The Dissertation Committee for Victoria Konstantinova Vernon certifies that this is the approved version of the following dissertation:

Household Economies of Scale, Food Consumption and Intra-Household Allocation of Time

Committee:

Li Gan, Supervisor

Daniel Hamermesh

Richard Dusansky

Douglas Dacy

Hong Yan

Household Economies of Scale, Food Consumption and Intra-Household Allocation of Time

by

Victoria Konstantinova Vernon, dipl.; M.A.

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Household Economies of Scale, Food Consumption and Intra-Household Allocation of Time

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Victoria Konstantinova Vernon, Ph.D.
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Supervisor: Li Gan

This thesis presents and empirically tests three utility theoretic models of the household behavior. Larger households economize money and time by sharing expenses and specializing labor within and outside of the home. A "paradox" arises when the budget share of food declines with household size in the consumer expenditure survey data contradicting the Barten model prediction that per capita food consumption should increase with household size. I test the Barten model in the expenditure data from the U.S., South Africa and Russia, and show that the share of food increases relative to a more public good and decreases relative to a more private good. This suggests food is less private than the composite of all other goods in the household budget; the likely public component of food being food preparation time. Extending the model to incorporate time, I explain the food consumption paradox: larger households choose more time intensive meals, thus per capita expenditures on food decline with household size while food consumption does not. In the data from Russia, doubling the size of household reduces per capita food expenditure by over 30% and per capita preparation time by about 75% in households with two and more people. Single men spend over three times more hours in food-related activities than men from two-person households spend. Single women enjoy smaller time saving for a similar transition, but married women enjoy no time saving at all. The quality of meals is unaffected by changes in household size. Finally, I study the effect of labor market shocks on the allocation of non-market time in transitional Russia. The model of a two-sector labor market with restricted hours of work in the state sector of employment and high fixed costs of entry in the private sector implies that earnings are a better approximation of worker's well-being than wages. Cross-sectional and panel data analysis shows the population enjoyed more leisure during transition than before and movement to and from employment took place mostly at the expense of leisure hours. In response to higher earning opportunities employed men reduced leisure while employed women also cut down on childcare and housework.

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Chapter 1

Introduction

Standards of living are affected by household size. Households enhance the welfare of constituents by sharing the cost of shelter, furnishings, maintenance and childcare. Along with economizing on expenses, individuals from larger households enjoy a considerable time advantage over their single counterparts as adults can specialize labor within and outside of the home, with household members taking on different responsibilities for market work, housework, and childcare. Money savings so afforded can be allocated toward more personal goods such as health, beauty care and own transportation. The extra hours of time freed by specialization may be allocated toward more private "consumption" time such as leisure and sleep or toward more work for wage. How do household expenditures and time allocation change with family size? What are the sources of these household economies of scale? How do shocks in the labor market affect allocation of time at home? Finding answers to these questions will improve our ability to compare welfare across households of different sizes and compositions and will also contribute to explaining individuals' labor market decisions. The next two chapters address the issue of household economies of scale in food consumption focusing on the decision of a household as a unit. Then the chapter that follows analyses individual's time allocation decision under imperfect labor market conditions.

The most straightforward measure of household economies of scale is percentage decrease in per capita expenditure or time spent in a particular activity as a result of a unit increase in household size. Recent literature on household economies focused on economies in expenditures and ignored economies in time. Using expenditure data, researchers found evidence of household economies in shelter, house maintenance, transportation and even in food, thus supporting Engel's (1895) observation that the share of food in household total expenditures decreases with family size.

Evidence of economies in food expenditures is perhaps the most interesting and somewhat puzzling. Larger households spend less per capita on food, even though food is a private non-sharable good. According to the simplest models of household economies, income and substitution effects of sharing public goods should results in higher per capita consumption of private goods as households grow larger. First introduced in Deaton and Paxson (1998), this contradiction between the theory and the empirical evidence became known as a food consumption "paradox". When food expenditure is taken to approximate food consumption, lower per capita food expenditure by larger households is not consistent with utility maximization.

The simplest model of household economies in size is the Barten model. It assumes that one of the goods (food) is more private than the other (all non-food consumption) and predicts that at constant per capita total expenditures larger households save on the public good and increase per-person expenditures on the private good. Given inconsistency between the data and the model, one may suspect the Barten model is wrong. Alternatively, our interpretation of the model may be too literal; if food is less private than the composite of all other goods in the consumer's budget then the model's predictions are accurate. In Chapter 2, I present evidence in support of the latter view by showing that the Barten model performs well in the data and by demonstrating indirect evidence in favor of the existence of the public component in food.

Using consumer expenditure data from the U.S., South Africa and Russia, I follow the assumptions of the Barten model precisely and examine food as a share of food plus the other goods known to be more public than food. I find that the food share indeed increases with family size relative to shelter as predicted by the Barten model. Likewise, when I analyze food as a share of food plus a good known to be more private than food, I observe that the food share decreases with family size relative to clothing and transportation, as consistent with the model. The findings suggest that the composite budget complement of food is more private than food. The most likely public component of food is food preparation time. Even though I do not directly examine data on food preparation time in this chapter, I find some support for the existence of the economies in time in the expenditure data: per capita expenditures on “food consumed away from home” decreases with family size as larger households take advantage of lower cost home-prepared meals.

The same chapter also addresses the issue of the differences in elasticity of food share with respect to household size for rich and poor households. The model postulates that poorer households should be the ones most willing to take advantage of the household economies of scale, and therefore, food share should increase more in poorer households with the number of adult-equivalents. However, previous literature compared estimates from different countries and found that the elasticity of food share with respect to household size is negative and larger in absolute value for poorer households than for rich households, meaning that households in poorer countries are actually most willing to substitute away from food as opportunities for sharing increase. The chapter argues against welfare comparison between households in different countries because it requires a very strong assumption of identical parameters for the utility functions across households of different socioeconomic background. Instead, I estimate the model by expenditure quartiles in each country under study. The elasticity of food share with respect to household size is found to be larger for poorer households within each country, consistent with the prediction of the Barten model.

The analysis of the Barten model suggests that food might be less private than often thought, but the model does not explain the nature of household economies of scale in food. The study of household economies is taken one step further in Chapter 3 where I introduce food preparation time into the household production model and prove that time is the major source of household economies in food.

The possibility of sharing monetary or time costs introduces a public component into fairly all goods households enjoy – food, housing, home maintenance, transportation and children. Even leisure, personal health and sleep may contain a public component if production of these commodities requires some fixed material costs that can be shared. For the public goods within household the income and substitution effects work in different directions. The income effect implies that household can afford higher consumption of all goods, including food, while the substitution effect implies there will be a shift toward relatively cheaper "more public" goods. Whenever market inputs and time are substitutes in production of final goods, there will also be a substitution toward the cheaper resource, market goods or time, the one in which economies of scale are larger.

In my model, purchased food is combined with time inputs to produce meals. A meal can be produced using more market inputs, such as more processed or semi-prepared food and eating out, or more time inputs, such as cooking at home, spending time shopping for better deals, buying food in season and conserving it for later use, and growing food in kitchen gardens. If preparation time and purchased ingredients are to some extent substitutes, an increase in household size changes the relative price of food ingredients and time, creating an incentive to reallocate resources within a household. The decision on expenditures and time is simultaneous. In response to an increase in size, utility maximizing households increase their food consumption while optimally choosing a more time-intensive production technology of meals.

The presence of income and substitution effects makes it difficult to estimate potential economies in household size. Economies in market inputs into food are arguably small but economies in food preparation time are potentially large. Indeed, it takes two times more spaghetti to make a pasta meal for a family of two adults than it takes for one person but it does not take two times longer to boil it. In case of complete economies in time, each individual from a family of two would spend on average only half of the time it takes a single person to cook a meal. Because time is a relatively cheaper resource for larger households, to the extent possible larger households will substitute time for market ingredients with cheaper more time-intensive home meals replacing expensive restaurant meal. All else constant, even in presence of complete economies in time, a couple may choose to spend per capita more than half of a single person's time in food preparation. While the substitution effect works to decrease per capita food expenditures as household size grows, the income effect works in the opposite direction. Larger households are better off and can spend more money on everything including market purchased food. Time released from food preparation may be spent on market work further increasing per capita expenditure on food, or it may be spent in more food-related activities. The substitution effect should dominate so that both per capita expenditure and per capita food-related time decrease with household size.

By introducing economies in time into the model of household economies I am able to explain the food consumption paradox of declining per capita expenditures on food in larger households: Bigger families do not decrease their food consumption but rather they take advantage of the economies in food preparation time by choosing more time intensive meals.

Using household expenditure and time-use survey data from Russia, I estimate the effect of changing household size on food expenditures and food-related time. The estimates indicate that doubling the size of household reduces per capita food expenditure by over 30% and per capita preparation time by about 75% in households with two and more people. A married man from a two adult household spends three times less time preparing food than a single man living alone. For a woman, a transition from a single to a two-person households results in more modest time saving of 45% in case such transition is not a result of a marriage. A married woman enjoys no time savings at all, while a woman with children spends more time in food-related activities than her single counterparts. I also find that the time intensity of meals increases with household size, but that the quality of meals is unaffected by changes in household size.

Chapter 4 looks at another aspect of household behavior, the effect of shocks in the labor market on the household allocation of time in the home sector. The emerging literature on time-use is in search of answers to the following questions: What do people do with their time when they become unemployed? Do they enjoy more leisure, take better care of their children, or increase work at home to replace market work? How does success in the labor market affect the allocation of time in the home sector? I use longitudinal data from transitional Russia taking advantage of its unique component, panel time use data.

Transitional Russia experienced a series of labor market shocks during its economic reforms of the 1990s. The country was moving away from guaranteed state jobs and a scale-based pay schedule toward the development of the private sector with market-determined wages. Some skills related to the planned economy became obsolete while the return to the market-oriented skills increased. The transitional labor market was still dominated by the old state sector with pervasive underemployment in the form of restricted hours of work and compulsory unpaid leaves. At the same time, the emerging private sector offered unrestricted hours and higher earnings potential but required time investment into learning new management skills and establishing business connections. The young entrepreneurs were ready to undertake this investment. Faced with declining real incomes, many working age adults, especially older people, engaged in moonlighting and subsistence agriculture.

Classical models use wages as a measure of the opportunity cost of time and predict that higher wages result in less home production. Given strong preference for goods versus time, higher wages should also result in longer time spent in the market and shorter hours of leisure. Some of these predictions do not hold in transitional Russia where hourly wages are positively associated with the time individuals spend in leisure and negatively associated with the time spent in the labor market. I model this phenomenon in a household production framework extending the classical model to reflect workers' choice between employment in the state and the private sectors. In presence of these market imperfections, hourly wages may not reflect the opportunity cost of time or the individual's ability. In the state sector, the underemployed higher ability workers are more likely to work longer hours in secondary jobs even though hourly earnings from secondary sources are lower than wages at primary jobs. Thus the hours of work and the worker's ability are negatively related to the individual's average hourly wages from all jobs. In the private sector, part of the labor market time does not generate income, thus longer hours of work are again negatively related to hourly wages. The opportunity cost of an extra hour of time is lower than the wage rate while in the private sector it is higher than the wage rate. I show that earnings are a better approximation of worker's well-being and abilities than hourly wages. Higher earnings are associated with longer hours of market work and shorter hours spent in all non-market activities.

The chapter shows that Russians respond to market incentives by reallocating their non-market time in a predictable way. The use of an individual's non-market time largely depends on his/her status in the market sector. The analysis of cross-sectional and panel time use data suggests that overall the Russian population, voluntarily or not, enjoyed more leisure during transition than before. For men, transitions to and from employment took place almost exclusively at the expense of leisure. Women, on the other hand, also adjusted their housework and childcare hours in similar circumstances. In response to higher earning opportunities already employed men reduced leisure while employed women further cut down their time spent in childcare and housework. I also find that transition to the market increased specialization within a household, with older women assuming more childcare responsibilities while highly educated working mothers supplying more time to the labor market at the expense of childcare. Another interesting trend is the steady decline in the number of hours the population spends in housework.

This dissertation made several contributions to the literature on the economics of the household. First, it showed that the household economies in food-related time are potentially large and important in household decisions. Not accounting for these economies results in under-estimation of the household food consumption and overall welfare of larger households. Second, it explained how household decision on expenditures and time can be modeled within a household production framework. This model permits various extensions that should be useful for researchers examining the nature of household economies in other goods and studying the possible labor market implications of such economies. Third, it pointed out the importance of knowledge of the labor market conditions for understanding individuals' allocation of time to different activities at home. In an imperfect labor market, average hourly wages may be a biased measure of the worker's ability and the individual's opportunity cost of time, the pitfall to be aware of for empirical researchers who use data from developing countries. Fourth, this study finds that men and women respond differently to changes in the labor market, with men's housework and childcare time varying little in response to employment shocks while women's work at home adjusting more to the labor market outcomes. This implies that a job loss by a man has a larger negative effect on household welfare than a job loss by a woman, everything else held equal.

Chapter 2

Food Consumption and Household Economies of Scale: Testing the Barten Model

2.1 Introduction

Standards of living are affected by the size of households. Adults who reside in multi-adult households are afforded significant sharing opportunities in the costs of shelter and furnishings and even in the time required for home chores such as cleaning and childcare. Any savings so afforded can be allocated toward more personal needs such as food, clothing, beauty care, health and own transportation. Sharing in households is an important issue in economics because of its implications for welfare measurements. Single cross-sectional metrics such as per capita total expenditures fail to capture meaningful variations in welfare across households of differing sizes such as material advantage roommates have over single adults and the material disadvantage of adults with children.

Evidence of household economies was documented more than a century ago by Ernest Engel. He observed that as a household of a given size became wealthier, the share of the household's total expenditures devoted to food fell. He also observed that as the size of the household increased holding total spending constant, the household was less wealthy and the budget share of food increased. These two observations led him and others to infer that the food budget share was inversely related to the household's economic well being, and that comparisons of households of different sizes and compositions could be made through the comparison of the household's food shares. By finding the level of total spending that equates the food shares across families, the Engel method determines how much more total spending would be needed for a family with *n* members to be equally well off as a single individual, the reference family unit. These proportional factors are the Engel equivalence scales.

More recently, Lazear and Michael (1977, 1980) estimated that expenditures by two adults living together and maintaining the same income as single individuals are 31-35% lower than expenditures of single adults. These savings are largest in food and shelter while smaller in services such as medical and personal care. Similarly, Nelson (1988) uses the CES to find large economies in shelter and smaller economies in furnishings, maintenance, food, clothing and transportation, shares accounting for 77% of consumption.

The share of food consumption in total expenditure or the budget share of other bundles of "necessities" is still used to compare economic welfare across households of different types and incomes (see, e.g., Deaton and Muellbauer 1986; Lanjouw and Ravallion 1995) despite more elaborate methods have been developed (see, e.g., a survey by Browning [1992]). Engel's method has an important advantage of being simple: it requires estimation of only one demand equation, with the food share of total expenditure as a dependent variable; single cross-sectional survey usually provides sufficient data for the analysis, and no information on prices is required. The drawback of Engel's approach is that it is based on empirical observations rather than on a utility theoretic model.

One of the first simple utility theoretic models of household economies in size was introduced by Barten (1964). Deaton and Paxson (1998) build on Barten's model and derive several controversial implications. The first is that, given incomes of household members remain constant and independent of the household size, larger households should consume per capita more private goods, such as food, and less per capita sharable goods, such as housing, therefore, food share should increase with household size, and housing share should decrease. This is diametrically opposite of what the Engel's Law predicts, and moreover, inconsistent with their own empirical tests. Using the 1990 U.S. Consumer Expenditures Survey, and also panel data from Great Britain, France, Taiwan, Thailand, Pakistan, and South Africa, Deaton and Paxson find strong evidence against predictions of the Barten model: the share of food decreases with household size.

The second implication of the Barten model is also contradicted by the data. The model postulates that poorer households should be the ones most willing to take advantage of the household economies of scale, and therefore, food share should increase more in poorer households with the number of adults. Thus the elasticity of the budget share of food with respect to household size should be larger in value in poor countries than in rich countries. The data, however, confirms exactly the opposite: the size elasticity is most negative in smaller households and in poorer countries. Such results are dubbed "entirely paradoxical" by Deaton and Paxson.

This chapter examines the food consumption paradox. Any inconsistency between empirical evidence and a theoretical model naturally casts doubt on the model. Rather than disposing of the model for not performing well in the data, I run a set of experiments with the data trying to follow following precisely the assumptions of the model. The two-good model assumes that one of the goods (food) is more private than the other (housing), so I examine food as a share of food plus the other goods known to be more public than food. In the food and housing subset, the paradox disappears: the food share indeed increases with family size as predicted. Likewise, when I analyze food as a share of food plus a good known to be more private than food, I observe that the food share decreases with family size, as predicted by the Barten model. It suggests that Deaton and Paxson's tests are based on the data that do not satisfy the assumptions of the Barten model. Considering food in total expenditures, they assume the composite budget complement of food is necessarily less private than food and the budget complement of shelter is necessarily less public than shelter. The results of this chapter suggest that food is most likely less private than the composite of all other goods. I find evidence that expenditure on "food consumed away from home" decreases with family size as households take advantage of the economies of scale in home food preparation time.

This chapter also addresses the issue of the elasticity of food share with respect to household size. The Barten model predicts that the elasticity of food share with respect to household size should be larger in value for poorer households, whereas the estimates of Deaton and Paxson show the opposite. Welfare comparison between households in different countries assumes identical parameters for the utility function across households of different socioeconomic background. To avoid such strong assumption, for each country under study, the United States, South Africa and Russia, the food demand equations are estimated by expenditure quartiles. The estimates show that the elasticity of food share with respect to household size is indeed larger for poorer households within each country, consistent with the prediction of the Barten model.

This chapter is organized as follows: Section 2.2 introduces the Paradox, reviews the Barten model and Deaton-Paxson's empirical work. Section 2.3 presents the proposed alternative empirical tests of the model and shows that the model performs well when the data are chosen carefully. Section 2.4 discusses and concludes the chapter.

2.2 The Paradox

The Barten model of household economies of scale is a simple one period model without labor, leisure or saving. A household size *n*, where *n* is the number of adult equivalents, allocates its total expenditure *x* across two goods, called food *f*, and everything else, named housing *h*. The household's problem is

$$\max_{q_f q_h} \; n\,u\left(\frac{q_f}{\varphi_f(n)}, \frac{q_h}{\varphi_h(n)}\right)$$

subject to (2.1)

$$p_f\left(\frac{q_f}{n}\right)+\left(\frac{p_h}{n}\right)q_h=\frac{x}{n}$$

where q_f and q_h are quantity demand for food and everything else, respectively. The prices for food p_f and for everything else p_h are assumed to be the same across households.

