys in developing countries. There are two other well-known surveys which we would add to this list: Indonesia Family Life Survey (IFLS), whose

¹ Different from unequally spaced panel data, unbalanced panel data, according to Arellano and Bond (1991), is a sample in which consecutive observations on individual units are available, but the number of time periods available may vary from unit to unit as well as the historical points to which the observations correspond.

survey periods are 1993, 1997 and 2000; and Russian Longitudinal Monitory Survey (RLMS), whose survey periods are 1992, 1993, 1994, 1995, 1996, 1998, 2000, 2001, 2002.

For unbalanced panel data, Arellano and Bond (1991) noted that nothing fundamental changes in the econometric methods, provided a minimal number of continuous time periods are available for each unit. Wooldridge (2002, Chapter 17) also remarks that, provided the decision to select units out of a panel is made randomly, any differencing method on any subset of the observed panel is consistent and the usual test statistics are valid. For the unevenly spaced panel, all observations are non-consecutive because in certain periods, the entire cross-section may not be observed. Such a pattern of data missing would cause complications when current outcome of certain variable depends on the lagged values of the variable itself or the lagged values of other variables. Baltagi and Wu (1999) considered the case in panel data where the disturbances following a stationary $AR(1)$. They develop a feasible generalized least squares (GLS) procedure that takes into account that under the normal procedure, the transformed disturbances are still heteroskedastic in the unequally spaced data. McKenzie (2001) studies $AR(1)$ models with an unequally spaced pseudo-panel. In this case, the differencing approach can no longer be directly applied and, furthermore, unequal spacing in a dynamic model imposes nonlinear restrictions on the parameters. In the pseudo-panel case, the population is divided into

certain cohorts and the mean of the cohorts is taken over the individual in each cohorts. The resulting data is a pseudo-panel over the cohorts. And non-linear least squares, minimum distance, and one-step estimators are used to estimate the parameters. In genuine panel data, averaging can be taken over the entire sample, but the estimates of the parameters can only be based on small observations in the averaged model.

This paper focuses on a dynamic model, where the outcome of the dependent variable depends on both the current value and the lagged value of the explanatory variables. Section 2 considers a model with a strict exogeneity assumption. A classic minimum distance estimation method and an one-step GMM method are proposed for the consistent estimates of the parameters. The two-step GMM method is also discussed. In section 3, the same model is studied without strict exogeneity assumption. Arellano and Bond (1991) method is used to account for the violation of strict exogeneity. The classic minimum distance estimation then follows to recover the structural parameters. It also shows that the same one-step GMM method also applies. Section 4 concludes the paper.

3.2 Estimation Under Strict Exogeneity Condition

3.2.1 Static Model

Consider the following panel data regression model:

$$y_{i,t} = x_{i,t}\beta + c_i + \mu_{i,t} \quad (i = 1, \dots, N; t = 1, 2, \dots, T) \quad (3.1)$$

, where $x_{i,t}$ is a $1 \times k$ -vector of explanatory variables, β is a $k \times 1$ -vector of parameters to be estimated; c_i , the time-invariant unobservables of unit i are allowed to be arbitrarily correlated with x_{it} ; $\mu_{i,t}$ is an idiosyncratic disturbance.

The strict exogeneity assumption is :

$$E(\mu_{i,t}|x_i, c_i) = 0 \quad (3.2)$$

So far, the model setup is a standard basic fixed effect model. When all the observations are missing for certain periods, as in the unequally spaced panel, this model becomes a special case of unbalanced panel covered by Wooldridge (2002). Following his notation, the selection indicators (s_{it}) in the unevenly spaced panel certainly depend only on exogenous rules, so the assumption

$$E(\mu_{i,t}|x_i, c_i, s_i) = 0 \quad (3.3)$$

is satisfied. In this case, the selection indicators are the same for all observations and they are all zero in certain periods, thus we can omit the subscript t in the indicator, that is: $s_t = 0$ for some t 's. Assume that all the observations are not missing in the first period ($t=1$) and the last possible period ($t=T$). Then the number of time periods observed for all observations should satisfy: $T_i \geq 2$, where $T_i = \sum s_{it}$.