The scaling functions reflecting the economies of household size are $\varphi_f\ (n)$ for food and $\varphi_h\ (n)$ for everything else. Commodity specific scale is assumed to be a function of family size. This scale equals

$$\varphi_i = n^{1-\sigma_i} \qquad i = f, h$$

where σ_i is the scale elasticity of the i^{th} commodity. The scale elasticity of a commodity represents how the good can be shared among family members. I can take logs of both sides of the expression above and differentiate:

$$\ln\varphi_i = (1-\sigma_i)\ln n$$

$$\sigma_i = 1-\frac{\partial\ln\varphi_i(n)}{\partial\ln n_i}, \qquad i = f,\ h \tag{2.2}$$

If σ_i=0, then $\varphi_i = n$ so the good is a private (excludable) good that cannot be shared and must be replicated if all family members are to enjoy the good to the same degree as a single individual.

If σ_i=1, then $\varphi_i = 1$ so the good is a pure public good that can enjoyed by all members of the family equally.

From the first order conditions, the per capita consumption of food is derived:

$$\frac{p_f q_f}{n}=\frac{p_f\varphi_f(n)}{n}g_f\left(\frac{x}{n},\frac{p_f\varphi_f(n)}{n},\frac{p_h\varphi_h(n)}{n}\right) \tag{2.3}$$

It follows that

$$\gamma^* = \frac{\partial\ln\left(p_f q_f\ /n\right)}{\partial\ln n}\Big|_{x/n} = \sigma_h(\varepsilon_{fx}+\varepsilon_{ff})-\sigma_f(1+\varepsilon_{ff}) \tag{2.4}$$

where ε_{ff} is the own-price elasticity for food, ε_{fx} is the income elasticity of food.

Consider the following hypothetical change: double the size of the family and its total spending. This change will leave the family's per capita spending *(x/n)* unchanged, but increase family size *(n)*. The effect on per capita food expenditures will be composed of three separate effects. First, if there are any positive scale economies in non-food consumption with the increase in family size, then the family will be made better off. With the rise in real income, per capita food consumption should rise. To the extent that sharing of non-food items is greater than sharing of food, the relative price of food will rise and the family will substitute away from food, with the result that the per capita food consumption will fall. The direct effect of the scale economies on per capita food consumption will also tend to depress per capita food consumption.

Here, γ^* in is the key parameter; it is the elasticity of per capita food consumption with respect to the household size. Much of the focus of Deaton and Paxson is on the sign and magnitude of this parameter. In particular, when food has limited substitutes (ε_{ff} is small in absolute value), and when food has significantly less economies of scale than does housing (σ_f/σ_h is small), a general implication of the model is $\gamma^* > 0$, i.e., at constant PCE, food shares should increase with household size. Thus, for a larger household with constant PCE, the economies of scale in shelter increase effective income that the household may spend on other goods, including food. Therefore, the share of food consumption in total expenditure increases as long as it is a normal good.

In order to examine how γ^* changes with income level, consider the first partial derivatives of γ^* with respect to price elasticity ε_{ff} and income elasticity ε_{fx}:

$$\frac{\partial \gamma^*}{\partial \varepsilon_{fx}} = \sigma_h > 0$$
$$\frac{\partial \gamma^*}{\partial \varepsilon_{ff}} = \sigma_h - \sigma_f > 0 \qquad (2.5)$$

Two assumptions are necessary for the inequalities in (2.5) to hold: housing is not a pure private good ($\sigma_h > 0$), and housing is ``more public" than food ($\sigma_h > \sigma_f$). One expects the income elasticity of food consumption ε_{fx} to be larger in poorer households, and the price elasticity ε_{ff} to be smaller in absolute value in poorer households. For both reasons, the inequalities in (2.5) imply that γ^* should be larger for poorer households.

In summary, Deaton and Paxson show that the Barten model predicts: (1) at constant PCE, the food share will rise with household size, and (2) the positive effect of household size on the food share should be larger for poorer households.

The empirical evidence in the Deaton and Paxson article consists of a nonparametric representation of Engel curves for households of different sizes and compositions, and a parametric and semiparametric regression analysis. In particular, they estimate weighted averages of the expected food shares conditional on PCE:

$$\int E(w_f \mid i, z) g(z) dz \tag{2.6}$$

where w_f is the share of food consumption, i is an index describing the composition of household (e.g., 1 adult-0 kids, 2 adults-0 kids, etc.), z equals the log of per capita expenditure, and $g(z)$ is a nonparametric kernel estimate of the density.

The parametric regression is based on:

$$w_f = \alpha + \beta \ln \frac{x}{n} + \gamma \ln n + \sum_{k=1}^{K-1} \eta_k \frac{n_k}{n} + \varsigma V + \varepsilon \tag{2.7}$$

where x/n is per capita expenditure, n is household size, n_k/n is the ratio of household members who fall in one of the K groups defined by age and sex to household size, and V is a vector of control variables. Note that γ in Equation (2.7) differs slightly from the elasticity γ^* from the demand for food equation (2.3):

$\gamma^* = \gamma / w_f$.

The signs of γ^* and γ are the same and either of the two may be used to test only for direction of the effect of household size. Similar empirical specification can also be found in Lanjouw and Ravallion (1995).

Errors in w_f and $ln(x/n)$ are almost inevitably correlated, so instrumental variables are necessary to avoid possible bias. Deaton and Paxson argue for using household cash income as an instrument, since cash income is highly correlated with expenditure but is measured independently.

According to Deaton and Paxson, household consumption data from seven countries - United States, Great Britain, France, Taiwan, Thailand (urban and rural), Pakistan, and South Africa (only African households) reject both predictions of the model. Their nonparametric Engel curves suggest that larger households are associated with smaller food shares of total consumption. Their parametric and semi-parametric estimates of the coefficient on family size γ are smaller in value for households in poorer countries than in richer countries.

2.3 Tests of the Barten Model.

2.3.1 Data

Deaton and Paxson's empirical tests of the first prediction of the Barten model critically depend on the relative economies of scale in food and housing, while their tests of the second prediction rely on the assumption of same utility functions for households from different countries. Deaton and Paxson define housing as total expenditure other than food and assume that food is more private than everything else. The latter assumption is crucial for their argument. For two reasons, however, this condition may fail to hold for food and nonfood consumption. First, all nonfood consumption may contain goods that are more private than food, such as clothing and transportation. Second, food itself has a public component, arising from economies in food preparation. Also, since households in different countries may differ in their preferences and living arrangements, the elasticities of food consumption with respect to family size across different countries are not directly comparable.

For the purposes of this study, I select datasets from three countries that vary widely with respect to geographical location and household income level: the United States, South Africa, and Russia. Appendix A gives a concise description of the U.S.

Consumer Expenditure Survey (CEX) for 1990, the South Africa Integrated Household Survey for 1994, and the second phase of the Russia Longitudinal Monitoring Survey (RLMS) for 1994 - 1998. The first two datasets are the same data sets used by Deaton and Paxson, and the third provides additional evidence[1].

Appendix 1 describes our sample selection, the choice of controls for the regression analysis, and the average budget shares for the main categories of household consumption. One can notice several remarkable cross-country differences. In the U.S., consumers allocate an equal share of about 23% to each of these goods: food, shelter, and transportation. In the other two countries, the share of food is much higher: 68% in Russia and 55% in South Africa. The shares of shelter and transportation are relatively low for Russia and South Africa, under 11% for shelter and under 5% for transportation in both countries. The budget share for clothing is rather modest in all three countries in our sample, as it does not exceed 7%.

2.3.2 Nonparametric Engel Curves

The nonparametric Engel curves are smoothed regression lines of the share of food in total expenditures on log of PCE. Engel curves allow us to test the following inequality:

$$E\left(\frac{p_f f}{n} \mid i, \frac{x}{n}\right) > E\left(\frac{p_f f}{n} \mid j, \frac{x}{n}\right)$$

where *i*,*j* are households of different types; *n* is household size and *x* is total household expenditure. Since the budget share of food is also the ratio of per capita food expenditure to per capita total expenditure, it is equivalent to

[1] The U.S. CEX data can be downloaded from ftp://elsa.berkeley.edu/pub/ices. The South Africa data can be obtained from the World Bank at http://www.worldbank.org/html/prdph/lsms/country/za94/za94home.html. The Russia data can be found at http://www.cpc.unc.edu/projects/rlms/home.html.

$$E\left(w_f \mid i, \frac{x}{n}\right) > E\left(w_f \mid j, \frac{x}{n}\right) \tag{2.8}$$

The nonparametric regression of food share on the log of PCE, $z = ln(x/n)$, is constructed as follows. I choose an interval within which most of the z fall, and construct a 50-point equally spaced grid over this interval. For each point denoted z_m I calculate a weighted regression where *i*-th observation gets weight

$$\omega_{im} = \frac{1}{h} K\left(\frac{z_i - z_m}{h}\right) \quad i=1\ldots N;\ m=1\ldots 50$$

The bandwidth *h* is selected based on the number of observations and the standard deviation. The following kernel function is used:

$$K(t) = \frac{15}{16}\left(1 - t^2\right)^2 I\left(|t| \leq 1\right)$$

Figure 2.1 displays the resulting Engel curves for households with no children and one to four adults. The food share declines with PCE for each household type which is consistent with the view that food share becomes smaller as the household gets richer. What was not obvious is, holding PCE constant, how the food share changes with the size of the household. The smoothed regression lines sometimes cross and in general, the curves of one-adult households are above those for larger households for a large of log PCE.

2.3.3 Does the food share increase with household size?

Whether food share increases with household size depends on the relative economies of scale of food and other goods. At least one previous study estimates economies of household size for different types of consumption goods. Using data from the 1960/61 and 1972/73 CEX, Nelson (1988) calculates economies of scale for five categories of goods that make up an average 77 percent of the household budget. She finds that household economies in food are larger than those in clothing and in transportation, and roughly the same as those in household furnishing/operations, whereas by far the largest economies of scale are in shelter. Given Nelson's estimates, the composite good made out of all nonfood consumption may not satisfy $\sigma_h > \sigma_f$. Shelter alone is more public than food, and therefore satisfies the above requirement, while transportation and clothing are each more private than food, thereby satisfying the opposite condition. One way to test the predictions of the Barten model is to restrict our analysis to food and one of the other goods at a time: shelter, transportation, or clothing expenditures. By doing so, I have to assume that utility is separable with respect to the selected two goods, and that the household optimally allocates its expenditures between this bundle and everything else.

To illustrate the weak separability of the utility function, let us consider a three-good model, (q_1, q_2, q_3) with a total expenditure x. If the utility function can be written as $u(q_1, q_2, q_3) = u'(v_1(q_1, q_2), v_2 (q_3))$, then the groups (q_1, q_2) and (q_3) are separable. Now consider an allocation of (q_1*, q_2*, q_3*) from a one-step optimization of $u(q_1, q_2, q_3)$. Let x_3* be the associated expenditure on good 3. Given (q_3*, x_3*), separability means that the same (q_1*, q_2*), will be obtained if q_1* and q_2* are chosen optimally subject to the budget constraint $x\text{-}x_3*$. A demand function such as Equation (7) assumes that utility is separable. This is the familiar two-stage budgeting. See Deaton and Muellbauer (1980, chap.5) for a more detailed description.

Following Deaton and Paxson, I construct weighted-average food shares for households of different compositions, as in the non-parametric equation (2.6). Along with food share in total expenditures, I also estimate the share of food in food plus shelter only. The weighted averages and their standard errors are presented in Table 2.1.

Standard errors are obtained from a bootstrapping procedure that takes into account geographical clustering of the observations. Ignoring geographical clustering when bootstrapping will result in understating sampling variability (see, e.g., Deaton 1997, p. 60). All three surveys we work with have a clustered design. In Russian and South African data geographical identifiers are provided. In the U.S. CEX, we do not have information on geographical clustering but we know that each household may be surveyed up to four times during the year and so can contribute up to four observations. We bootstrap by drawing with replacement 500 random samples of *clusters* and using all households in each cluster selected. For each sample drawn, we estimate the Engel curves, densities of PCE, and averages in Table 2.1. In the United States, we bootstrap by drawing random samples of *households* and then using all observations on the selected households.

As one can see from Table 2.1, the food share in total expenditures decreases with household sizes as found by Deaton and Paxson. For example, for one-adult-only (1,0) family in the U.S. panel, the food share is .237, and it decreases to .230 as the number of adults in an adult-only family increases to 4. Similar patterns are repeated for South Africa and Russia. These results are inconsistent with the Barten model. However, the food share in only food plus shelter increases a majority of the time with household size. In a (1,0) family in the U.S. panel, the share is now .597, and increases to .615 for a 4-adult-only (4,0) family. For South Africa, the share for a (1,0) family is .807, but for a (4,0) family it increases to .844. For Russia, the share for a (1,0) family is .870, but for a (4,0) family it rises to .930, as is consistent with the Barten model. Note that all the differences discussed here are statistically significant.

These relationships are preserved when we estimate Equation (2.7) controlling for several family characteristics such as size, composition, time of the survey, geographical location, and the number of wage earners. The results are in show in Table 2.2. Three different food shares are used: food share in total expenditure in Column (1), food share in food and shelter in Column (2), and food share in food and transportation in Column (3)[2]. In Panel A for the United States, the share of food in total expenditures decreases with family size, similar to Deaton and Paxson's results. However, when the

[2] Transportation is one of the three largest expenditure categories in the US. One might think that the sharing of rides in a family car would make transportation a ``public'' expenditure, but Nelson (1988) found it to be more private than food. We believe that had Nelson's estimates been repeated using 1990 CEX data, she would have found transportation to be even more private than in 1972. Between those years, the number of vehicles per capita increased from 0.48 to 0.72, the number of vehicles per household increased from 1.16 to 1.77, and the average household size decreased from 3.16 to 2.56, all according to the U.S. Department of Energy's Transportation Energy Databook found at http://www-cta.ornl.gov/data/.

share of food in expenditure for food and housing alone is estimated, γ changes sign and become significantly positive. In the case of the food share in food and transportation, the γ estimate is significant and negative. This result is consistent with Nelson's finding that transportation is even more private than food.

The results also hold in Panel B for South Africa and in Panel C for Russia. Thus focusing on expenditures just on food and another good known to be more or less private than food, the results are consistent with the Barten model.

If one wishes to avoid the assumption of separability of the utility function, it is possible to combine food with other private goods, like clothing, into a composite good, thereby increasing the chances that such good is more private than the rest. Column (4) in Table 2.2 reports the regressions of the share of food and clothing in total expenditure. The estimates of γ in all three panels are positive. It appears that the resulting composite private good does not suffer from the inconsistency between the model and the data, and therefore may be a better measure of welfare than food only.

A potential source of bias is the non-separability of household consumption with leisure. The Barten model abstracts from the choice of labor hours and assumes that households take income as given, but perhaps travel to work and food consumption at work may affect the publicness of food and of transportation. In an attempt to correct for this possible bias, we include the logarithm of the average household work hours per adult into all regressions in Table 2.2. Despite a significant coefficient on the hours of work in these regressions (not reported here), other estimates, including γ, from these alternative specifications are very similar to ones reported in this chapter.

2.3.4 Treatment of the Owner-Occupied Housing

In the case of food and shelter, the measurement of housing consumption becomes an important issue. Housing expenditures for homeowners and renters are often very different. For example, a large portion of expenditure on shelter for homeowners is mortgage payments.

Households whose mortgage is paid off will show up with a value of zero for housing consumption, which is clearly inaccurate. We wish to test the robustness of our result against the potential measurement error associated with including both renters and homeowners into the sample, particularly the result in Column (2), so we consider two alternative specifications for the U.S. data[3]. The CEX offers another measure of expenditure, RENTEQVX, which is the rental equivalence of an owned home. One problem with the variable RENTEQVX is that it is top coded. In the 1990 CEX, all values higher than \$1,500 per month are coded as \$1,500. Among all 12,820 cases of owner-occupied households that have RENTEQVX, 6.49% are top-coded. The rent measure is also top-coded at \$1,000 per month.

In the first specification, we divide our sample into subsamples of renters and homeowners and run separate regressions for each subsample. The top-coded observations are deleted in the homeowners' subsample. The coefficient estimate of the log of family size is $\hat{\gamma}$ = 0.099 (10.2) with R^2 =.26 for the renters subsample, and $\hat{\gamma}$ = .083 (8.2) with R^2 = .12 for the homeowners' subsample. Thus, both estimates are positive and statistically significant.

The second specification adopts a more structural approach by making assumptions about the density function of ε in Equation (2.7). Let the right hand side of this equation be simplified as $Xb+\varepsilon$. Let f be food consumption and h^* be true shelter consumption. Then Equation (2.7) becomes:

$$w_f = \frac{f}{f + h^*} = Xb + \varepsilon \qquad (2.9)$$

For rented shelter, the true shelter consumption is the actual rent h^r, top-coded at $\bar{h}^r$. For owner-occupied shelter, h^* may be approximated by RENTEQVX, denoted as

[3] Among these three data sets, only the CEX for the U.S. carries information about rental equivalence and the actual mortgage payment. The housing consumption for South Africa is imputed by the data collectors. For Russia, the housing payments include utilities.

h^e, which is top-coded at $\bar{h}^e$. Let $\bar{h} = \bar{h}^r$ for renters, and $\bar{h} = \bar{h}^e$ for homeowners. Then $h^* > \bar{h}$ is equivalent to

$$\varepsilon \geq \frac{f}{f + \bar{h}} - Xb$$

Maximum likelihood method is used to obtain estimates. The likelihood function is given by:

$$\sum_{h_i^* < \bar{h}} \ln g\left(\frac{f_i}{f_i + h_i^*} - X_i b\right) + \sum_{h_i^* \geq \bar{h}} \ln\left[1 - G\left(\frac{f_i}{f_i + \bar{h}} - X_i b\right)\right] \qquad (2.10)$$

where g and G are the probability density function and cumulative distribution function of ε.

In Table 2.3, we consider three variations. First, we let ε be normally distributed. Second, we take the logarithm of the food share and let ε be normally distributed. And last, we consider another variation of (2.9) in which:

$$\frac{f}{f + h^*} = \frac{\exp(Xb + \varepsilon)}{1 + \exp(Xb + \varepsilon)} \qquad (2.11)$$

where $\varepsilon \sim N(0, \sigma^2)$. Such specification preserves the signs of the relationship between the food share and the variables in X. In this case, the marginal effect is

$$\frac{\partial w_f}{\partial X} = b(1 - w_f)w_f$$

This specification has the advantage that the predicted the food share always falls into the interval (0,1). The specification in (2.11) is in essence ``logit-transformation." To control for the possible difference between actual rents and the rental-equivalent of an owned home, I include a dummy variable identifying owner-occupied residences. Estimates for the key estimated coefficients are reported in Table 2.3. In all three specifications, estimates of γ are positive and significant - which is consistent with the Barten model.

2.3.5 Evidence of Economies of Scale in Food Preparation

If the time and effort required to prepare a meal rises less than proportionally with the number of people served the meal, then the per capita cost of a home-cooked meal will be lower for larger households. The per capita cost of restaurant meals and other types of food eaten away from home, in contrast, does not decline with family size. Therefore, larger households should be willing to substitute toward relatively cheaper home-prepared meals. In that case, the share of food expenditure away from home in total expenditures should decrease with household size, i.e., γ should be negative for this particular component of food expenditure. Results in Deaton and Paxson's paper suggest that a significant drop in expenditures on food eaten out indeed takes place as we move from single-adult households to larger households; however, adding an extra person to households with more than one adult does not result in any shift away from food eaten out to home prepared food. Hence, Deaton and Paxson do not believe economies in food preparation time can solve the inconsistency between the Barten model and the data.

These results of Deaton and Paxson, however, are not robust to changes in estimation method and to the changes in the dependent variable. Column (1) and (2) of Table 2.4 illustrates the point that while OLS produces positive and borderline significant effect on family size, instrumental variable regressions produce a borderline significant negative coefficient. In addition, I make a minor change in food away from home: I treat expenditure on alcohol consumed away from home as part of food expenditures. The reason for this is that alcohol provides calories and can be consumed as a substitute to food[4]. In the 1990 CEX, the average consumption for food away from home was $301.5 per quarter, and the average consumption on alcohol away from home

[4] According to the U.S. Department of Agriculture, Agricultural Research Service (1999), USDA Nutrient Database for Standard Reference, Release 13, Nutrient Data Laboratory Home Page, http://www.nal.usda.gov/fnic/foodcomp: a 12 oz. bottle/can of regular beer contains 146 calories, which is the same as one baked potato (145 calories); 12 oz of red table wine have 255 calories, or more than a slice of pizza (184 calories). According to the National Institute on Alcohol Abuse and Alcoholism (http://silk.nih.gov/silk/niaaa1/database/qf.htm), 88% of the total volume of alcohol consumed in 1994 was beer, 7% was wine and the remaining 5% was spirits.

was \$34.6 per quarter, or 10% of all meals eaten out. In the data sets for Russia and South Africa, we cannot distinguish alcohol consumed away from home from alcohol consumed at home.

Column (3) and Column (4) report the results for food and alcohol away from home as a share of total expenditure. The OLS estimates of γ are not significantly different from zero, but instrumental variable estimates become negative and significant. This result suggests that larger households tend to reduce their expenses on food and alcohol away from home, in sharp contrast with the result for the Deaton and Paxson approach replicated in Column (1). Thus the economies of scale in food preparation can be larger than suggested by simple OLS estimation.

So far I have shown that the food share increases with family size relative to goods more public than food, such as housing. This observation does not necessarily conflict with Engel's Law, since all it implies is that the share for housing decreases faster than the share for food when an extra person is added to the household. I have also shown that food may contain a significant public component due to economies in food preparation. Having discussed the reasons why $\gamma<0$ for the food share in total expenditure, I focus next on the other prediction of the Barten model.

2.3.6 Is the elasticity of food share with respect to household size smaller for poorer households?

Barten's model predicts that, at constant PCE, γ should be larger for poorer households. In contrast, Deaton and Paxson estimate that this parameter is generally smaller in value for households from poorer countries. For example, it is smaller than -.05 for Thailand, Pakistan, and South Africa, but larger than -.008 for both the United States and the United Kingdom.

If the Barten model is to be tested from estimating (2.7) using a cross-section, it requires that all observations have the same utility function. That assumption may be difficult enough to swallow when the data are from a cross-section of households, but it is even more troublesome when the data are a cross-section of different countries. Therefore, instead of interpreting the Barten model to say that the effect of household size on food share should be larger for poor countries, I interpret it to say that the effect of household size on food share should be larger for poor households within the same country. I divide each country's sample by per capita expenditure quartile and compare the coefficients across different quartiles within the same country.

I estimate (2.7) with $ln(w_f)$ as the dependent variable in order to obtain the value of interest, γ^* in (2.3), that is the elasticity of per capita food consumption with respect to household size. When the only concern is the sign of γ^*, either specification will work. However, when the value of this parameter is our primary interest, the log of food share as the dependent variable is a more appropriate specification.

The estimation results for all three countries are in Table 2.5. In Panel A, using the U.S. data, the poorest two quartiles have larger coefficients than the richest quartiles. This is consistent with the Barten model. In Panel B, using South Africa, the coefficient γ^* decreases as households become richer, as predicted, except in the richest quartile where the estimate is not statistically significant. In Panel C, using Russian data, γ^* decreases as households become richer. I conclude that the prediction of the Barten model is consistent with the data in each country.

Although the elasticity of food share with respect to family size decreases as households become richer within each country, the patterns are not the same across countries. The United States has the largest coefficients (between .150 and .217), followed by Russia (between .014 and .111), while South Africa has the smallest coefficients (between -.068 and .021). This result is consistent with the findings of Deaton and Paxson, where the richer countries have larger values of γ^*. In other words, the predictions of the Barten model are violated when one looks across countries, where we believe the assumption of identical utility function is least appropriate, but they are supported when one looks across households within the same country.

2.4 Conclusions

This chapter studies an a paradox arising from an inconsistency between the model and the data in Deaton and Paxson (1998): The Barten model of economies in household size predicts that food share should increase with household size when per capita expenditure is held constant, while empirical evidence supports the opposite. This inconsistency is important since it casts doubt on the well-established practice of using food share as a measure of well-being across different income groups. In general, it also raises questions about how to understand the economies of scale within a household and how to measure individual welfare in households that have different compositions.

Since the inconsistency may result simply from the invalidity of the two-good model, I suggest a test of the model that follows precisely the assumption of the Barten. Two predictions of the model are tested: (1) the share of the good that is more private relative to the other good should increase with family size; and, (2) the elasticity of food share with respect to household size should be larger in value for poorer households.

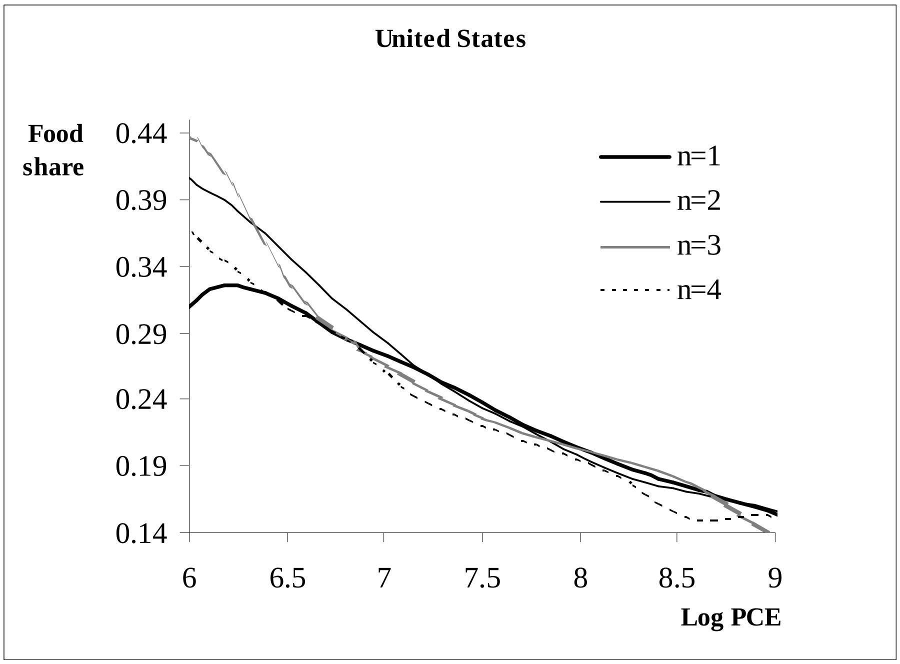
With regard to the first prediction, I examine food share in food and the other good known to be more public than food (i.e., housing). When I do so, we find that the food share indeed increases with family size. When I analyze food share in food and a good known to be more private than food, the food share decreases with family size, as predicted by the Barten model. A composite good that combines food and clothing increases the chances that the composite good is more private than everything else. This combined good may therefore be a better measure of welfare than food alone. There is evidence that “food consumed away from home" decreases with family size, supporting the proposition that meals at home contain a public component.

The inconsistency concerning the second prediction of the Barten model is resolved in separate regressions for households from different income groups within the same country. Comparisons among different countries are not appropriate because the utility functions are not the same across countries with very different socioeconomic status and living arrangements.

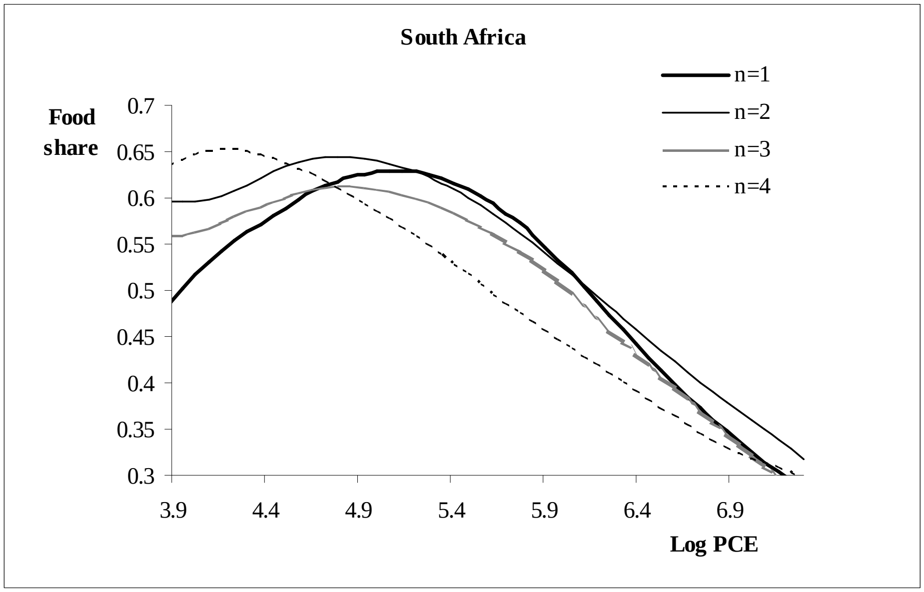
This chapter sheds some light on the food consumption puzzle but it does not resolve it. Utility maximizing households choose to reduce their expenditure on food as household size grows and per capita income stays the same. This study points to possibly large economies in food preparation time. An in interesting subject for future research would be to model the economies in food preparation time directly and examine whether economies in time can explain the behavior of households of different sizes with regard to food expenditure. In particular, it would be challenging to come up with a utility theoretic model in which households optimally reduce their expenditures on food in response to higher economies of scale in food or in another good.

Figure 2.1 Nonparametric Engel Curves for Households with No Children and Differing Number of Adults. US, South Africa and Russia

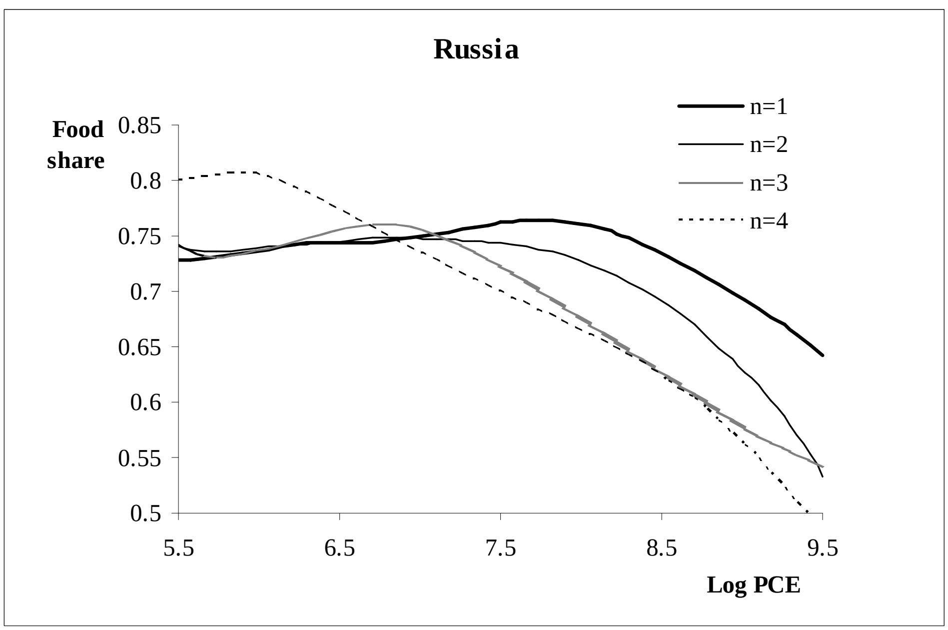
a). United States



b). South Africa



c) Russia



Note.- The bandwidth for the United States is 0.5, for South Africa and Russia the bandwidth is 1.

Table 2.1 Food Shares: Average for Each Type of Household (Weighted by Density of PCE)

(Adults, Children)	United States: In Total Expenditure	United States: In Food and Shelter	South Africa: In Total Expenditure	South Africa: In Food and Shelter	Russia: In Total Expenditure	Russia: In Food and Shelter
(1, 0)	0.237	0.597	0.618	0.807	0.752	0.87
	(0.009)	(0.020)	(0.037)	(0.025)	(0.018)	(0.015)
(2, 0)	0.24	0.621	0.618	0.864	0.731	0.903
	(0.007)	(0.016)	(0.035)	(0.016)	(0.015)	(0.010)
(3, 0)	0.237	0.625	0.587	0.872	0.703	0.916
	(0.012)	(0.030)	(0.036)	(0.024)	(0.021)	(0.012)
(4, 0)	0.23	0.615	0.568	0.844	0.691	0.93
	(0.021)	(0.048)	(0.037)	(0.033)	(0.043)	(0.022)
(1, 1)	0.23	0.512	0.665	0.883	0.673	0.916
	(0.019)	(0.040)	(0.052)	(0.023)	(0.044)	(0.022)
(2, 2)	0.221	0.513	0.622	0.868	0.644	0.926
	(0.008)	(0.017)	(0.032)	(0.016)	(0.020)	(0.011)
(1, 2)	0.243	0.515	0.642	0.891	0.666	0.924
	(0.024)	(0.041)	(0.031)	(0.072)	(0.072)	(0.029)
(2, 4)	0.23	0.552	0.577	0.862	…*	…
	(0.027)	(0.062)	(0.038)	(0.029)	…	…

Note.—Shares are weighted averages of the expected food shares conditional on different levels of PCE, $\int E(w_f \mid i, z) g(z) dz$, with weights (density) given by the kernel estimate of the density of the total PCE. The weights are common across household types so PCE is held constant as one moves down each column. Standard errors (in parentheses) are bootstrapped using procedure described in the chapter. The bandwidth used for the regressions is 0.5 in the U.S. data and 1 in South Africa and Russia.

* Not enough observations to obtain estimates.

Table 2.2 Food Share Regressions

	Food in Total Expenditure (1)	Food in Food and Shelter (2)	Food in Food and Transportation (3)	Food and Clothing in Total Expenditure (4)
A. United States (CEX), 1990 (Instrumental Variable Regressions)				
ln(family size)	-0.009	0.084	-0.054	0.017
	(-5.0)	(19.8)	(-13.6)	(7.7)
ln(PCE)	-0.075	-0.095	-0.079	-0.045
	(-59.1)	(-16.9)	(-14.8)	(-17.0)
R-squared	0.23	0.11	0.14	0.095
B. South Africa, 1994 (Instrumental Variable Regressions)				
ln(family size)	-0.038	0.004	-0.019	0.016
	(-7.0)	(1.6)	(-7.3)	(2.2)
ln(PCE)	-0.091	-0.064	-0.033	-0.061
	(-20.1)	(-11.0)	(-8.6)	(-10.8)
R-squared	0.32	0.13	0.27	0.29
C. Russia, 1994–98 (Instrumental Variable Regressions)				
ln(family size)	-0.005	0.014	-0.007	0.022
	(-1.9)	(4.9)	(-3.0)	(4.5)
ln(PCE)	-0.063	0.016	-0.019	-0.016
	(-31.0)	(6.4)	(-10.9)	(-6.4)
R-squared	0.21	0.05	0.09	0.12

Note.—Col. 1 is OLS regression replicated from Deaton and Paxson’s article. Cols. 3–4 are instrumental variable regressions with log of per capita after-tax income as an instrument for total PCE.
t-values are in parentheses.

Table 2.3 Maximum Likelihood Estimates for Food Share in Food and Housing, U.S.CEX, 1990

	Normal	Lognormal	Logit Transformation
ln(family size)	0.084	0.25	0.085
	(20.0)	(24.8)	(20.8)
ln(PCE)	0.03	0.087	0.024
	(10.0)	(13.9)	(8.6)
Owned shelter	0.79	0.18	0.096
	(22.7)	(19.5)	(26.7)
Variance:			
If rent	0.14	0.42	0.16
	(171.0)	(201.0)	(123.0)
If own	0.16	0.43	0.2
	(121.0)	(127.0)	(94.7)

Note.— Housing is defined as actual rents and rental equivalent.
t-values in parentheses

Table 2.4 Regressions of Food Away from Home as a Share of Total Expenditures

	Food Away from Home		Food and Alcohol Away from Home	
	OLS	Instrumental Variable*	OLS	Instrumental Variable
	1	2	3	4
ln(family size)	0.003	-0.003	-0.001	-0.007
	(1.9)	(-1.8)	(-0.7)	(-4.2)
ln(PCE)	0.016	0.017	0.017	0.018
	(20.9)	(12.2)	(19.8)	(12.0)
R-squared	0.08	0.06	0.09	0.08

Note.—All regressions exclude one-adult households.

t-values in parentheses

* The instrumental variable is the log of per capita after-tax income

Table 2.5 Regressions for the Log of the Food Share in Food and Shelter By PCE Quartile

	Smallest	Second	Third	Biggest
A. United States				
ln(family size)	0.191	0.217	0.15	0.157
	(10.9)	(12.4)	(8.4)	(7.4)
ln(PCE)	0.329	-2.05	0.076	-0.321
	(2.9)	(-3.40)	(3.4)	(-3.86)
R-squared	0.073	0.091	0.065	0.036
B. South Africa				
ln(family size)	0.021	-0.017	-0.068	-0.014
	(1.9)	(-1.64)	(-5.02)	-(0.6)
ln(PCE)	0.054	-1.45	-8.49	-0.511
	(1.4)	(-4.52)	(-5.39)	(-3.15)
R-squared	0.107	0.094	0.085	0.082
C. Russia				
ln(family size)	0.111	0.107	0.052	0.014
	(7.5)	(8.5)	(4.6)	(1.3)
ln(PCE)	0.161	0.713	0.925	0.156
	(4.7)	(2.4)	(3.0)	(3.2)
R-squared	0.151	0.089	0.079	0.076

Note. - Instrumental variable estimates with log per capita income as instrument for PCE

Chapter 3

Food Expenditure, Food Preparation Time and Household Economies of Scale

3.1 Introduction

Economists have long been interested in comparing welfare between households with different compositions, both for measuring total welfare and for measuring the incidence of poverty. There are many economies of scale to living in a larger household, including shared housing, appliance use, and childcare. Along with sharing expenses, individuals from larger households enjoy a considerable time advantage over their single counterparts. A household with two or more adults can specialize labor within and outside of the home, with household members taking on different responsibilities for market work, housework, and childcare. Because home production is a substitute for goods purchased on the market, households make decisions about expenditures and time use simultaneously. Understanding how changes in family size influence decisions regarding food will improve our understanding of the household's overall well-being and will contribute to explaining individuals' labor market decisions.