Fixed effect estimation can be extended easily to the unevenly spaced panel and the FE estimator is consistent under strict exogeneity assumption in equation (3). Furthermore under homoskedasticity and serial independence assumption for the error term, the normal inference also holds, as shown in Wooldridge (2002, Section 17.2).

3.2.2 Dynamic Model with Lagged Explanatory Variables

Now assume a dynamic model with lagged explanatory variables:

$$y_{i,t} = x_{i,t}\beta + w_{i,t-1}\alpha + c_i + \mu_{i,t} \quad (i = 1, \dots, N, t = 1, \dots, T) \quad (3.4)$$

where $x_{i,t}$ is a $1 \times k$ vector of explanatory variables that are dated contemporaneously with the dependent variable $y_{i,t}$; $w_{i,t-1}$ is a scalar, which is dated one-period lag of the dependent variable.

The strict exogeneity assumption in this model is:

$$E(\mu_{it}|x_i, w_i, c_i) = 0 \quad (3.5)$$

This assumption is the key assumption for the estimation method we propose in this section. So far the model is standard. In the unevenly spaced panel, we need some notation to specify the pattern of missing data. Let us denote the observed time periods by t_s , where $s = 1, 2, \dots, \tau$ and $\tau \leq T$. That is, $y_{i,t_s}, x_{i,t_s}, w_{i,t_s}$ are observed. Then the model specified in equation(3.4), in the unevenly spaced panel case, should be:

$$y_{i,t_s} = x_{i,t_s}\beta + w_{i,t_s-1}\alpha + c_i + \mu_{i,t_s} \quad (i = 1, \dots, N, s = 1, \dots, \tau) \quad (3.6)$$

The $\tau - 1$ equations in this model can be written as:

$$y_i = x_i\beta + w_{i,-1}\alpha + c_i j_\tau + \mu_i \quad (i = 1, \dots, N) \quad (3.7)$$

,where j_τ is a $(\tau - 1) \times 1$ vector of ones.

In this dynamic model, w_{i,t_s-1} may not be observed. The closest observed period to the $(t_s - 1)^{th}$ period is period (t_{s-1}) . We can use the value in the closest period to predict w_{i,t_s-1} .

The assumption we make about the data generating process of $w_{i,t}$ is that the lineal projector, $L(w_{i,t_s}|w_{i,t_s-m})$, is stationary for $m \geq 1$. That is, we assume:

$$w_{i,t_s} = \pi_m w_{i,t_s-m} + \nu_{it_s} \quad (3.8)$$

for $m = 1, 2, \dots$. This assumption does not put restrictions on the coefficient of the lagged dependent variable if the lag length is different, and it only assumes the coefficient to be the same for the same lag length. By definition of a linear projection, the error term ν_{it_s} has the following properties:

$$E(\nu_{it_s}) = 0 \quad (3.9)$$

$$Cov(w_{i,t_s-m}, \nu_{it_s}) = 0 \quad (3.10)$$

At the same time, since x_{it} does not help predict $w_{i,t}$ for all t , we also have the following property of ν_{it_s}

$$Cov(\nu_{it_s}, x_i) = 0 \quad (3.11)$$

Based on the model specified in equation (3.8), we can predict w_{i,t_s-1} by the following equation:

$$w_{i,t_s-1} = \pi_{(t_s-1)-(t_{s-1})} w_{t_{s-1}} + \nu_{it_{s-1}} \quad (i = 1, 2, \dots, N; s = 1, 2, \dots, \tau) \quad (3.12)$$

Substitute equation (3.12) into equation (3.6), we can write:

$$y_{i,t_s} = x_{i,t_s} \beta + w_{t_{s-1}} \pi_{(t_s-1)-(t_{s-1})} \alpha + c_i + \mu_{i,t_s} + \alpha \nu_{i,(t_s-1)} \quad (3.13)$$