However, most studies have focused on economies in sharing expenses and have not addressed time inputs to home production. Lazear and Michael (1977, 1980) estimate that the expenditures of two adults living together are 31-35% lower than a single-adult household using the U.S. Consumer Expenditure Survey (CES), with the largest savings in food and shelter expenditure and smaller savings in personal care.

Deaton and Paxson (1998) present evidence of economies of scale in food consumption from a number of developed and developing countries.

The observed economies of scale in food expenditures are particularly interesting and somewhat puzzling. Food itself is a private good which can not be shared, but there likely to be a substantial public component in preparing meals. Models that do not include time costs predict that at a constant per capita expenditure larger households save on public goods like housing and increase per-person expenditures on private goods like food. However, empirical evidence shows the opposite for both modern households and those observed a century ago by Engel. Per capita food expenditures fall as households grow.

This seeming paradox was introduced by Deaton (1980) and extended by Deaton and Paxson (1998). Several subsequent studies have attempted to resolve it in a variety of ways. Gibson (2002) suggests that large estimates of economies in size may be due to a measurement error in recall expenditure data. Gan and Vernon (2003) show that food expenditures increase relative to another more sharable good and decrease relatively to a less sharable good, and therefore that the paradox disappears when subsets of expenditures are examined. Although recent papers shed new light on the nature of household economies, the puzzle remains unresolved: Why do utility maximizing households respond to an increase in size by reducing per-capita food expenditure? It seems rather unlikely that larger households choose to forego part of their meals in exchange for other goods or perhaps even for the pleasure of being a part of a larger household.

This chapter explains the puzzle in a novel way, merging current research in food consumption with time use research. I show that lower per capita food expenditure becomes an optimal decision for larger households who allocate money and time simultaneously. If preparation time and purchased ingredients are to some extent substitutes, an increase in household size changes the relative price of food ingredients and time, creating an incentive to reallocate resources within a household. I model this decision within a household production framework. Purchased food is combined with time inputs to produce meals. A meal can be produced using more market inputs (such as more processed or semi-prepared food and eating out) or more time inputs (such as cooking at home, spending time shopping for better deals, buying food in season and conserving it for later use, and growing food in kitchen gardens). As the relative price of time falls and ingredients become more expensive, individuals will substitute where possible away from market expenditures towards home production. As a result, larger households may increase their food consumption while optimally choosing a more time-intensive production technology of meals, so that observable per-capita expenditure on food actually falls.

Deaton and Paxson (1998) question the existence of economies of scale in time and argue that such economies would intensify rather than resolve the food puzzle. They claim that economies of scale in time would make food relatively cheaper for larger households, and that food consumption should therefore increase, not decrease. This would be true if time and ingredients were complements instead of substitutes, in which case a relatively cheaper value of time would increase the demand for both time and ingredients. I maintain and prove that food consumption stays the same or increases, but that food expenditures go down.

Cutler et al. (2003) describe the general trend in food consumption in the U.S. Since 1970, technological innovations in the mass preparation of food have reduced the time Americans spend on cooking and cleaning. At the same time, food consumption, the frequency of consumption, the consumption of food in each group, and the variety of foods consumed by Americans have all increased.

According to the BLS, in 2002 the average U.S. household spent over 14%[5] of its total expenditures, or just over $140 per week, on food and alcohol. In addition to the money spent on food, Gronau and Hamermesh (2003) show that Americans spend a nontrivial amount of our precious time in preparing meals and eating. The average married couple in the U.S. spends 145 hours/month (33.7 hours/week) buying food,

[5] Alcohol accounts for 0.8% of average expenditures, or $441 per year, other food is 13.1%, or $6,881 per year. See Bureau of Labor Statistics at ftp://ftp.bls.gov/pub/special.requests/ce/share/2002/cucomp.txt

cooking and consuming meals. That translates to 4.8 hours a day, or, assuming sleep takes 8 out of 24 hours per day, about 15% of each individual's total waking time. At an hourly wage rate of $10, the opportunity cost of preparing meals for a couple is thus $337 per week, and at a wage rate equal to $30, the cost of time is over $1,000. The value of the time inputs to food production in the home dwarf the cost of market inputs. Even if eating itself includes a leisure component (such as enjoyment of time spent together over dinner), a substantial amount of the total time is spent on food preparation. It seems reasonable that larger households would try to take advantage of possible economies of scale in time.

Gronau and Hamermesh (2003) also look at the relative good- and time-intensities of nine commodities that comprise everything households produce/consume at home (sleep, lodging, appearance, eating, childcare, leisure, health, travel, miscellaneous). Data on married couples aged 20-70 from the U.S. and Israel show that eating is relatively goods-intensive. Eating time declines with schooling, while food expenditures and the goods-intensity of food increase. The goods-intensity of eating has an inverse U-shaped relationship with age, reaching its maximum for middle aged couples ages 45-54 and dropping sharply at retirement age household. In this chapter, I use a very different data set but arrive at a similar conclusion: a higher hourly wage increases the goods-intensity of food consumption.

Aguiar and Hurst (2004) report evidence that households adjust food expenditure and time use in response to exogenous factors. They find that the dramatic (17%) decline in expenditures at the time of retirement is matched by an equally dramatic (53%) increase in time spent shopping and preparing food. Despite a decline in food expenditures, neither the quality nor the quantity of food intake deteriorates with retirement status. This indicates that market expenditure may be a poor proxy for consumption.

Using household expenditure and time-use survey data from Russia for the years 1994-98, I use a spline regression to estimate the effect of changing household size on food expenditures. The estimates indicate that doubling the size of household reduces per capita food expenditure by over 30% and per capita preparation time by about 75% in households with two and more people. A single man spends 217% less time preparing food than a man from a two-person household. Women enjoy a modest time saving of 45% for a similar transition, all else equal. A married woman enjoys no time savings, while a woman with children spends more time in food-related activities than her single counterpart. Wages and non-labor income also affect expenditure and time allocation in a predictable way. I also find that the time intensity of meals increases with household size, but that the quality of meals is unaffected by changes in household size.

This chapter is organized as follows. Section 3.2 presents a theoretical model and comparative statics results. Section 3.3 describes the data set. In Section 3.4 outlines the methodology and tests the model's predictions using data on household expenditures and time allocations. Section 3.5 concludes and discusses possible extensions of the research.

3.2 Model and Comparative Statics

3.2.1 Theoretical Model

Suppose a household is composed of *n* identical individuals who derive utility from consuming two goods, food and nonfood commodities. Let z_1 and z_2 be total household consumption of each good. Commodity-specific household economies are modeled as a function of family size. In the presence of consumption economies, each individual consumes more than z_i/n share of each commodity. The household maximizes total utility:

$$\text{Max} \quad n * u\left(\frac{z_1}{\phi_1(n)}, \quad \frac{z_2}{\phi_2(n)}\right) \tag{3.1}$$

The scale of consumption economies is equal to

$$\phi_i(n) = n^{1-\sigma_i} \qquad i=1,2 \tag{3.2}$$

Here $0 \le \sigma_i \le 1$ is the scale elasticity of the i^{th} commodity within household.

If $\sigma_i = 0$, then $\phi_i = n$, implying that the good is a private good that cannot be shared and must be replicated if all family members are to enjoy the good to the same degree as a single individual.

If $\sigma_i = 1$, then $\phi_i = 1$ and the good is a pure public good that can enjoyed by any and all members of the family without diminishing the enjoyment of others in the household.

The scale elasticity is derived by taking logs of both sides of (3.2) and differentiating:

$$\ln \phi_i = (1 - \sigma_i) \ln n$$

$$\sigma_i = 1 - \frac{\partial \ln \phi_i(n)}{\partial \ln n} \qquad (3.3)$$

Along with consumption economies, there are economies in production of each commodity. The commodities are produced by households out of market-purchased inputs and preparation time:

$$z_i = n f_i \left(\frac{x_i}{\psi_{1i}(n)}, \frac{t_i}{\psi_{2i}(n)} \right) \qquad i=1,2 \qquad (3.4)$$

where x and t are total household inputs of ingredients and time. Time and market inputs are imperfect substitutes. The function $f_i(x_i,t_i)$ describes a constant returns to scale production technology for a one-person household. Production technologies do not vary between households of different sizes, but in the presence of production economies there are increasing returns to household size. Thus, households with two or more persons can produce the same per-capita output of food with less per-capita inputs of market goods and time than would be possible for a single person.

The input-specific production economies are modeled similarly to consumption economies. Let $0 \le \gamma_{ji} \le 1$, $i, j = 1,2$ be the four parameters of the economies in market goods and time, so that

$$\psi_{ji}(n) = n^{1-\gamma_{ji}} \qquad i, j=1,2$$

Economies in purchased food ingredients are measured by the scale parameter γ_{11}. Such economies may arise if larger households buy fewer per-capita ingredients to produce the same number of meals as smaller households. This could occur if larger families waste a lower share of their purchased inputs, buy in bulk and pay less per unit, or substitute home-produced meals for more expensive restaurant meals.

Economies of scale in food preparation time are measured by γ_{21}. If there are no economies of scale in time, then the time inputs required for food preparation for each additional household member are the same as those required for a single person. In terms of the parameters, this implies $\gamma_{21}= 0$ and $\psi_{21}(n) = n$. On the other hand, full economies of scale in food preparation time exist when the time it takes to prepare a meal for *n* household members is the same as that needed to cook for one person. In that case, $\gamma_{21}=1$ and $\psi_{21}(n) = 1$.

Non-food economies in market input, γ_{12} , are possible due to sharing costs for housing, appliances, etc. Non-food economies in time, γ_{22} , come from within-household specialization in running errands, childcare, etc.

The marginal rate of technical substitution between market ingredients and the time inputs to production of each commodity depends on the relative economies of scale:

$$MRTS_i = -\frac{dx_i}{dt_i} = \frac{\dfrac{\partial f_i}{\partial t_i}}{\dfrac{\partial f_i}{\partial x_i}} \frac{\psi_{1i}}{\psi_{2i}} \quad i=1,2 \qquad (3.5)$$

In food production, this MRTS implies that in order to maintain the same level of food-output, a household with more than one adult increases time inputs less when decreasing market inputs by one unit than a single person household would.

Total household time endowment T is allocated between market work l and the production of both commodities:

$$T = l + t_1 + t_2$$

If time t_i and l are measured in hours per week, T is the total number of weekly hours available for market work, food preparation and other activities.

Finally, there is a budget constraint. Assuming market wage rate w and non-labor income V, total household income I is spent on market purchased inputs into food and non-food commodities:

$$p_1 x_1 + p_2 x_2 = wl + V = I$$

where p_1 and p_2 are prices of the market inputs.

The time and money constraints are combined into a full income constraint:

$$p_1 x_1 + p_2 x_2 + wt_1 + wt_2 = wT + V = I \qquad (3.6)$$

The household problem is to maximize the utility function (3.1) subject to the production functions (3.4) and the full income constraint (3.6). I simplify the problem by making it look like the decision facing a single-person household. These new variables are indicated with asterisks. They may be interpreted as the "effective" quantities and prices for household size n:

$$z_i^* = \frac{z_i}{\phi_i} \qquad x_i^* = \frac{x_i n}{\phi_i \psi_{1i}} \qquad t_i^* = \frac{t_i n}{\phi_i \psi_{2i}}$$

$$p_i^* = \frac{p_i \phi_i \psi_{1i}}{n} \qquad w_i^* = \frac{w \phi_i \psi_{2i}}{n} \qquad i = 1,2$$

The "effective" prices p_i reflect household savings from sharing, as higher economies of scale in a particular input means lower "effective" price per unit of the input. Time has a different "effective" price in each activity, w_i , because economies of scale in time use are different for food and non-food commodities.

The problem becomes:

$$\text{Max} \quad n * u\left(z_1^*,\ \ z_2^*\right) \qquad \text{s.t.}$$

$$z_i^* = f_i\left(x_i^*, t_i^*\right) \qquad i=1,2 \tag{3.7}$$

$$p_1^* x_1^* + p_2^* x_2^* + w_1^* t_1^* + w_2^* t_2^* = I$$

Taking derivatives with respect to x_1, x_2 , t_1 t_2 provides the following first-order conditions:

$$\frac{\frac{\partial f_i}{\partial x_i^*}}{\frac{\partial f_i}{\partial t_i^*}} = \frac{p_i^*}{w_i^*} \qquad i=1,2 \tag{3.8}$$

$$\frac{\frac{\partial u}{\partial z_1^*}}{\frac{\partial u}{\partial z_2^*}} = \frac{p_1^*}{p_2^*} \frac{\frac{\partial f_2}{\partial x_2^*}}{\frac{\partial f_1}{\partial x_1^*}} = \frac{w_1^*}{w_2^*} \frac{\frac{\partial f_2}{\partial t_2^*}}{\frac{\partial f_1}{\partial t_1^*}} \tag{3.9}$$

The first condition requires that the marginal rate of technical substitution between goods and time in production of any commodity is equal to the cost of converting time into goods. The second condition guides the allocation of resources between food and nonfood. The ratio of marginal utilities for food and nonfood commodities should equal their relative prices. Each household selects a combination of effective market and time inputs that minimizes the cost of producing commodities.

The solution of the problem is given by four demand functions:

$$x_i * = g_{x_i}(p_1^*, p_2^*, w_1^*, w_2^*, I^*) \qquad i=1,2$$

$$t_i * = g_{t_i}(p_1^*, p_2^*, w_1^*, w_2^*, I^*) \qquad i=1,2$$

The next step is to examine how household size, wages and non-labor income affect the demand for market and time inputs by deriving the corresponding elasticities of demand. Using zero-degree homogeneity of demand functions and switching back from "effective" to actual quantities, I expand the per-capita demand functions for both inputs:

$$\frac{x_i}{n} = \frac{\phi_i(n)\psi_{1i}(n)}{n^2} g_{x_i}\left(\frac{p_1\phi_1(n)\psi_{11}(n)}{n^2}, \frac{p_2\phi_2(n)\psi_{12}(n)}{n^2}, \frac{w\phi_1(n)\psi_{21}(n)}{n^2}, \frac{w\phi_2(n)\psi_{22}(n)}{n^2}, \frac{I}{n}\right)$$

$$\frac{t_i}{n} = \frac{\varphi_i(n)\psi_{2i}(n)}{n^2} g_{t_i}\left(\frac{p_1\varphi_1(n)\psi_{11}(n)}{n^2}, \frac{p_2\varphi_2(n)\psi_{12}(n)}{n^2}, \frac{w\varphi_1(n)\psi_{21}(n)}{n^2}, \frac{w\varphi_2(n)\psi_{22}(n)}{n^2}, \frac{I}{n}\right)$$

The problem is symmetric with respect to food and non-food goods because the general form of the demand functions is identical. The following results are for the demand for food, but are analogous to those for non-food goods. Taking logs, the demand functions become:

$$\ln\frac{x_1}{n} = ln\phi_1(n) + ln\,\psi_{11}(n) - 2ln\,n + \ln g_{x_1}(\bullet) \tag{3.10}$$

$$\ln\frac{t_1}{n} = \ln\phi_1(n) + \ln\psi_{21}(n) - 2\ln n + \ln g_{t_1}(\bullet) \tag{3.11}$$

3.2.2 Elasticity of Per-capita Food Expenditures with Respect to Household Size

Totally differentiating (3.10) with respect to ln *n*, I derive the elasticity of demand for market inputs with respect to household size, as follows. The derivation is explained in detail in Appendix 2.

$$\varepsilon_{x_1 n} = -(\sigma_1 + \gamma_{11})(1 + \varepsilon_{x_1 p_1}) - (\sigma_2 + \gamma_{12})\varepsilon_{x_1 p_2} - (\sigma_1 + \gamma_{21})\varepsilon_{x_1 w_1} - (\sigma_2 + \gamma_{22})\varepsilon_{x_1 w_2} - \varepsilon_{x_1 I} \tag{3.12}$$

The five components of the above expression reflect five different channels through which household size affects the demand for purchased food inputs. Of interest is how each component of this expression influences the elasticity $\varepsilon_{x_1 n}$.

First, if food is a necessity, then its own price elasticity is $\varepsilon_{x_1 p_1} \in [-1,0]$. The first component is therefore the product of two non-negative numbers. The per-capita demand for market inputs is more likely to decrease with household size when economies in market ingredients are high and the own price elasticity of food is low in absolute value.

The second term indicates that $\varepsilon_{x_1 n}$ is more likely to be negative the more substitutable are food and non-food and the higher are economies of scale in non-food market inputs.

The third term is negative, since a higher price of time spent in food preparation induces substitution towards more good-intensive food production. The higher price of time needed for food production may also induce some substitution away from food, but that effect should be small.

The fourth term is positive. A higher price of time in non-food may result in substitution towards good-intensive production of both goods and may also induce substitution towards food. Since it is subtracted, this represents another negative net effect of household size on the demand for food ingredients. Finally, the fifth term, the income elasticity of demand for market food goods, is also positive, contributing a negative effect to the overall elasticity of food expenditure with respect to household size.

At a constant per-capita full income and price of time, the elasticity of demand for market inputs into food production with respect to household size is described by the first two components of (3.12):

$$\alpha_1 = -(\sigma_1 + \gamma_{11})(1 + \varepsilon_{x_1 p_1}) - (\sigma_2 + \gamma_{12})\varepsilon_{x_1 p_2}$$

The empirical estimate of α_1 is in the center of Deaton and Paxson's paradox. Using a model which does not consider time inputs, Deaton and Paxson argue that α_1 should be positive because economies in food are close to zero (in the context of this model, $\sigma_1+\gamma_{11}=0$), and the income effect dominates, implying that market purchased food and non-food inputs are complements, or $\varepsilon_{x_1 p_2} < 0$. In their model, a lower effective price of shared goods leads to higher per-capita consumption of food. The production model explains why this may not occur when there is the possibility of economies of scale in preparation time.

Note that α_1 does not directly measure economies of scale in food-inputs. The scale of economies is assumed to be $\sigma_1+\gamma_{11}$. Instead, what the elasticity of demand for inputs with respect to household size represents is a typical household's percentage-point re-allocation of per-capita food expenditures if the household size were to be doubled holding wages and non-labor income constant. Because market inputs are substitutes in a household's budget, and the own price elasticity of food is less than unity in absolute value, α_1 is expected to be negative.

3.2.3 Elasticity of Per-capita Food Preparation Time with Respect to Household Size

The elasticity of per-capita food preparation time with respect to household size is derived in Appendix 2 in a similar fashion:

$$\varepsilon_{t_1 n} = -(\sigma_1 + \gamma_{21})(1 + \varepsilon_{t_1 p_1}) - (\sigma_2 + \gamma_{12})\varepsilon_{t_1 p_2} - (\sigma_1 + \gamma_{21})\varepsilon_{t_1 w_1} - (\sigma_2 + \gamma_{22})\varepsilon_{t_1 w_2} - \varepsilon_{t_1 I} \quad (3.13)$$

The expression has five components. In the first term, the elasticity of time-demand with respect to the price of the market inputs should be positive, even though a higher price of food may also induce some small substitution away from food. With the negative sign, this component should have a negative effect on $\varepsilon_{t_1 n}$.

In the second term, the sign of the elasticity of demand for food preparation time with respect to the price of nonfood is ambiguous. On the one hand, a relatively more expensive price for nonfood goods results in substitution towards food and towards more time-intensive meals. On the other hand, higher market prices of nonfood goods lead to more time-intensive production of nonfood and perhaps away from food preparation time. In the third term, the time-price elasticity must be negative. The third effect, therefore, works in the opposite direction, as it affects $\varepsilon_{t_1 n}$ positively. In the fourth term, a higher price of time in nonfood implies substitution to more good-intensive production of nonfood, but the effect on time in food is ambiguous since substitution towards more food preparation time is also possible. In the fifth term,, higher income should increase the demand for market ingredients relative to time, contributing a positive effect on $\varepsilon_{t_1 n}$.

At constant income and wages, the time demand elasticity with respect to household size becomes:

$$\beta_1 = -(\sigma_1 + \gamma_{21})(1 + \varepsilon_{t_1 p_1}) - (\sigma_2 + \gamma_{12})\varepsilon_{t_1 p_2}$$

As in the case of the demand elasticity for market inputs, the time elasticity with respect to household size, β_1, does not provide a direct measure of the economies in time γ_{21}. Rather, it gives the overall effect of an increase in household size that shifts relative prices within a household, a percentage-point change of per-capita food preparation time if the household size were to be doubled holding wages and non-labor income constant. The parameter β_1 is expected to be negative, and it is larger in absolute value when economies of scale in food preparation time γ_{21} are large, when the time demand elasticity with respect to the price of market food $\varepsilon_{t_1 p_1}$ is large and when the substitution away from food preparation time in response to an increase in the price of nonfood $\varepsilon_{t_1 p_2}$ is small.

3.2.4 Elasticity of Per-capita Food Expenditures with Respect to Wage

The effect of an increase in wage on per-capita food expenditure at constant household size is:

$$\alpha_2 = \frac{d \ln \frac{x_1}{n}}{d \ln w} = \varepsilon_{x_1 w_1} + \varepsilon_{x_1 w_2} + \varsigma_w \varepsilon_{x_1 I} \quad (3.14)$$

Here $\varsigma_w = \frac{\partial \ln((wT + V)/n)}{\partial \ln w}$ is the elasticity of full income with respect to wage, which is a positive number close to one. The demand for market ingredients in food should increase with wages, since all components of this elasticity are expected to be positive.

Holding income constant, the wage elasticity is a sum of elasticities with respect to the price of time in both activities should be a positive number:

$$\alpha_2 = \frac{d \ln \frac{x_1}{n}}{d \ln w} = \varepsilon_{x_1 w_1} + \varepsilon_{x_1 w_2}$$

3.2.5 Elasticity of Per-capita Food Preparation Time with Respect to Wage

The demand for food preparation time responds to an increase in hourly wage in the following way:

$$\beta_2 = \frac{d \ln \frac{t_1}{n}}{d \ln w} = \varepsilon_{t_1 w_1} + \varepsilon_{t_1 w_2} + \varsigma_w \varepsilon_{t_1 I} \quad (3.15)$$

The first term is the substitution effect – a higher price of time reduces the demand for food preparation time. The second term is the effect of a higher price of time in the alternative activity. This effect may be positive if it results in substitution towards food and away from nonfood goods. However, it is likely that a higher price of time would cause a shift towards good-intensive techniques in food as well. Finally, there is also an income effect - individuals can afford more of both time and market goods as total income increases, which may increase or decrease the demand for time. However, the net effect is most likely negative since the substitution effect should dominate.

At constant income, the parameter of interest is given by the sum of elasticities of the price of time:

$$\beta_2 = \frac{d \ln \frac{t_1}{n}}{d \ln w} = \varepsilon_{t_1 w_1} + \varepsilon_{t_1 w_2}$$

3.2.6 Elasticity of the Goods-Intensity of Meals with Respect to Household Size

The goods-intensity of food varies with household size as follows:

$$\chi = \frac{d \ln \frac{x_1}{t_1}}{d \ln n} \qquad (3.16)$$

The goods-intensity of meals decreases with household size ($\chi<0$) if larger households find time relatively cheaper and substitute time for market ingredients.

3.2.7 Elasticity of Food Share with Respect to Household Size

The share of food in total household expenditures is:

$$s_f = \frac{p_1 x_1}{p_1 x_1 + p_2 x_2}$$

Differentiating with respect to *n*,

$$\delta = \frac{ds_f}{dn} = \frac{p_1 p_2}{(p_1 x_1 + p_2 x_2)^2} \left(x_2 \frac{\partial x_1}{\partial n} - x_1 \frac{\partial x_2}{\partial n} \right) \qquad (3.17)$$

The food share decreases with household size if $x_2 \frac{\partial x_1}{\partial n} < x_1 \frac{\partial x_2}{\partial n}$, which is equivalent to

$$\frac{\partial \ln(x_1 / n)}{\partial \ln n} < \frac{\partial \ln(x_2 / n)}{\partial \ln n}, \quad \text{or} \quad \varepsilon_{x_1 n} < \varepsilon_{x_2 n}.$$

The last condition implies that the budget share of the good declines with household size if the demand for that good is more responsive to changes in household size than the demand for the other good. A negative value of δ implies that the demand for market purchased food inputs is more elastic with respect to household size than the demand for everything else. In the simple Barten model, a lower share of food expenditures at a given budget is assumed to mean lower consumption of food, because food expenditures are treated as synonymous with food consumption. In contrast, there is no direct link between food share of expenditures and food consumption in the household production model. A decline in the food share of expenditures as household size increases may take place while per capita food consumption, z_1^* remains unchanged or even increases,, if larger households adopt less goods-intensive food production technologies.

3.3 Data

3.3.1 Russian Longitudinal Monitoring Survey 1994-98

The data are four waves of the Russian Longitudinal Monitoring Survey (RLMS) for the years 1994-98. The RLMS, a project of the Carolina Population Center at the University of North Carolina at Chapel Hill, is a household-based survey with information on 41,069 individuals representing over 15,000 households. Many of those households participated in more than one rounds of the survey, providing a panel component which I do not taking advantage of in this chapter. The RLMS includes information on household expenditures for a number of food and nonfood items, along with information on demographic characteristics and labor market participation. The RLMS is a representative sample of the Russian population, and households of different sizes are well represented.

Most importantly for this research, the survey provides weekly-recall data for all household members on the amount of time spent in several major food production activities, including shopping for food, cooking food, and growing food for home consumption. Survey respondents are asked "How much time in the last 7 days did you spend looking for and purchasing food items? " "How much time in the last 7 days did you spend preparing food and washing dishes?" and "How much time in the last 7 days did you spend working on your individual land plot, dacha, or garden plot, excluding farm plots, or on a personal subsidiary farm?" Unfortunately, the amount of time spent consuming food is not recorded, and neither is time spent cleaning after meals other than washing dishes. The survey asks respondents about the total time spent cleaning last week, but it is impossible to distinguish between cleaning related to food production and other household cleaning. The total time of "food preparation" is thus taken as the sum of time spent on shopping for food, cooking, and growing food in kitchen gardens[6].

This measure of food-related time almost certainly underestimates actual time households spend on food. It does not include time for eating and cleaning the kitchen. It also excludes time households spend collecting wild mushrooms and berries. And because the survey is taken in the late fall and the winter while the peak gardening time is late spring, summer and early fall, our measure of time spent on the kitchen plot underestimates actual time households spend growing food.

The primary advantage of this survey is that both expenditure and time data are available for the same household over the same week. The main drawback is the recall nature of the time-use component. Time-use data collected through recall are generally of inferior quality compared to those collected through detailed time diaries. Another drawback is that expenditure data are only available at the household level, and cannot be assigned to individuals within a household.

An ideal survey for my analysis would record food-related expenses for each individual in the household as well as diary time use for each individual over the same

[6] Many Russian households have dachas or other small plots of land where they grow fruits and vegetables. Russians also spend time collecting wild mushrooms and berries. The imputed value of home produced food reflects the valued of food grown in the kitchen garden and collected in the wild. The time spent in the garden is recorded in the survey but the time spent collecting mushrooms and berries is not available.

period of time. Individuals of such a survey would need to be drawn randomly from households of different size. Most surveys contain either expenditure or time use data, but not both[7]. Several surveys from developing countries contain expenditure and time use data on households[8]. Those datasets may be good candidates for the future empirical research if quality of those data can be ascertained. In the absence of the ideal data, the RLMS provides a good basis for an empirical analysis of the model.

Most of the analysis below uses a sample of adults aged 18 and older. The household level data is also used for examining the relative good-and time-intensity of food production. To construct a sample of individuals, I pool four years of observations, remove children and individuals with missing household size, missing food expenditures or missing food related time use. This leaves a final sample of 30,734 observations on individual adults and 14,395 households. Households with complete time, age, expenditure and demographic records are included in the final sample of households with 14,395 observations.

Expenditures on market food inputs include all expenditures on food eaten at home, food eaten away from home, and alcohol. The survey also provides imputed values for home-produced food, which make up over 20% of total food consumption. However, these are not included in total food expenditures. If anything, they should be highly correlated with household production time in late spring and summer. Per-capita food expenditures are calculated as household expenditure divided by the family size where family size includes all household members, adults and children.

Hourly wages are computed from the total weekly earnings and time spent in all jobs for pay. Over 20% of households claim to have no wage earners, and over 40% of adults are either unemployed or do not provide information on weekly earnings and time spent in the labor market. For such individuals I impute hourly wages using a

[7] The United Nations Statistical Division provides an overview of available time-use surveys: http://unstats.un.org/unsd/demographic/sconcerns/tuse/
[8] For example, Nicaragua Living Standards Measurement Study Survey 1993, 1999, 2001 and Kazakhstan Living Standards Measurement Survey 1996 available from the World Bank at http://www.worldbank.org/lsms/guide/select.html.

standard two-step estimation technique with a participation equation and a wage function.

3.3.2. Analysis of Summary Statistics

Table 3.1 summarizes the key characteristics of the sample of individuals. Each round of the survey contributed about an equal number of observations to the final sample. An average individual is 45 years old and comes from a household of 3-4 people. In this sample, 43% are men and 59% of the sample is employed. Every fourth person is retired and every fourth lives in a rural area. Over half of adults come from households with children, 28% own a house, and 19% own a car.

An average adult spends 14.6 hours a week in food preparation, including 8.5 hours cooking, 2.9 hours shopping for food and 3.2 hours gardening. Gardening is an important source of food for many families: some 68% grow some of their own food. Expenditures on groceries make up the largest share of food expenditures – 87%. Meals eaten out make up 12.5% of the total food budget. Alcohol makes up only 0.5% of total expenditures on food[9].

Relatively low per-capita income numbers suggest that income is most likely grossly under-reported. Average reported income is less than half of average food expenditures. While underreporting of income is a common problem in most surveys, especially those that are not focused on collecting income data alone, the problem may be greater in Russia than in other industrialized countries, given high income tax rates, possibly unfamiliarity with and suspicion of household surveys, and a higher reliance on informal labor relations and transfers from family. The hope is that the reported income is highly correlated with actual income, but estimates on income should be interpreted with caution.

[9] Food expenditures account for about 68% of total household expenditures. The high share of food is in part due to subsidized housing. In 1994-98 rounds of RLMS, the average share of housing, including utilities, was just over 6% of the household budget.

Table 3.2 reports the averages for most of these variables by year of the survey. From those we see some trends over time. A decrease in employment, hours worked, labor earnings and hourly wages is accompanied by a decrease in food expenditures. The average household spent two times less on food in 1998 than it did in 1994. It is unclear whether households actually cut their real expenditures on food by 50%, since some of the drop may be attributed to price changes even though I used numbers that were corrected for price changes. Price changes were complicated by the devaluation of the Russian currency which made buying imported food much more expensive but led to increased local production, and it is unclear how much of this is captured in price changes.

Food preparation time decreased over the years by about 20%. Part of this change is probably due to improvements in household production technologies such as the availability of new household appliances during economic liberalization or the expansion of retail outlets and the greater availability of more processed foods. If, on the other hand, lower food expenditures reflect a trend of lower quantity of food consumed in the later years of the survey, then lower time inputs may be due to the production of fewer meals. Even if the quantity of food consumed remained unchanged over the four years of the survey, the quality of foods slightly decreased, as indicated by the declining percent of protein in individuals' daily diet but the standard deviation of this variable is low and the difference may not be significant.

Table 3.3 presents the summary statistics by gender and employment status. The average age of employed men and women is 39 while the average age of the non-employed is over 51. Women's earnings and wages are lower than men's. Employed men and women spend about 10% more on groceries than non-wage earners, twice as much on food eaten out, and 40% more on alcohol.

Of particular interest are the differences in time use between men and women. A non-employed woman spends twice as much time on food preparation as a non-employed man, contributing 21 hours compared to only 10.7 hours contributed by a man. A working woman spends three times more time on food preparation than a working man, 18.7 hours compared to 6.2 hours. Gardening time accounts for almost half of men's time spent in food preparation. Men spend 40% more time gardening than women. Employed women spend the most time shopping for food, 3.9 hours compared to 3.8 hours for non-employed women, 2.1 hours for non-employed men and 1.4 hours for employed men. Women who do not work for wage spend more time cooking than any other group of individuals: 13.7 hours compared to 13 hours for the employed women, 3 hours for non-working men and under 2 hours for employed men.

To compare per-capita time use and food expenditures by households of different sizes, I tabulate these variables by household "type" in Table 3.4, selecting those types for which I have more than one hundred observations. The type is defined as a two-digit number; the first digit is the number of adults and second is the number of children.

Table 3.5 presents some of those mean values for households without children. Each mean value is followed by an index number in parentheses. The index is calculated as a ratio of the expenditure or time devoted to food by an average individual from a larger household to the corresponding mean expenditure or time spent on food by a single adult. These indices may serve as a rough measure of the household economies of scale. In absence of any economies, each additional adult would add at least as much as a single individual to the total household expenditure on food, so the index for a two adult household would be no less than two. With no economies in time, individuals from larger households would on average spend as much time as single adults in food-related activities, after accounting for men and women's intra-household specialization.

As one can see from the table, the index numbers under total household food expenditures are lower than the corresponding number of family members. A two-adult household spends only 50% more on food than a single person and a family of five spends less on food than three separate individuals. Thus per-capita expenditure on food decreases with household size. The index under per capita expenditure shows that a member of a two-adult household spends 25% less money on food than a single adult, with the corresponding food expenditure 75% of those of a single individual. A member of a three-adult household spends 39% less while a member of a five-adult household spends 49% less than their single counterpart. The economies diminish as household size grows with the largest savings occurring for two single people creating a joint household. The transition from a single to the joint household is accompanied by a relatively larger drop in expenditure on alcohol and restaurant meals than that on groceries.

Again, there is a substantial gender difference in changes in time allocation associated with different household structures. For women, a move from a one- to a two-person household is accompanied by a 22% increase in food preparation time, from 17.2 to 21 hours per week, including a 29% increase in cooking time (from 10.5 to 13.5 hours), a 17% increase in shopping time (from 3.4 to 4 hours), and a 7% increase in gardening time (from 3.3 to 3.5 hours). A further increase in family size results in steadily decreasing food-related time for women. But even being part of a four-adult household, an average woman spends more time cooking than her single counterpart. A woman from a five-adult household spends only 8% less time in food-related activities than a single woman.

All the benefits of the household economies of scale in time use accrue to men. The economies are particularly large for men moving from a single to a two-person household. As part of a two-adult household, an average man spends 29% less time on food preparation than a single man, 9.7 hours compared to 13.7 for a single man. That includes a large drop in the man's cooking time to less than a third of a single guy's time spent in the kitchen, from 7.8 to 2.5 hours per week, and a 32% drop in the shopping time. Men's involvement in cooking decreases steadily with household size: a man from a five-adult household spends seven times less in the kitchen than his single counterpart, just over on hour. As women spend more hours cooking, men from households size two and larger accept more gardening responsibilities. The transition to a joint household by a single man is accompanied by an 84% increase in time spent cultivating land.

Overall, per-capita food preparation time decreases with household size for men and women. An exception is single women moving to a two-person household. Even taking into account extra hours spent on food preparation by a married woman and extra gardening hours for a married man, the net per-capita food preparation time supplied by men and women together decreases steadily with household size.

Table 3.4 includes age, gender and labor market participation data for individuals by household type. Demographics explain some of the differences in food-related expenditures and time between different types of households. For example, individuals in smaller households are older and more likely to be retired, with low incomes and a low opportunity cost of time. Therefore age may be associated with a higher level of time inputs and lower level of market inputs.

For households of a similar type, on average men generally spend more per-capita on food than women. Per-capita expenditures on food decrease with the number of children when the number of adults is held constant. This is expected, since young children need less food than adults. Individuals from households with children are on average younger and more likely be employed than those without children. As the number of children increases, women specialize more in cooking: the average time a woman spends cooking increases with each extra child and men's average time in the same activity goes down. An extra child is associated with some additional gardening time for men and women and a reduction in time spent shopping for food.