If $t_s - 1 = t_{s-1}$, then (3.13) reduced to a standard model in an equally spaced data. In vector form, let h be the number of distinct lag length between period (t_{s-1}) and period $(t_s - 1)$, where $(h > 1)$. And also denote the magnitude of the

gap by m_j with $m_j = (t_s - 1) - (t_{s-1})$, $j = 1, \dots, h$. Then $\tau - 1$ equation in

(3.13) can be written as:

$$y_i = x_i\beta + w_{i,-1}^*\Pi\alpha + c_i j_\tau + \epsilon_i \quad (3.14)$$

where $w_{i,-1} = (w_{i,t_2-1}, w_{i,t_3-1}, \dots, w_{i,t_\tau-1})'$ is a $(\tau - 1) \times 1$ vector of the lagged explanatory variables that we want to predict; $\Pi = f(\pi) = (\pi_{m_1}, \pi_{m_2}, \dots, \pi_{m_h})'$ is a $h \times 1$ vector of parameters in predicting $w_{i,-1}$. And $w_{i,-1}^*$ is a $(\tau - 1) \times h$ matrix, where the non-zero element $w_{i,t_1}, w_{i,t_2}, \dots, w_{i,t_\tau-1}$ is located in column m_j ; m_j is the gap in time period between the element in $w_{i,-1}^*$ and the corresponding element in $w_{i,-1}$. Lastly, $\epsilon_i = \mu_i + \alpha\nu_i$ is a $(\tau - 1) \times 1$ vector of error terms. Now the error term will consist of an extra term if $w_{i,t_{s-1}}$ is estimated from w_{i,t_s-1} .

For example, if $t_1 = 1; t_2 = 3; t_3 = 6; t_4 = 7; t_5 = 9$, the estimation equation in

(3.14) will be:

$$\begin{bmatrix} y_{i,3} \\ y_{i,6} \\ y_{i,7} \\ y_{i,9} \end{bmatrix} = \begin{bmatrix} x_{i,3} \\ x_{i,6} \\ x_{i,7} \\ x_{i,9} \end{bmatrix} \beta + \begin{bmatrix} 0 & w_{i,1} & 0 \\ 0 & 0 & w_{i,3} \\ w_{i,6} & 0 & 0 \\ 0 & w_{i,7} & 0 \end{bmatrix} \begin{bmatrix} 1 \\ \pi_1 \\ \pi_2 \end{bmatrix} \alpha + c_i j_\tau + \begin{bmatrix} \mu_{i,3} + \alpha\epsilon_{i,2} \\ \mu_{i,6} + \alpha\epsilon_{i,5} \\ \mu_{i,7} \\ \mu_{i,9} + \alpha\epsilon_{i,8} \end{bmatrix}$$

The first method we consider to estimate β and α is the classic minimum distance (CMD) estimator. Letting $z_i = (x_i, w_{i,-1}^*)$ be a $(\tau - 1) \times (k + h)$ matrix of exogenous variables, and $\theta = (\beta', \gamma')'$ be $(k + h) \times 1$ vector of parameters to be estimated, where $\gamma = \Pi\alpha$. The model in (3.14) can then be expressed as:

$$y_i = z_i\theta + c_i j_\tau + \epsilon_i \quad (i = 1, \dots, N) \quad (3.15)$$

Under strict exogeneity assumptions in (3.5) and the conditional mean assumptions in (3.10) and (3.11), together with usual rank conditions, the fixed effect estimator for (3.15) is consistent. We call this fixed effect estimator $\hat{\theta}_{FE}$. And $\hat{\theta}_{FE} = (\sum_i \sum_{t_s} \ddot{z}'_{i,t_s} \ddot{z}_{i,t_s})^{-1} (\sum_i \sum_{t_s} \ddot{z}'_{i,t_s} \ddot{y}_{i,t_s})$, where the double dots stands for demeaned form of variables.