3.4 Regression analysis

3.4.1 Methodology

The size economies from Table 3.5 almost certainly do not represent the true scale of household economies because simple averages do not account for household composition and other factors that may affect demand for meals and inputs into production of meals. For example, if older people living in households of different size tend to spend less money and more time on food, than the simple averages would confound the effect of household size with the effect of age. A three-person family with two parents and a child may have lower per-capita expenditures on food than a three adult household because children need less food. Married people may spend more time in food-related activities if they enjoy shopping and cooking together. Individuals from rural areas most likely grow more food and spend less on market ingredients.

The pattern in simple averages with regard to household size suggests that per capita expenditure and time inputs do decrease with household size, but perhaps discontinuously, with a distinct change at the two-person household. A move from a one- to a two-person household is associated with an increase in women's time spent on food while every subsequent increase in family size is associated with a lower per-capita time input. For men, on the other hand, average food preparation time decreases substantially with a move from a one- to a two-person household. Much of the discontinuity between these two types of households is likely to be explained by factors other than economies of scale.

Let x_i and t_i be the individual's expenditure on food and food preparation time, respectively. In order to account for additional factors that affect households decisions and for the possible discontinuity, I model the demand for food-inputs as spline functions of household size *n* and the following variables: individual wage *w*, per-capita non-labor income *v*, the number of children of different ages, age, employment and married status, geographical location and the year of the survey.

Let *d* be an indicator for a family size one or two: $d = 1 \ if \ n \leq 2$. Then the demand functions are:

$$\ln x_i = \alpha_0 + \gamma_1 d + (\alpha_1 + \gamma_2 d) \ln n + \alpha_2 \ln w + \alpha_3 \ln(v) + \alpha_4 X + \xi_1 \tag{3.18}$$

$$\ln t_i = \beta_0 + \gamma_3 d + (\beta_1 + \gamma_4 d) \ln n + \beta_2 \ln w + \beta_3 \ln(v) + \beta_4 X + \xi_2 \tag{3.19}$$

The spline method in this case is equivalent to splitting each of the samples into two sub-samples representing (households size two and larger, and households size one and two) and estimating separately the demand functions in each sample. Thus equation (3.18) can be split into a demand function for households size two and larger, with intercepts α_0 and slope α_1, and a function for households size one and two with intercept $\alpha_0 + \gamma_1$ and slope $\alpha_1 + \gamma_2$. To join the two parts of the function at the knot, the value of the dependent variable must be the same at $n=2$, or

$$\alpha_0 + \alpha_1 \ln 2 = \alpha_0 + \gamma_1 + (\alpha_1 + \gamma_2) \ln 2$$

This imposes the following restriction on the coefficients:

$\gamma_1 = -\gamma_2 \ln 2$ and similarly: $\gamma_3 = -\gamma_4 \ln 2$

Inserting this restriction into (3.18) and (3.19) yields two equations:

$$\ln x_i = \alpha_0 + \alpha_1 \ln n + \gamma_2 d(\ln n - \ln 2) + \alpha_2 \ln w + \alpha_3 \ln(v) + \alpha_4 X + \xi_1 \qquad (3.18')$$

$$\ln t_i = \beta_0 + \beta_1 \ln n + \gamma_4 d(\ln n - \ln 2) + \beta_2 \ln w + \beta_3 \ln(v) + \beta_4 X + \xi_2 \qquad (3.19')$$

To assign household expenditures to individuals within the household, I assume that consumption is shared equally among men, women and children within the household. This allows the use of per-capita food expenditure on the left hand size of equation (3.18’). Assigning per-capita expenditure to adults implies that adults with more children will have a lower ratio of total expenditures to family size than households with fewer or no children. The demand regressions correct for the number and ages of children and fix this problem. A more serious problem with this approach is that the assumption of equal distribution of goods within the household may not be realistic. If men consume more food and spend more money on food, then for households with more than one person men’s true expenditures on food will be understated and women’s true expenditures overstated.

Time is reported for each individual, allowing the use of adults’ own time inputs for the dependent variable in (3.19’). One problem is that older children, especially teenagers, participate in food preparation. In this sample, 82% of girls and 68% of boys aged 14-17 report positive food preparation time. An average girl in this age group spends 6.1 hours a week on food preparation (1.3 hours buying food, 3.8 hours cooking, and 1 hour gardening). An average boy spends 4 hours a week (0.8 buying food, 1.1 cooking and 2.1 gardening). Children are not included in estimating the demand equations. Rather, the time they spend in food preparation is including in the total time spent by the household for the household-level regression of goods-intensity of food. In addition, a small share of younger children report their time contribution in preparing food. However I take a skeptical view as to the ability of young children to help solve the household problem of time scarcity and I view their cooking time as leisure and omit it entirely.

3.4.2 Imputed Wages

Before the demand equations can be estimated, wages for the unemployed individuals are imputed using a two-step wage regression consisting of a labor market participation equation and a corrected wage equation for the employed.

The probability of labor market participation is modeled as the function of education, age, gender, marital status, the interaction of marital status and gender, household size, presence of pre-school children, an interaction of a the latter with gender, per capita income of other household members, rural location and unemployment rate by the site of the survey. I also include dummies for asset ownership (ownership of land and a house) as indicators of wealth and better employment opportunities. Dummies for students, retired and disabled mark groups that are less likely to earn wages. Finally, the dummy variables for the year of the survey are included in order to correct for the general declining trend in employment and wages.

Hourly wages are assumed to be determined by some of the same variables as labor market participation (education, age, gender, married status, rural location, income of other household members, land and house ownership, year of the survey). I exclude presence of young children, its interaction with gender, household size, local unemployment rate and the student or retired status. Those variable supposedly matter for individual's decision to work for wage, but they do not affect the wage level. The wage function includes several new variables: an indicator for wage arrears, dummies for seven geographical regions and ownership of a car. Less than 10% of Russian households own cars and having own transportation should afford better earnings opportunities for the employed individuals.

The full probit procedure results for the first step are reported in Table 3.6 and the wage equation OLS results in Table 3.7.

The estimated coefficients of the participation and wage regressions largely conform to the expectations. The probability of being employed and wage increase with the level of education and the profile is concave in age. Married men are more likely to work and receive higher pay. Students and retired and disabled individuals are less likely to work for wages, as are married women with young children. Individuals from rural areas and those whose salaries are in arrears receive substantially lower wages. The estimate for lambda- a factor that corrects for a possible participation bias- is significant and positive, suggesting that not correcting for this bias would result in underestimation of wages. I use the estimated wage function coefficients to impute wages for individuals with missing wage data.

3.4.3 Demand Equations

3.4.3.1 Per Capita Food Expenditures

I estimate the demand equations (3.18') and (3.19') with OLS separately for men and women. The full sets of coefficients are in Table 3.8[10]. Gamma denotes the slope of the extra term in the spline functions.

Negative coefficients on household size for men and women suggest that the demand for both inputs into food decreases with household size. In households of two

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[10] I am interested in analyzing the marginal effects. My demand equations have the following general form: $\ln y = \alpha + \beta \ln x + \delta z + \varepsilon$, therefore the marginal effects are $\frac{\partial y}{\partial x} = \beta \frac{y}{x}$ and $\frac{\partial y}{\partial z} = \delta y$

or more persons, doubling the size of the household decreases per capita food expenditure by 31-32%. The drop in per capita expenditures may be larger for single individuals moving in together, but the evidence is not strong since the negative coefficient is not significant at the 5% level.

The demand for market inputs increases with wage and income and is higher for the employed and wealthier car-owners. As expected, per-capita expenditures are lower for families with children, especially young children who consume less food. Married women spend more money on food than single women do, while marital status does not affect men's food expenditures. Rural households, households living in a house, and those that own a plot of land spend less per capita on food. Food expenditures are also lower in several relatively poor regions of the country, and they declined on average over the years the survey was taken.

The age profile of food expenditures, on the other hand, is convex, indicating that expenditures decrease with age. The age profile of this cross-section is steeper than a typical individual's life cycle profile. This is because the sample was drawn at the time of economic reforms in Russia that impoverished older persons relative to younger adults. This shows up as a steep decline in food expenditure at older ages in this sample.

3.4.3.2 Food-Related Time

The coefficients on household size in the time demand equations suggest that doubling the size of the household decreases individuals' food preparation time by 74-77% for households with two or more persons. This suggests that potentially economies in food preparation time are larger than economies in food expenditures. However, because of intra-family specialization and because of differences in household composition, the gains so afforded are not distributed evenly between men and women.

The gamma-coefficient on the spline term is highly significant for men and women suggesting a structural break at *n=2* in the demand for time for both men and women. Adding large negative gamma to the coefficient on household size in the regression for men, I calculate that the typical man's time input into food is 217% higher when he lives alone compared to a man from a two-person family. On top of that, a married man however spends only 18% more time in food-related activities than a single man. When this "marriage time premium" is considered, a single man still spends almost 200% more time preparing food than a married man from in a two-person household. In other words, by getting married a typical man may expect a three times reduction in food preparation time, which corresponds to time savings of 4-6 weekly hours in this sample.

An employed man spends 34% less time on food than a non-employed man. Each pre-school age child adds 20% to men's food preparation time while each older child adds up to 15%. Men from rural areas, those who own a house and come from households that grow food spend a combined 84% more time on in food related activities than men from urban areas who live in apartments and do not engage in subsistence agriculture.

For women, the gamma-coefficient has the opposite sign, it is positive. Adding the spline term coefficient to the coefficient on household size I conclude that women living in a two-person household economize 45% on food preparation time compared to their single counterparts.

If women's food-related time decreases even when we move from one person to a two-person household, why do the mean values in Table 3.4 show increased time inputs from women? There are several explanations. First, there is an age affect. Age is one the main determinants of the women's time allocation, as seen from highly significant and positive coefficient on age in the women's time regression. Second, the coefficient on the dummy for marital status suggests that married women spend almost 47% more time in food-related activities. Thus, a 45% drop in food-related time due to economies in household size, combined with a 47% increase in food related time for married women, results in a net increase in time spent looking for food and cooking. In households with children, an average woman spends 18% more time on food. In addition, every preschool age child increases the time a woman spends in food preparation by 20%, while every older child increases it by fewer than 12%. Thus women with children from small households spend more time in food-related activities than single women.

There is a small positive coefficient on wages in the men's time regression. This should be interpreted cautiously, since the wages of the employed are calculated as a ratio of earnings to time spent in the labor market, and the latter may be negatively correlated with food preparation time.

The effect of the total per-capita income of other household members on the demand for market inputs and time is positive and relatively larger for men's time: the higher the income of other household members, the more time individuals spend on food. The fact that both market and time inputs respond positively to an increase in income suggests that wealthier households consume higher quantities of food and perhaps higher quality. For women, the percentage increase in market inputs due to a unit increase in the income of other household members is proportionally larger than the increase in preparation time for women, suggesting substitution into more goods-intensive meals in response to higher income.

In this sample, the age profile of time inputs into meals is increasing with age and concave, indicating that older men and women spend relatively more time cooking than younger people. The coefficients on the survey year dummies indicate that over time food expenditures per capita decreased as did the time women spend on food, while men's time in food-related activities (mostly gardening) increased slightly due to food shortages during the transition period. Both men and women in rural areas spend more time and less money on food.

The time regression for men has a poor fit, suggesting that most of the variation in men's time use comes from unobservable individual or household characteristics and preferences which are not explained by wages, income, family size, composition and demographics.

Interestingly, when I merge residuals from the men's and women's regressions by household, I find a significant positive correlation (equal to 0.09) between the unexplained component in women's and men's time use. Husbands who spend more time in the kitchen tend to have wives who spend more time in the kitchen as well, and vice versa. The correlation of residuals from women's food expenditures and time use regressions is also significant and positive, but small, only 0.026. This may suggest that the purchase of more ingredients, for example for a holiday meals, requires more time to shop and cook, but the value of this coefficient is too small to derive any conclusions. For men, residuals from time and expenditure regressions are not correlated suggesting men do not change their cooking-shopping-gardening effort in response to unusually large or small purchases of food.

3.4.4 The Goods-Intensity of Food

As seen from the estimates for men and women, expenditures on market inputs decrease with household size proportionately less than time spent in meal preparation. If economies of scale for market food inputs are smaller than economies in food preparation, than larger households choose more time-intensive food production techniques. I test this prediction in a sample of households using total household food expenditures and total food preparation time. This enables me to include the time supplied by 14-17 year olds. I estimate the following function:

$$\ln(x/t) = \alpha_0 + \gamma_1 d + (\alpha_1 + \gamma_2 d)\ln n + \alpha_2 \ln w + \alpha_3 \ln(v) + \alpha_4 X + \xi_3 \qquad (3.20)$$

The goods-intensity of food is defined as total household food expenditures divided by food preparation time. I model the goods-intensity of meals as a function of household size, wage, unearned income, household composition defined by the ratio of children different ages to household size and ratio of men to household size, the share of employed adults to the number of adults, asset ownership, year of the survey and geographical location. The wage, age and gender of the household head are also included, with the household head being the person in the household with the highest wage. Estimates are reported in Table 3.9.

The coefficient on household size is negative, suggesting that larger households choose more time-intensive methods of food production compared to smaller households. Doubling household size decreases the goods-intensity of food by 26%. There is evidence to support the hypothesis of a structural break in the function at $n=2$: the gamma-coefficient is significant and negative, implying that goods-intensity decreases with a steeper slope between one- and two-person households.

As expected, the goods-intensity of food increases with the hourly wages. Older households choose more time- intensive food technologies, as do households from poorer geographical regions, and rural areas and owners of land for small scale agriculture. The goods-intensity of food increases with the number of school-age children with the exception of teenagers 14-17 years of age, who themselves contribute their time to food preparation. Ownership of a car, which is a proxy for wealthier households and those able to work more jobs, is associated with a higher goods-intensity of food. At the same time, ownership of a house and ownership of a plot of land is associated for lower goods-intensity of food. The goods-intensity of food use decreased over time during the transition. Per-capita non-labor income (transfer payments, property income, etc) does not affect the goods-intensity of food production.

3.4.5 Household Size and Nutrition

So far I have found evidence that larger households economize of food expenditures and time, and that relatively high economies in time induce substitution toward more time-intensive meals. However, this does not answer an important question of whether larger households have higher per-capita food consumption. Assuming limited substitution between food and everything else in the household utility function, food consumption per capita should not decrease with household size. Deaton and Paxson assume expenditures approximate consumption; hence evidence of economies in food expenditures is viewed as puzzling because lower food expenditures imply individuals in larger families consume less food. My model explains that expenditures are only one of the two inputs into food, and per capita expenditures may decrease with household size while food consumption per capita remains the same or even rises.

It would be interesting to find empirical evidence showing whether larger households do not consume lower quantity and/or quality of food. A non-negative relationship between individuals' caloric intake and household size would indicate non-decreasing quantity of food consumed. The source of calories – fat, carbohydrates or protein – may convey information about the quality of foods consumed.

Unfortunately, RLMS does not provide information on publish individuals' caloric intake. However, it does include the share of fat, carbohydrates and protein in every surveyed individual's daily diet calculated by the Carolina Population Center at the University of North Carolina at Chapel Hill[11]. Assuming the quality of nutrition may be measured by the share of protein in the individual's daily diet, I model the quality of nutrition, p_i, as a function of household size, age, gender, number of children in each age group, wage, employment status, per-capita income of other family members, asset ownership, marital status, geographical location and year of the survey. The average adult obtains 12.7% of total calories from protein. I estimate the following equation using the full sample of adults:

$$p_i = \alpha_0 + \gamma_1 d + (\alpha_1 + \gamma_2 d)\ln n + \alpha_2 \ln w + \alpha_3 \ln(v) + \alpha_4 X + \xi_4 \qquad (3.21)$$

The coefficient estimates are reported in Table 3.10. The coefficient on household size is not significantly different from zero, suggesting that the quality of meals does not decrease with family size. In fact, gamma, the extra term of the spline function, is positive, implying that the move from a one-person to a two-person household results in a 37% increase in the protein content of meals.

[11] Nutrition data is missing for 100 people in my sample.

Higher quality meals are also associated with higher wages and higher unearned income. Men, married and employed individuals, those who live in rural areas and those who own a car consume better quality meals, while households that grow their own food and live in relatively poorer locations have a lower quality nutrition. Family composition and age do not affect the quality of meals. Overall, the share of protein in the diet decreased slightly over time.

However, the nutrition regression has a very poor fit. The model is only able to explain about 3% of the variation in the protein content of the diet. There is little variation in the dependent variable, and its standard deviation (as reported in Table 3.4) is very low.

3.5 Conclusions

This chapter examined the sources of household economies of scale in food in a household production framework. Previous research has been unable to explain why larger households spend less per capita on food. By explicitly incorporating time requirements for food production in the model, I showed that household decisions depend on the relative prices of market-purchased inputs and the time needed to prepare meals, and that these relative prices are affected by household size. In the presence of large economies of scale in food preparation time, optimizing households choose more time-intensive food production technologies in response to an increase in household size.

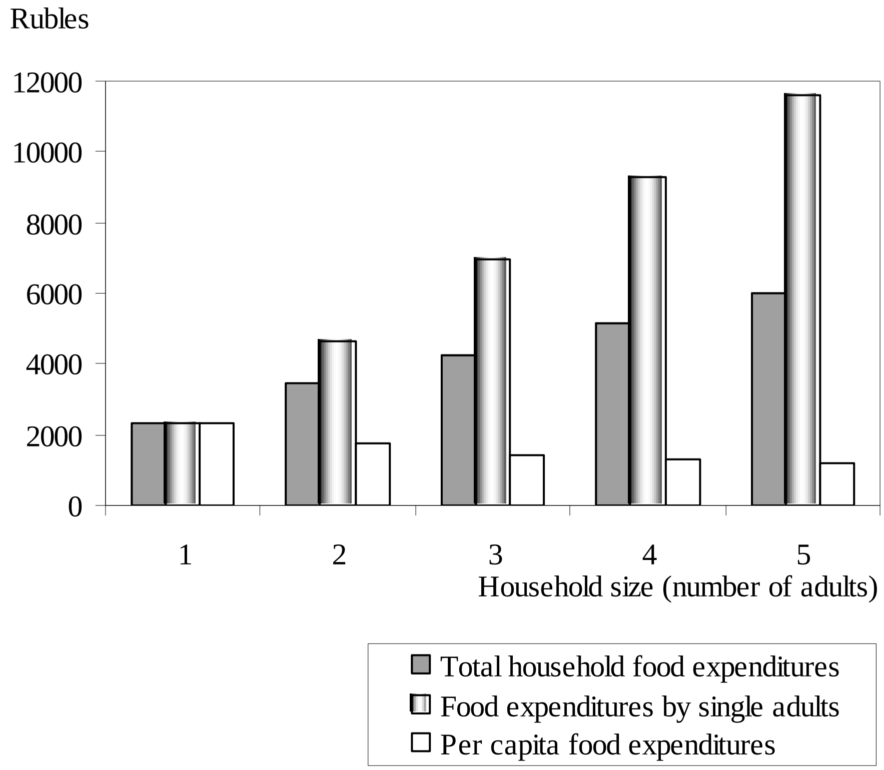
The evidence from Russia supports the existence of economies in food expenditures and food preparation time. I estimate that for households with two or more people doubling household size while holding wages, non-labor income and family composition constant decreases household food expenditures by over 30% and decreases individuals' food preparation time by over 75%. The economies of scale from moving from a one-person household to a two-person household differ by gender. After moving into a two-person household, a man may expect to spend three times less time preparing food, while a woman will on average spend 45% less time preparing food if she is not married and no less time as before if she gets married. I find evidence that a larger household size induces substitution towards relatively more time-intensive meals. The quality of meals most likely does not decrease with household size, but more research is needed to confirm this finding.