Without further assumptions on the serial correlation in the error term, the demeaned form of error term $\ddot{\epsilon}_i$ might be serially correlated and heteroskedastic. Thus the robust variance matrix estimator should be applied for any statistical inferences. The estimated robust variance matrix of the fixed effect estimator for this model is:

$$\hat{\Omega} = \widehat{Avar}(\hat{\theta}_{FE}) = (\sum \ddot{z}'_i \ddot{z}_i)^{-1} \hat{V} (\sum \ddot{z}'_i \ddot{z}_i)^{-1} \quad (3.16)$$

where, $\hat{V} = \sum_i \ddot{z}'_i \ddot{\hat{\epsilon}} \ddot{\hat{\epsilon}}' \ddot{z}_i$ and $\ddot{\hat{\epsilon}}$ is the error term from fixed effect estimation, that is,

$\ddot{\hat{\epsilon}} = \ddot{y}_i - \ddot{z}_i \hat{\theta}_{FE}$. This variance matrix is valid in the presence of any heteroskedasticity or serial correlation, provided that τ is small relative to N (Wooldridge 2002).

The fixed effect estimator $\hat{\theta}_{FE}$ is a $(k + h) \times 1$ vector of estimated coefficients in the “reduced ”form. We denote the “structural ”form of coefficients to be a $(k + 1) \times 1$ vector: $\theta_o = (\beta', \alpha)$. To denote that the “reduced ”form of coefficients $\theta = (\beta', \pi_{m_1} \alpha, \dots, \pi_{m_h} \alpha)'$ is a non-linear function of θ_o , we write $\theta = f(\theta_o)$, $f : R^{k+1} \rightarrow R^{k+h}$ is a continuously differentiable function. Since $\hat{\theta}_{FE}$ is a

consistent estimator of θ , we can recover the estimates of the θ_o from $\hat{\theta}_{FE}$. The classical minimum distance estimator of θ_o , denoted by $\hat{\theta}_{CMD}$ is the solution to the problem:

$$\text{Min}_{\theta_o} [\hat{\theta}_{FE} - f(\theta_o)]' \hat{\Omega}^{-1} [\hat{\theta}_{FE} - f(\theta_o)] \quad (3.17)$$

,where $\hat{\Omega}^{-1}$ is given in (3.16).

The solution $\hat{\theta}_{CMD}$ solves the first order condition:

$$[\nabla_{\theta_o} f(\hat{\theta}_{CMD})]' \hat{\Omega}^{-1} [\hat{\theta}_{FE} - f(\hat{\theta}_{CMD})] = 0 \quad (3.18)$$

,where $\nabla_{\theta_o} f(\hat{\theta}_{CMD})$ is a $(k + h) \times (k + 1)$ Jacobian of $f(\hat{\theta}_{CMD})$. Hansen (1982) establishes that the resulting estimator $\hat{\theta}_{CMD}$ is consistent and asymptotically normal. The estimated variance of $\hat{\theta}_{CMD}$ takes the form:

$$\widehat{Avar}(\hat{\theta}_{CMD}) = N^{-1} \{ [\nabla_{\theta_o} f(\hat{\theta}_{CMD})]' \hat{\Omega}^{-1} [\nabla_{\theta_o} f(\hat{\theta}_{CMD})] \} \quad (3.19)$$

The second method we consider is joint estimation of π, β, α through generalized method of moment. This is an application of GMM framework for sequential estimation studied by Newey and McFadden (1994). In this application, the feasible estimation of β and α depends on the estimation of π in the first place. By applying the general GMM formula to simultaneously estimate the two sets of parameters, we can get consistent standard error estimators for the estimation of β and α .

The first set of moment conditions does not include parameter β and α . It only involves using observed period in the estimation of π . For example, the following regression contains π_1 and π_2 in previous example:

$$\begin{bmatrix} w_{i,3} \\ w_{i,7} \\ w_{i,9} \end{bmatrix} = \begin{bmatrix} 0 & w_{i,1} \\ w_{i,6} & 0 \\ 0 & w_{i,7} \end{bmatrix} \begin{bmatrix} \pi_1 \\ \pi_2 \end{bmatrix} + \begin{bmatrix} \varepsilon_{i,3} \\ \varepsilon_{i,7} \\ \varepsilon_{i,9} \end{bmatrix}$$

In general, we write

$$w_i = w_{i,-1}^{\star\star} \Pi + \varepsilon_i \quad (3.20)$$

The dimension of w_i is $l \times 1$ where $l \geq h$; and $w_{i,-1}^{\star\star}$ is a $l \times h$ matrix of observed values of w as well. In other words, the dimension of w_i and $w_{i,-1}^{\star\star}$ depend on the lag length in observed data as well as the missing period. In order to be able to use the estimators from the observed period, the lag length between observed periods must include the lag length needed to estimate the missing period. The number of moment conditions depends on the lag length of observed periods as well as the lag length needed to estimate the missing period.

We use $f_1(w, \pi)$ to denote the first set of moment conditions which involves parameter π only:

$$f_1(w, \Pi) = E[w_{i,-1}^{\star\star'}(w_i - w_{i,-1}^{\star\star} \Pi)] = 0 \quad (3.21)$$

The second set of moment condition, denoted by $f_2(w, x, \beta, \alpha, \Pi)$, is specified in the differenced form of (3.14), where the unobserved time-invariant heterogeneity is differenced out. This set of moment conditions involve the estimation of β, α as

well as Π :

$$f_2(w, x, \Pi, \beta, \alpha) = E \left[\begin{matrix} x'_i \\ w^{\star'}_{i,-1} \end{matrix} \right] [\Delta y_i - (\Delta x_i \beta - \Delta w^{\star}_{i,-1} \Pi \alpha)] = 0 \quad (3.22)$$

Define the sample version of f_1 and f_2 by $\hat{f}_1$ and $\hat{f}_2$, where

$$\hat{f}_1(w, \Pi) = \frac{1}{N} \sum_{i=1}^N w^{\star\star'}_{i,-1} (w_i - w^{\star\star}_{i,-1} \Pi) = 0 \quad (3.23)$$

$$\hat{f}_2(w, x, \Pi, \beta, \alpha) = \frac{1}{N} \sum_{i=1}^N \left[\begin{matrix} x'_i \\ w^{\star'}_{i,-1} \end{matrix} \right] [\Delta y_i - (\Delta x_i \beta - \Delta w^{\star}_{i,-1} \Pi \alpha)] = 0 \quad (3.24)$$

The moment conditions for simultaneous estimation of Π, β, α are

$$\hat{f}(w, x, \Pi, \beta, \alpha) = [\hat{f}_1(w, \Pi)', \hat{f}_2(w, x, \Pi, \beta, \alpha)']' \quad (3.25)$$

The GMM estimate of the parameters thus is the solution to the following minimum criteria:

$$\min(\hat{f})' \hat{W}(\hat{f})' \quad (3.26)$$

and the optimal weighting matrix $\hat{W} = \widehat{Var}[\hat{f}(w, x, \Pi, \beta, \alpha)]$.

Further, let $\theta = (\beta' \alpha)'$ and call the GMM estimates of θ and Π , $\hat{\theta}$ and $\hat{\Pi}$. Define the sample Jacobian terms by $\Gamma_{11} = \nabla_{\Pi} \hat{f}_1(w, \hat{\Pi})$; $\Gamma_{21} = \nabla_{\Pi} \hat{f}_2(w, x, \hat{\Pi}, \hat{\theta})$ and $\Gamma_{22} = \nabla_{\theta} \hat{f}_2(w, x, \hat{\Pi}, \hat{\theta})$ and $\Psi = -\Gamma_{11}^{-1} \hat{f}_1$. In our application,

$$\Gamma_{11} = -\frac{1}{N} \sum_{i=1}^N (w^{\star\star}_{i,-1} w^{\star\star}_{i,-1})' \quad (3.27)$$

$$\Gamma_{21} = -\frac{1}{N} \begin{bmatrix} \alpha \sum_{i=1}^N (x_i' \Delta w_{i,-1}^*) \\ \alpha \sum_{i=1}^N (w_{i,-1}^{*'} \Delta w_{i,-1}^*) \end{bmatrix} \quad (3.28)$$

and

$$\Gamma_{22} = -\frac{1}{N} \begin{bmatrix} \sum_{i=1}^N (x_i' \Delta x_i) & \sum_{i=1}^N (x_i' \Delta w_{i,-1}^* \hat{\Pi}) \\ \sum_{i=1}^N (w_{i,-1}^{*'} \Delta x_i) & \sum_{i=1}^N (w_{i,-1}^{*'} \Delta w_{i,-1}^* \hat{\Pi}) \end{bmatrix} \quad (3.29)$$