This research can be extended in several ways. First, estimates from other countries are needed in order to generalize the evidence on the size of household economies of scale in food. The estimates may be affected by the level of income and development. Russia presents a specific example of an industrialized country with low incomes and high food expenditures. Anderson and Vahid (1997) provide evidence that the income elasticity of family food consumption may be affected by the level of household income.

Second, more reliable nutrition data would provide additional insights into how the quantity and quality of food is affected by household size. Such information would be invaluable if the key interest is in household welfare.

Third, this chapter focused on food without considering the demand for other goods. However, there are likely to be substantial opportunities for larger households to economize in other important areas, such as housing. Extending the analysis of household economies to other goods is a good way to learn more about the nature of household economies of scale.

Figure 3.1 Expenditures on Food for Households with no Children and Differing number of Adults



Note. – The first bar shows average total household food expenditures on food. The second bar illustrates how large the household's food expenditures would be if each adults lived separately (calculated as the number of adults times single person's average food expenditures). The third bar is per capita actual food expenditures.

Figure 3.2 Per Capita Food-Related Time for Men and Women from Household without Children

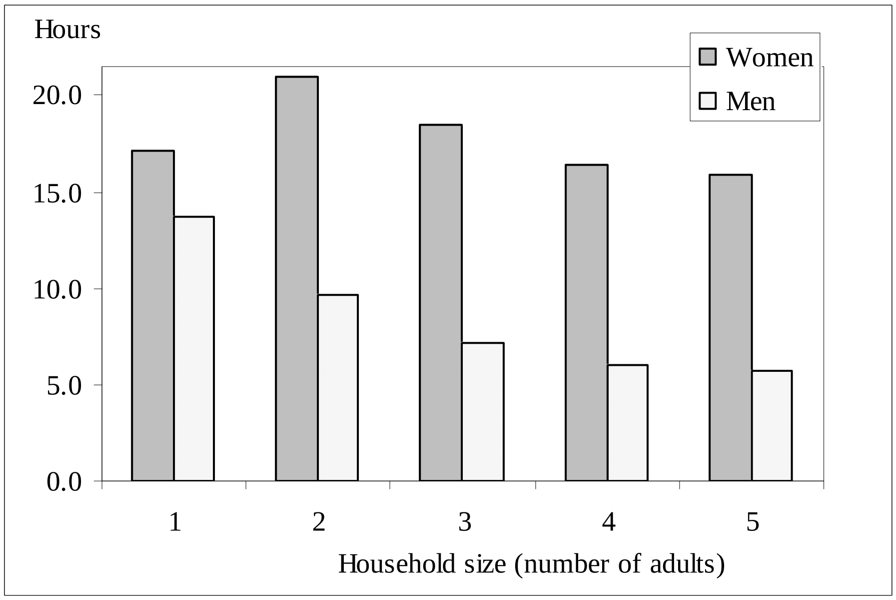


Table 3.1 Sample Means, Standard Deviations, Minimum and Maximum Values

Variable	Mean	Std	Minimum	Maximum
Household size	3.5	1.5	1	12
Male	0.432	0.5	0	1
Age	45.5	17.5	18	101
Married	0.721	0.4	0	1
Employed	0.588	0.5	0	1
Student	0.032	0.2	0	1
Retired	0.259	0.4	0	1
Hourly wage rate for the employed	28.4	82.5	0.13	4634
Hours worked per week	20.9	22.8	0	160
Earnings per week, Rb	356	823	0	28702
Per capita total income	540	1113	0	80652
No children	0.469	0.5	0	1
Children under 7	0.284	0.6	0	5
Children 7-13	0.358	0.6	0	6
Children 14-17	0.186	0.4	0	3
Per capita food expenditures, weekly,Rb	1435	1675	0	85750
Including: Groceries	1254	1351	0	33156
Food eaten out	110	645	0	64571
Alcohol	70	214	0	6805
Imputed value of home produced food	323	2114	0	250882
All food-related time, weekly hours	14.6	14.9	0	122
Including: Shopping for food	2.9	4.4	0	42
Cooking	8.5	9.9	0	98
Gardening	3.2	8.8	0	98
Percent protein in daily diet	12.7	3.6	0	57
Own house	0.279	0.4	0	1
Own car	0.192	0.4	0	1
Grow food	0.676	0.5	0	1
Rural area	0.258	0.4	0	1
Year=1995	0.246	0.4	0	1
Year=1996	0.245	0.4	0	1
Year=1998	0.251	0.4	0	1

Note. – Here and in the tables below, unless otherwise specified, the sample includes adults age 18 and older, the sample size is 30,734.

Table 3.2 Sample Means by Year of the Survey

	1994	1995	1996	1998
N	7929	7560	7536	7709
Per capita food expenditures, Rb	1808	1665	1387	874
Including: Groceries	1568	1464	1214	765
Food eaten out	135	135	106	67
Alcohol	105	66	67	42
Imputed value of home produced food	468	329	231	256
Food-related time, hours per week	15.6	15.4	14.7	12.5
Including: Cooking	3.7	2.9	2.4	2.4
Shopping for food	9.6	8.4	8.1	7.9
Gardening	2.3	4.1	4.1	2.3
Age	45.2	45.6	45.6	45.5
Per capita total income	680	561	530	388
Household size	3.6	3.3	3.3	3.6
Male	0.44	0.43	0.43	0.43
Employed	0.61	0.60	0.58	0.56
Hourly wage rate	35.1	26.8	29.9	20.9
Hours worked per week	21.4	21.6	21.0	19.4
Earnings per week, Rb	459	367	358	234
Percent protein in daily diet	12.8	12.8	12.7	12.5

Table 3.3 Sample Means by Gender and Employment Status

	WOMEN		MEN	
	Non-employed	Employed	Non-employed	Employed
	8495	8928	4191	9120
Per capita food expenditures, Rb	1251	1525	1357	1556
Including: Groceries	1139	1318	1221	1316
Food eaten out	63	135	71	150
Alcohol	50	71	65	90
Imputed value of home produced food	352	268	434	297
Food-related time, hours per week	21.0	18.7	10.7	6.3
Including: Shopping for food	3.8	3.9	2.1	1.4
Cooking	13.7	13.0	3.0	1.9
Gardening	3.6	1.9	5.6	3.0
Age	55.2	39.6	51.8	39.3
Per capita total income	440	597	456	618
Earnings per week, Rb	0	479	0	729
Hours worked per week	0	32.7	0	38.3

Table 3.4 Sample Means by Household Type

Household type (adults, children)	**10**	**11**	**12**	**20**	**21**	**22**	**23**	**30**	**31**	**32**	**33**	**40**	**41**	**42**	**50**	**the rest**
ALL INDIVIDUALS																
Number of observations	1882	440	198	6850	4207	3423	495	3503	2336	832	159	1498	1461	843	559	2048
Per capita food expenditure	2325	1746	1068	1738	1503	1170	1029	1424	1285	1094	809	1292	1126	954	1196	947
Including: Groceries	1994	1518	934	1534	1282	1016	899	1254	1142	968	704	1123	993	846	1049	836
Food eaten out	181	165	106	115	141	101	74	104	98	89	82	101	84	74	96	68
Alcohol	150	63	27	89	79	52	56	66	44	37	22	69	49	34	51	43
Home produced food	370	208	174	437	220	280	263	343	233	260	311	253	206	254	271	503
Age	58.1	38.9	37.1	56.7	36.5	35.7	36.3	47.9	40.6	41.4	37.9	46.5	42.5	43.8	46.5	41.4
Per capita total income	748	551	387	603	625	483	332	551	485	419	364	503	457	338	551	404
Male	0.34	0.07	0.06	0.42	0.47	0.49	0.50	0.47	0.43	0.41	0.46	0.43	0.42	0.43	0.44	0.45
Employed	0.39	0.79	0.83	0.40	0.77	0.82	0.73	0.54	0.66	0.63	0.64	0.56	0.61	0.55	0.53	0.54
Hourly wage rate	234	480	392	227	526	566	401	297	397	359	310	332	361	307	296	257
Hours worked per week	13.1	26.3	29.5	14.2	27.7	29.5	26.5	19.2	23.1	23.0	25.9	19.8	20.2	20.1	18.7	19.7
WOMEN																
Per capita food expenditure	2067	1736	1083	1628	1483	1159	1034	1403	1231	1062	805	1233	1112	940.4	1116	945
Food-related time	17.2	16.3	18.8	21.0	20.4	23.6	25.8	18.5	18.9	20.1	23.7	16.4	17.8	21.6	15.9	18.9
Including: Cooking	3.4	3.5	3.7	4.0	4.3	4.1	3.9	3.6	3.8	3.5	3.1	3.3	3.9	3.7	2.9	3.2
Shopping	10.5	11.7	14.3	13.5	14.6	16.8	17.6	12.4	12.8	13.3	15.9	11.0	12.2	14.8	9.9	12.5
Gardening	3.3	1.0	0.8	3.5	1.6	2.6	4.3	2.5	2.3	3.4	4.6	2.1	1.7	3.1	3.1	3.2
MEN																
Per capita food expenditure	2832	1877	810.5	1892	1525	1181	1023	1446	1354	1140	813.3	1371	1146	971.1	1297	950.1
Food-related time	13.7	8.0	10.4	9.7	6.1	6.9	7.9	7.2	6.2	6.7	7.8	6.1	6.5	7.5	5.7	6.9
Including: Cooking	3.2	1.9	1.2	2.2	1.5	1.4	1.3	1.5	1.2	0.9	1.0	1.3	1.2	1.1	1.4	1.1
Shopping	7.8	4.1	3.1	2.5	2.1	1.9	1.9	2.0	1.8	1.4	1.4	1.5	1.8	1.2	1.1	1.2
Gardening	2.8	2.0	6.0	5.0	2.5	3.6	4.7	3.6	3.2	4.3	5.4	3.2	3.5	5.1	3.2	4.6

Table 3.5 Per Capita Expenditures on Food and Adult Food Preparation Time in Households without Children and Differing Number of Adults

Household size (number of adults)	1	2	3	4	5
ALL ADULTS					
Household food expenditures, Rb	2325	3476	4271	5170	5978
	(1)	(1.5)	(1.84)	(2.22)	(2.57)
Per capita food expenditures, Rb	2325	1738	1424	1292	1196
	(1)	(0.75)	(0.61)	(0.56)	(0.51)
Including: Groceries	1994	1534	1254	1123	1049
	(1)	(0.77)	(0.63)	(0.56)	(0.53)
Food eaten out	181	115	104	101	96
	(1)	(0.64)	(0.57)	(0.56)	(0.53)
Alcohol	150	89	66	69	51
	(1)	(0.59)	(0.44)	(0.46)	(0.34)
WOMEN					
Food preparation time, hours	17.2	21.0	18.5	16.4	15.9
	(1)	(1.22)	(1.08)	(0.96)	(0.92)
Including: Shopping for food	3.4	4.0	3.6	3.3	2.9
	(1)	(1.17)	(1.05)	(0.96)	(0.83)
Cooking	10.5	13.5	12.4	11.0	9.9
	(1)	(1.29)	(1.18)	(1.05)	(0.94)
Gardening	3.3	3.5	2.5	2.1	3.1
	(1)	(1.07)	(0.77)	(0.65)	(0.95)
MEN					
Food preparation time, hours	13.7	9.7	7.2	6.1	5.7
	(1)	(0.71)	(0.52)	(0.44)	(0.42)
Including: Shopping for food	3.2	2.2	1.5	1.3	1.4
	(1)	(0.68)	(0.48)	(0.42)	(0.46)
Cooking	7.8	2.5	2.0	1.5	1.1
	(1)	(0.32)	(0.26)	(0.2)	(0.14)
Gardening	2.8	5.0	3.6	3.2	3.2
	(1)	(1.84)	(1.32)	(1.16)	(1.15)

Note.- Numbers in parentheses are shares relative to a single adult household

Table 3.6 Labor Market Participation Equation

Variable	Coef	Chi-sq	Prob
Intercept	0.627	31.72	<.0001
No high school	-0.168	27.63	<.0001
Vocational school	0.076	6.37	0.0116
Technical school	0.221	55.00	<.0001
College degree	0.307	84.89	<.0001
Male	-0.250	40.95	<.0001
Age	0.073	294.97	<.0001
Age squared	-0.001	202.39	<.0001
Married	0.419	130.84	<.0001
Married * woman	-0.579	161.78	<.0001
Kids under 7 * woman	-0.517	129.84	<.0001
Log household size	-0.139	27.93	<.0001
Kids under 7 dummy	0.170	20.65	<.0001
Log per cap income of others in hhold	-0.059	55.10	<.0001
Student	-1.362	596.73	<.0001
Retired	-2.739	3807.52	<.0001
Disabled	-0.556	130.23	<.0001
No alcohol consumption reported	-0.123	33.09	<.0001
Own land	0.145	39.03	<.0001
Own house	-0.114	17.62	<.0001
Unemployment rate by site of survey	-2.646	670.63	<.0001
Rural area	0.082	8.68	0.0032
Year=1995	0.059	4.13	0.042
Year=1996	-0.068	5.62	0.0177
Year=1998	-0.089	9.24	0.0024

Note. - Probit regression coefficients.
Dependent variable: Employed (N=12,670), Unemployed (N=18,048).
Log-Likelihood = -10405.

Table 3.7 Wage Equation

Variable	Coef	t-stat
Intercept	2.442	21.17
Inverse Mills ratio	0.120	3.08
No high school	-0.197	-6.27
Vocational school	-0.091	-3.45
Technical school	0.071	2.76
College degree	0.264	9.88
Male	0.151	3.97
Age	0.044	8.94
Age-squared	-0.001	-10.15
Married*woman	-0.209	-4.84
Log per cap income of others in household	0.027	4.28
Married	0.168	4.85
No alcohol consumption reported	-0.157	-8.87
Disabled	-0.104	-1.84
Own land	-0.085	-4.4
Own car	0.216	10.37
Own house	-0.120	-4.47
Wage arrears reported	-0.435	-23.86
Rural	-0.419	-16.24
Northwest	-0.070	-1.69
Central	-0.408	-12.67
Ural	-0.306	-9.1
Volga	-0.612	-18.23
Caucasus	-0.336	-8.75
East Siberia	-0.061	-1.6
West Siberia	-0.019	-0.49
Year=1995	-0.203	-8.51
Year=1996	-0.112	-4.61
Year=1998	-0.466	-18.88

Note. - OLS regression coefficients.
Dependent variable: Log hourly wage, N=12,812, R-squared = 0.25.

Table 3.8 Demand for Market Inputs and Food Preparation Time for Men and Women

	MEN, N=13,310				WOMEN, N=17,422			
	Market inputs		Time		Market inputs		Time	
	Coef	t-stat	Coef	t-stat	Coef	t-stat	Coef	t-stat
Intercept	6.864	56.5	-1.182	-5.6	6.095	57.3	0.196	1.6
Log household size	-0.321	-7.7	-0.740	-10.2	-0.306	-8.9	-0.771	-19.8
Log wage	0.196	13.7	0.061	2.5	0.229	14.5	0.028	1.5
Gamma*	-0.137	-1.4	-1.431	-8.3	-0.074	-1.0	0.321	3.9
No children in household	-0.022	-0.6	-0.044	-0.7	-0.030	-0.9	-0.182	-4.9
Number children under 7	-0.078	-3.0	0.195	4.4	-0.079	-3.3	0.205	7.7
Number of children 7-13	-0.051	-2.3	0.142	3.6	-0.059	-2.8	0.112	4.8
Number of children 14-17	-0.017	-0.6	0.150	3.0	-0.006	-0.2	0.118	3.9
Log per cap income others	0.106	13.3	0.133	9.6	0.149	19.7	0.047	5.4
Age	-0.022	-5.3	0.065	9.1	-0.007	-2.4	0.132	37.7
Age-squared	0.000	6.6	-0.001	-8.3	0.000	3.4	-0.001	-39.3
Employed	0.233	8.7	-0.337	-7.2	0.230	10.5	-0.282	-11.3
Own house	-0.354	-11.6	0.099	1.9	-0.302	-11.2	0.061	2.0
Own car	0.272	10.3	-0.172	-3.7	0.244	9.6	-0.051	-1.8
Grows food	-0.140	-5.4	0.342	7.6	-0.083	-3.7	0.121	4.8
Married	-0.025	-0.8	0.183	3.2	0.068	3.0	0.465	17.7
Rural area	-0.710	-23.4	0.397	7.5	-0.693	-25.9	0.096	3.2
Year=1995	-0.022	-0.7	0.097	1.9	0.050	1.8	-0.020	-0.7
Year=1996	-0.188	-6.2	0.192	3.7	-0.110	-4.1	-0.057	-1.9
Year=1998	-0.521	-16.6	-0.005	-0.1	-0.499	-17.6	-0.078	-2.4
Northwest	0.079	1.4	-0.045	-0.5	0.129	2.7	0.005	0.1
Central	-0.078	-1.7	-0.293	-3.8	-0.002	0.0	-0.027	-0.6
Urals	-0.176	-3.8	-0.383	-4.7	-0.147	-3.7	-0.195	-4.3
Volga	-0.424	-9.2	-0.418	-5.2	-0.311	-7.7	0.048	1.1
Caucasus	0.242	4.8	-0.178	-2.1	0.280	6.4	-0.007	-0.2
East Siberia	-0.031	-0.6	-0.193	-2.2	-0.039	-0.9	-0.025	-0.5
West Siberia	-0.233	-4.6	-0.081	-0.9	-0.282	-6.4	-0.030	-0.6
R-squared		0.26		0.09		0.25		0.18

Note. - OLS regression coefficients.
Dependent variables: log per capita expenditures on food, $ln(x/n)$ and log food preparation time, $ln(t_i)$
*Gamma is the slope of the extra term in the spline functions.