The variance of $\hat{\theta}$ is given by Newey and McFadden (1994) as the following:

$$\widehat{Var}(\hat{\theta}) = (\Gamma_{22}^{-1}) \left\{ \frac{1}{N} \sum_{i=1}^N [(\hat{f}_2 + \Gamma_{21} \Psi)(\hat{f}_2 + \Gamma_{21} \Psi)'] \right\} (\Gamma_{22}^{-1})' \quad (3.30)$$

It is worth mentioning the alternative of estimating the parameters through a two-step GMM estimation. The first step is to estimate Π by the moment conditions given in (3.21). The second step is to estimate β and α by the moment conditions given in (3.22), taking Π from the first step as given. Newey and McFadden (1994) derives the condition, under which the standard error of the estimates of β and α is not affected by the estimation of Π from (3.21) only. The condition is $\Gamma_{21} = 0$. In our application, it means that if and only if $\alpha = 0$, does the first step have no effect on the second-step asymptotic variance. In empirical application, when the null hypothesis that $\alpha = 0$ can not be rejected from the two step estimation, the standard error from the second step need not

be corrected. In other cases when $\alpha \neq 0$, the one-step GMM estimation outlined above is no less efficient than the two-step GMM and the standard error is correct. One concern in terms of the computation of the one-step GMM is that the iteration may not converge since the moment conditions are not linear in parameters. This may be alleviated by using the two-step estimates as the initial value in the iteration.

3.3 Estimation Without Strict Exogeneity Condition

3.3.1 Static Model

We are still look at the following model in the unevenly spaced panel:

$$y_{i,t_s} = x_{i,t_s}\beta + c_i + \mu_{i,t_s} \quad (3.31)$$

but the assumption we make on the error term μ_{i,t_s} is the following:

$$E(\mu_{i,t_s} | x_{i,t_s-1}, x_{i,t_s-2}, \dots, x_{i,1}, c_i) = 0 \quad (3.32)$$

By this assumption, x_{i,t_s} is uncorrelated with error terms μ_{i,t_j} for $t_s < t_j$, conditional on time invariant heterogeneity. In other words, x_{i,t_s} is *predetermined*. So, the correlation of the error terms with contemporaneous and future values of the explanatory variables is allowed. One example would be the regression of working hours on wage arrears shock, when working hours affect the possibility of wage arrears shocks in the subsequent period.

The general method used for the model with violation of strict exogeneity assumption also applies in the unevenly spaced panel. First difference the data in the unevenly spaced panel gives us:

$$y_{i,t_s} - y_{i,t_{s-1}} = (x_{i,t_s} - x_{i,t_{s-1}})\beta + (\mu_{i,t_s} - \mu_{i,t_{s-1}}) \quad (3.33)$$

and the observed level or change in the lagged value of x_{i,t_s} can be used as instrument variables. That is, $x_{i,t_{s-2}}, x_{i,t_{s-3}}, \dots$, or $(x_{i,t_{s-2}} - x_{i,t_{s-3}})$, $(x_{i,t_{s-3}} - x_{i,t_{s-4}})$...can be used as instrument variables for $(x_{i,t_s} - x_{i,t_{s-1}})$ in a GLS estimation. Or in the Arellano and Bond (1992) framework, more of the instruments can be explored in the GMM estimation.

3.3.2 Dynamic Model

Consider the following model:

$$y_{i,t_s} = x_{i,t_s}\beta + w_{i,t_s-1}\alpha + c_i + \mu_{i,t_s} \quad (i = 1, \dots, N, s = 1, \dots, \tau) \quad (3.34)$$

We assume that conditional on individual time invariant heterogeneity, explanatory variables x_i and w_i are predetermined with respect to the error term:

$$E(\mu_{it}|x_{i,t_s-1}, x_{i,t_s-2}, \dots, x_{i,1}; w_{i,t_s-1}, w_{i,t_s-2}, \dots, w_{i,1}; c_i) = 0 \quad (3.35)$$

The within estimator for (3.34) is inconsistent because the within transformed error is a function of predetermined information and thus is not orthogonal to the within transformed explanatory variables. A common econometric approach for

handling violation of strict exogeneity is to first differencing this equation and apply instrument variables on the differenced equation. The differenced equation can be written as:

$$\Delta y_{i,t_s} = \Delta x_{i,t_s} \beta + \Delta w_{t_s-1} \alpha + \Delta \mu_{i,t_s} \quad (3.36)$$

,where Δ denotes the first difference operation. That is, $\Delta y_{i,t_s} = y_{i,t_s} - y_{i,t_{s-1}}$;

$\Delta x_{i,t_s} = x_{i,t_s} - x_{i,t_{s-1}}$; $\Delta w_{i,t_s-1} = w_{i,t_s-1} - w_{i,t_{s-2}}$ and

$\Delta \mu_{i,t_s} = \mu_{i,t_s} - \mu_{i,t_{s-1}}$.

As we mentioned before, w_{i,t_s-1} may not be observed in the unevenly spaced panel and the most recent recent period that is observed is period t_{s-1} . Based on the assumptions of (3.8) and (3.10) for w , we can predict w_{i,t_s-1} by using observed period. But we need to be careful in the prediction when w_{it} is not strict exogenous with respect to the error term. For example, when $t_{s-1} = t_s - 1$, that is the previous one period is the most recent period observed for some s , the fact that $E(w_{i,t_{s-1}} \mu_{i,t_{s-1}}) \neq 0$ will cause the predicted term to be correlated with the error term. In this case, we need to use one lag period before the most recent period, that is $w_{i,t_{s-2}}$, to predict $w_{i,t_{s-1}}$. But if all the gap between two periods are greater than one, then we can still use the most recent period to predict the missing period. To simply the notation, we assume that the gap between two observed period is greater than one, thus we can use the most recent period as predictor. The first differenced form of the model in terms of observed

period can be written as:

$$\begin{aligned}
y_{i,t_s} - y_{i,t_{s-1}} &= (x_{i,t_s} - x_{i,t_{s-1}})\beta + [w_{i,t_{s-1}}\pi_{(t_s-1)-(t_{s-1})} \\
&\quad - w_{i,t_{s-2}}\pi_{(t_s-2)-(t_{s-2})}]\alpha + (\mu_{i,t_s} - \mu_{i,t_{s-1}}) \\
&\quad + (\nu_{i,t_{s-1}} - \nu_{i,t_{s-2}})\alpha
\end{aligned} \tag{3.37}$$

In matrix form, (3.37) can be written as:

$$\Delta y_i = \Delta x_i \beta + \Delta w_{-1}^* \Pi \alpha + \Delta \epsilon_i \tag{3.38}$$

where, $\Delta \epsilon_i = \Delta \mu_i + \alpha \Delta \nu_i$.

There are two issues that need to be addressed. One is that the correlation between $\Delta x_{i,t_s}$ and $\Delta \mu_{i,t_s}$ is nonzero, because $E(\Delta x_{i,t_s} \Delta \mu_{i,t_s}) = E(x_{i,t_s} - x_{i,t_{s-1}})(\mu_{i,t_s} - \mu_{i,t_{s-1}}) = E(x_{i,t_s} \mu_{i,t_s}) - E(x_{i,t_s} \mu_{i,t_{s-1}}) + E(x_{i,t_{s-1}} \mu_{i,t_{s-1}})$. All these three terms are not equal to zero, according to the assumption that x_i are predetermined. Another issue is that the parameter $\Pi \alpha$ is nonlinear and we want to “recover ” the “structural ” coefficient α .

The first issue can be addressed easily by instrument variable estimation. The possible instruments for $\Delta x_{i,t_s}$ are $[x_{i,t_1}, x_{i,t_2}, \dots, x_{i,t_{s-2}}]$. For example, starting from period t_3 , in the Arellano and Bond (1991) framework, the matrix of

instruments, denoted by Z_i is :

$$Z_i = \begin{pmatrix} [x_{i,t_1}, (w_{i,t_2} - w_{i,t_1})] & & 0 \\ & \ddots & \\ 0 & & [x_{i,t_1}, x_{i,t_2}, \dots, x_{i,t_{\tau-2}}, (w_{i,t_{\tau-1}} - w_{i,t_{\tau-2}})] \end{pmatrix}$$

The estimated weighting matrix is:

$$\hat{\Phi} = \Sigma_i Z_i' (\hat{\Delta}\epsilon_i) (\hat{\Delta}\epsilon_i)' Z_i \quad (3.39)$$

$\hat{\Delta}\epsilon_i$ is residuals from the preliminary consistent estimator, such as 2SLS using a couple of lags as instrument variables. The consistent estimator, denoted by

$\hat{\theta}_{GMM} = (\hat{\beta}'_{GMM}, \hat{\Pi}'\alpha_{GMM})'$, is:

$$\hat{\theta}_{GMM} = [(\Delta x_i, \Delta w_{-1}^*)' Z_i \hat{\Phi}' Z_i' (\Delta x_i, \Delta w_{-1}^*)]^{-1} [(\Delta x_i, \Delta w_{-1}^*)' Z_i \hat{\Phi}' Z_i' \Delta y_i] \quad (3.40)$$

A consistent estimate of the asymptotic variance of $\hat{\theta}_{GMM}$ is given by:

$$\hat{\Omega} = Avar(\hat{\theta}_{GMM}) = [(\Delta x_i, \Delta w_{-1}^*)' Z_i \hat{\Phi}' Z_i' (\Delta x_i, \Delta w_{-1}^*)]^{-1} \quad (3.41)$$

To recover the parameter $\theta_o = (\beta', \alpha)$ from $\hat{\theta}_{GMM}$, we can apply the classic minimum distance estimator in (3.17) and (3.18) to obtain consistent estimator of θ_o .

The one-step GMM method proposed in section 2 can also be applied in this case. The only difference is that the set of moment conditions in (3.22) will be in the following form:

$$f_2'(w, x, \Pi, \beta, \alpha) = E \left[\begin{matrix} x_{i,-2}' \\ w_{i,-1}' \end{matrix} \right] [\Delta y_i - (\Delta x_i \beta - \Delta w_{i,-1}^* \Pi \alpha)] = 0 \quad (3.42)$$

Starting from t_3 ,

$$x_{i,-2} = \begin{pmatrix} [x_{i,t_1}], & & & 0 \\ & [x_{i,t_1}, x_{i,t_2},] & & \\ & & \ddots & \\ 0 & & & [x_{i,t_1}, x_{i,t_2}, \dots x_{i,t_{\tau-2}}] \end{pmatrix}$$

Thus β , α as well as Π can be estimated through:

$$\hat{f}'(w, x, \Pi, \beta, \alpha) = [\hat{f}_1'(w, \Pi)', \hat{f}_2'(w, x, \Pi, \beta, \alpha)']' \quad (3.43)$$

The one-step GMM method is no more complicated in the case without strict exogeneity than the case with strict exogeneity. The only difference is there will be fewer possible moment conditions in the second set of moments containing the parameters β and α . The variance of the estimates of β and α given in (3.30) also applies.

3.4 Conclusion

Estimation in unevenly spaced panel in a static model does not involve more complication. In a dynamic model, the estimation involves predicting the missing lagged value. In this paper, we consider a model with one lagged explanatory variable. The classic minimum distance estimation can be applied to recover the structural parameters from the consistent estimator of the reduced form parameters. The consistent estimator for the reduced form parameters can be

obtained from either fixed effect estimation or GMM estimation, depending on the assumption about the exogeneity of the explanatory variables with respect to the error term. Also, the one-step GMM method can be applied in both cases.

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