Table 3.9 Goods-Intensity of Food

	Estimate	t-stat
Intercept	4.713	32.03
Log household size	-0.256	-5.6
Gamma	-0.212	-2.79
Log wage	0.276	14.74
Only adults, no children	0.048	0.77
Age	-0.030	-6.84
Age-squared	0.000	8.44
Male	0.027	1.06
Log per cap non-labor income	0.002	0.23
Share of children under 7	0.484	2.98
Share of children 7-13	0.556	4.0
Share of children 14-17	0.085	0.52
Share of men in adults	0.010	0.2
Employed	0.492	13.43
Own house	-0.221	-6.57
Own car	0.300	9.32
Grows food	-0.304	-10.88
Rural area	-0.650	-19.54
Year=1995	-0.003	-0.09
Year=1996	-0.189	-5.79
Year=1998	-0.280	-8.38
Northwest	-0.006	-0.11
Central	-0.005	-0.1
Urals	0.042	0.85
Volga	-0.319	-6.34
Caucasus	0.093	1.7
East Siberia	-0.043	-0.8
West Siberia	-0.24	-4.48

Note. - OLS regression coefficients. Dependent variable: *ln (x/t)*.
Sample: households, N=14,394, R-squared =0.26

Table 3.10 Percent Protein in Daily Diet

	Estimate	t-stat
Intercept	11.121	47.5
Log household size	-0.038	-0.48
Log wage	0.268	8.53
Gamma	0.370	2.15
No children in household	0.107	1.47
Number of children under 7	0.002	0.03
Number of children 7-13	-0.060	-1.32
Number of children 14-17	-0.080	-1.36
Log per cap income of others	0.107	6.63
Male	0.470	10.94
Age	0.005	0.66
Age-squared	0.000	-0.1
Employed	0.250	5.0
Own house	0.021	0.34
Own car	0.515	9.52
Grows food	-0.270	-5.4
Married	0.194	3.54
Rural area	0.346	5.83
Year=1995	0.100	1.69
Year=1996	0.039	0.66
Year=1998	-0.035	-0.56
Northwest	-0.556	-5.19
Central	-0.647	-7.49
Urals	-0.441	-4.9
Volga	-0.096	-1.07
Caucasus	-0.112	-1.15
East Siberia	-0.519	-5.33
West Siberia	-0.58	-5.98

Note. – OLS regression coefficients. Sample: adults, N=30,635.
Dependent variable: Percent of protein in daily diet. R-squared = 0.03.

Chapter 4

The Russian Labor Market in Transition: Time to Work or Time to Rest?

4.1 Introduction

Russia's transformation from a centrally-planned to a market economy began with the dissolution of the Soviet Union in December 1991. The transition brought profound changes to the Russian labor market. During the 1990s, most of the work force remained employed in the state sector, which was heavily dependent on state subsidies and often-uncompetitive and inefficient. When subsidies were cut off, many factories were forced to shut down or reduce work hours. Wage payments to workers were often delayed for several months. Those workers who kept their jobs experienced hidden unemployment in the form of restricted work hours and unpaid leave. At the same time, the new private sector emerged. In contrast to other East European countries, where small entrepreneurship had existed legally during communism, the Russian communist regime abolished private enterprise in the 1920s and did not legalize it until the late 1980s with *perestroika*. The result was that the new Russian entrepreneurs lacked not only start-up capital, but also management experience and training. The investment of long work hours in building management skills and business networks were an unavoidable part of the fixed costs of starting up own business. The investment was worth it: private sector employment generally offered higher monetary reward compared to the state sector.

Recent literature on labor markets in transition, reviewed in the next section, focused extensively on labor market participation decision, returns to education, investment in human capital, wage arrears and occupational mobility. Surprisingly, none of the papers modeled a two-sector labor market and a worker's decision with regard to the sector of employment. Also, none of the recent studies examined the broader issue of how various labor market shocks during transition affected the family's allocation of time within the home sector.

When people became unemployed, what did they do with their time? Did they enjoy more leisure and take better care of their children, or did increased work at home merely replace market work? Did people who experienced positive shocks in the labor market reduce their involvement into housework and childcare, or did extra time in the market come at only the expense of leisure? The Russian transition provides a convenient setting for studying individuals' time allocation decisions in response to exogenous labor market changes. This study demonstrates the importance of a proper understanding of individual's labor options in analyzing the non-market sector.

This chapter models the decision of an individual who allocates time to market and non-market activities and who may work in either the state-run or the private sector. A household production framework is used. The flexibility and theoretical grounds for this framework are discussed in Section 4.2. I extend the classical version of the household production model to incorporate the features of the Russian labor market in transition and show that earnings are a better approximation of worker's well-being and abilities than wages. Using cross-sectional and panel data, I estimate that the Russian population overall, whether voluntarily or not, enjoyed more leisure during transition than before. Men and women who became unemployed during transition substituted ¾ of time previously spent in the market for leisure. Unemployed individuals who became employed gave up mostly leisure time for market work. In response to higher earning opportunities, men who were already employed reduced leisure while employed women also cut down their time spent in childcare, housework and sleep.

Following the literature overview in Section 4.2, I discuss the theoretical model of the individual allocation of time in Section 4.3. Section 4.4 introduces the data set and describes the empirical results. Section 4.5 discusses the results.

4.2. Literature Review

4.2.1. Transitional Russia: The Two-Sector Economy

Under central planning, occupational training was paid for by the state, jobs were centrally assigned and guaranteed, and involuntary unemployment was virtually non-existent. Hours, wages and benefits were set by the state rather than by the labor market. At the same time, the Soviet labor market resembled Western labor markets in several important respects. The male-female wage differential was about 30%, similar to that of the US. The returns to investment in human capital were positive: higher levels of education and job experience provided higher compensation and better access to non-wage benefits[12]. Market reforms removed the state monopoly on training and employment. Wages in the new economy, unlike the old, were determined by supply and demand for skills. Certain skills quickly became obsolete, such as training in the economics of planning and law. Demand for training in business, management, finance, economics, international law, accounting and computers increased.

The emergence of the new economy was accompanied by the collapse of production in the government sector. During the years 1992-1996, per-capita real GDP in Russia declined by 8.5% per year on average, and by 1998 the economy was at 50% of its 1991 volume. In spite of this tremendous fall in output, official unemployment rose only by 7%, from 4.9% in 1991 to 11.7% in 1998. Two unique phenomena contributed to this. First, state sector enterprises retained workers by resorting to pay cuts, nonmonetary compensations, restricted hours and mandatory leaves rather than to layoffs. Earl and Sabirianova (1999) and Lehmann et al. (1999) suggest that persistent wage arrears in the state sector also contributed to workers' incentive to remain longer

[12] Gregory and Kohlhase (1988) use a survey of over 2,700 immigrants to the United States in 1979-82 who were asked to recall their earnings back in the Soviet Union. They report return to university education in the Soviet Union relative to secondary was around 22%, return to experience was 2-3%. They find women's earnings were 22-29% less than those of men with similar education and personal characteristics.

with their employers even despite being able to procure only part time work.

The second factor was a simultaneous increase of entrepreneurial activity, secondary employment and moonlighting. Two out of three families, including urban and highly educated but mostly older households, engaged in small-scale agriculture for household consumption[13]. With plenty of spare time and looking for cash income, some government employers often worked extra hours in low skill occupations. A doctor might run a clothing store, a musician work as a cab driver, a professor sell newspapers, or an engineer exchange currency. According to one estimate[14], the size of the shadow economy rose from 19% of GDP in 1992 to 54% in 1997.

In the official sector, 70% of large state enterprises were privatized by 1998. Those companies, however, remained uncompetitive, suffering from poor management and disorganization[15]. Against this backdrop, many young Russians chose small business entrepreneurship, a course made more difficult by high start up costs, punitive taxes, widespread corruption, and the absence of functioning capital markets.. Entrepreneurship often required substantial investment of time, effort and resources in hope to gain experience and establish a functioning business. Young people were ready to make this investment.

The effects on the rapidly-implemented market reforms varied between the young and the old, between men and women, and between those with more and less educated. Several studies of the Russian labor market (e.g. Brainerd, 1998, Flemming and Micklewright, 1999) have documented an increase in wage inequality attributable to changes in the returns to human capital. Brainerd conjectures that older people fared worse than the young because they had less incentive to acquire new skills, while women fared worse than men because private sector employers perceived women as

[13] In 1998 home food production accounted for 53% of agriculture, 19% of household income, and 4% of GDP, according to Mroz, Henderson and Popkin (2001) p. 5, and Economic Research Service US Department of Agriculture at www.ers.usda.gov/briefing/Russia.

[14] See Eilat and Zinnes (2000). They report the size of the shadow economy using electricity consumption.

[15] See Blanchard and Kremer (1997) for a micro analysis of disorganized bargaining between suppliers and buyers in transition.

higher-cost employees because of their responsibility for caring for the family. On the other hand, older women were more willing than older men to undertake retraining, which was most likely a consequence of men's lower life expectancy.

In contrast to increased labor force participation of women in the industrialized countries throughout the 1990s, the market participation of the Russian women declined. Foley (1997a) finds that education became a major factor determining labor market participation. Brainerd (1998) and also Nesterova and Sabirianova (1999) show the returns to education nearly doubled between 1992 and 1994, and increased only modestly in the later years, and that returns were higher for women than for men. Brainerd (2000) and Newley and Reiley (1999) find that the male-female wage differential widened in transition. Foley (1997b) showed that married women and older individuals had experienced longer unemployment spells at the start of the transition. Sabirianova (2000) documents a substantial increase in occupational mobility during the transition, explained by the destruction of existing jobs and the creation of new opportunities.

4.2.2. The Household Production Framework

The household production model introduced by Becker (1965) and extended by Gronau (1976) is a rich and flexible framework that permits numerous extensions and allows the exploration of several non-market activities at a time. Its approach is to treat the household as a firm that produces a utility maximizing set of commodities from a combination of market goods and time. A wealth of research has applied the household production framework to various issues in labor economics and other fields.

Gronau (1977) established several stylized facts, such as that married women work more at home and spend more time with children than men, while men work more in the market. An increase in wages reduces individual's work at home, while an increase in household income increases leisure and decreases market work. Graham and Green (1984) included the possibility of joint production so that time in housework may also serve as leisure. They found evidence that jointness is stronger for wives than for husbands. Becker (1985) extended his earlier model of household production to include another dimension, effort. He argued that lower market earnings for women may be a result of the lower effort intensity of women's market jobs due to the more demanding nature of childcare and housework responsibilities. A study by Kiker and Mendes de Oliveira (1991) suggested that failing to account for the joint determination of household time to different activities leads to underestimation of the returns to human capital in the conventional Mincer wage equations, even when corrected for selectivity bias with the Heckman two-stage technique. Solberg and Wong (1991) analyzed how the fixed time costs of commuting affect the allocation of time between market work, housework and leisure, and found that a longer commute is positively related to time spent in the market and negatively related to time spent in all non-market activities. Biddle and Hamermesh (1990) explored the relationship between sleep time, wages and market work in a model where sleep influences wages by affecting labor market productivity. They demonstrated that both an increase in the time in the labor market and an increase in wages reduce sleep. More recently, Gronau and Hamermesh (2001) analyzed how differences in the opportunity costs of time resulting from different educational attainment affect the demand for a variety of non-work activities. Benhabib, Rogerson and Wright (1991) introduced household production into the macroeconomic stochastic growth model and argued that this approach helped explain several puzzles of the business cycle. In the legal economics literature, the household production framework is widely used to calculate the losses from home services in the event of divorce, disability or wrongful death.

4.3 Theory of the Allocation of Time within the Household

4.3.1 The Classical Household Production Model

The classical model of household production used here was developed by Becker and extended by Gronau. In this model, a single person household derives utility from the consumption of commodities *X* and leisure time *l*. Commodities can either be purchased in the market, X_M , or produced at home, X_H. The composition of *X* does not affect utility. The value of home goods and services is measured in terms of market equivalents. Home goods are produced from home production time *H*, whose production technology *f(H)* is subject to decreasing marginal productivity. The endogenous budget constraint postulates that expenditure on market goods may not exceed labor and non-labor income. The time constraint requires that the total time spent on market work , work at home and leisure is equal to the time available.

The individual solves the following problem:

max $U(X, N)$ subject to

$$\begin{aligned} X &= X_M + X_H \\ X_H &= f(H) \\ X_M &= wL + V \\ L + H + N &= T \end{aligned} \qquad (4.1)$$

The optimal combination of goods and time for the interior solution is given by the first-order conditions:

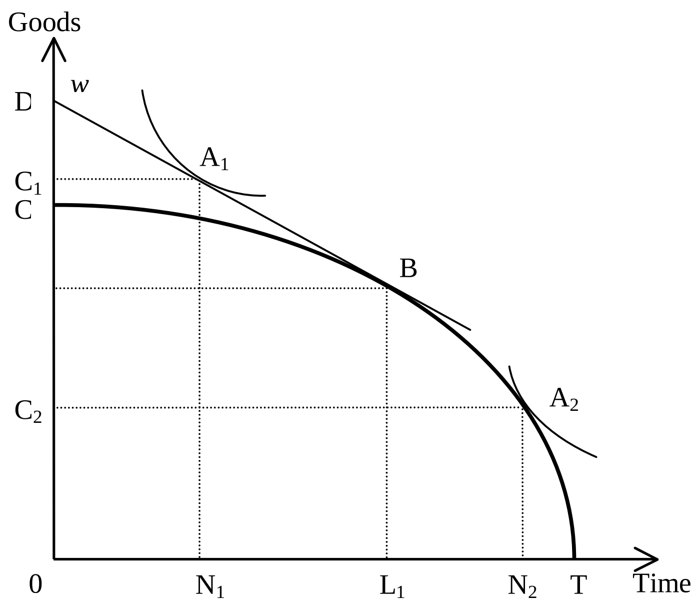
$$\frac{U_N}{U_X} = f' = w \qquad (4.2)$$

These conditions require that the marginal product of work at home is equal to the marginal rate of substitution between goods and leisure, which in turn equals the shadow price of time, *w*. For a person who works in the market the shadow price of time is the wage rate. The individual's choices are illustrated in Figure 4.1.

The home production function is described by the concave curve TC. The more time the individual spends working at home, as measured by the horizontal distance from point T, the greater the amount of home goods produced. If the individual spends all of his time at home, he can produce OC units of goods. With the real wage rate *w* described by the slope of the line BD, the opportunity frontier expands to TBD. At the optimum, a person with a high preference for goods will choose a good-intensive combination of goods and leisure, such as point A_1, which provides C_1 units of goods, N_1 units of leisure, and implies N_1L_1 units of time on work in the market and L_1T units of time on work at home. A person with a high preference for leisure will choose point A_2, where he works at home N_2T producing C_2 units of goods and enjoys ON_2 units of leisure.

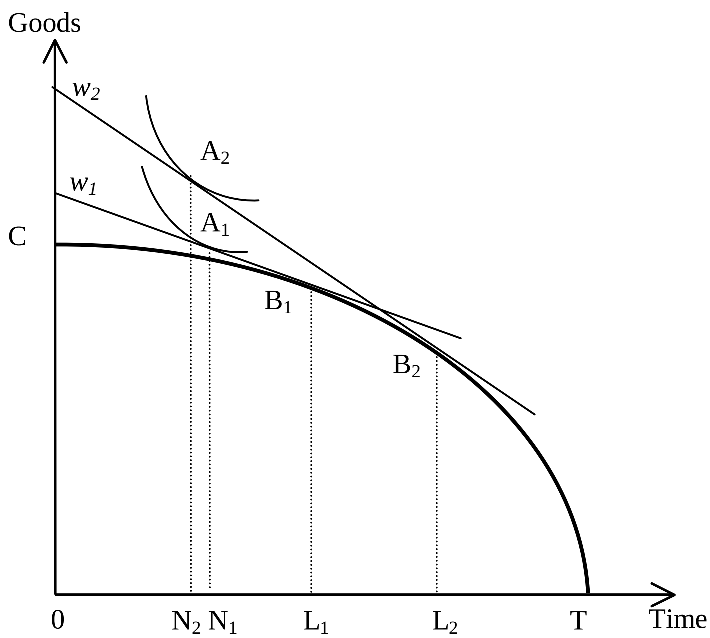
An increase in wages may lure a person who initially does not work and consumes at immediately to the right of point B into the market, or it may leave the individual choice completely unaffected, such as at point A_2 .

Figure 4.1. Individual's Choices: Classical Household Production Model



An increase in the real wage rate from w_1 to w_2 is illustrated in Figure 4.2 below. For an employed individual, the wage rate affects the rate of substitution between leisure and goods as well as the profitability of home production. Market goods become relatively cheaper, so work at home decreases from L_1T to L_2T. The effect of the wage increase on leisure and market labor supply depends on the relative strength of the income and substitution effects. If the income elasticity of leisure is small, the marginal utility of goods is high and the marginal productivity of home production is low, then the market labor supply will increase and leisure time will decrease as wages go up. This case is illustrated in the Figure 4.2, where the higher wage rate w_2 corresponds to more market work ($N_1L_1 < N_2L_2$) and less leisure ($ON_1 > ON_2$). With a higher preference for leisure, point N_2 would be between N_1 and L_1, meaning that both market work and leisure may increase at the expense of home production time.

Figure 4.2. Increase in The Wage Rate: Classical Household Production Model



Gronau (1977) argues that an increase in unearned income does not change the amount of time an employed individual spends working at home, but rather increases his leisure at the expense of market work. For an unemployed individual, he shows that higher unearned income decreases work at home in favor of leisure.

Children are treated as exogenous in this model and are usually regarded as home commodities. This assumption implies that intra-family differences in the number of children reflect differences in utility functions and random factors. Outside the model, Gronau shows that children have the greatest impact on the woman's allocation of time. An increase in the demand for children results in an increase in specialization, meaning the woman spends more time in work at home and less time in the market.

In transitional Russia, where the population is relatively poor and subsistence household production is prevalent, the marginal utility of goods must be high and the marginal productivity of home production must be low. Thus, according to the classical household production model, higher wages in Russia should result in more time spent in the market and less leisure. A higher opportunity cost of time as measured by the hourly wage rate should also result in fewer hours spent on household production. However, hourly wages and hours spent in the market are negatively correlated in Russia. In a sample of employed adults described in details in the data section, the statistically significant coefficient of correlation of individual time spent working for a wage and the hourly wage rate is -0.10. Moreover, hourly wages are positively correlated with time devoted to non-market activities such as pure leisure, excluding household production and sleep (the coefficient of correlation is 0.8 and highly significant) and sleep (the coefficient of correlation is 0.02 and significant at the 5% level). While household production time is significant and negatively correlated with wages, the coefficient is small in absolute value: only -0.04[16].

4.3.2. Market Imperfections in the Household Production Model

There are several reasons why the observed hourly wages reflect neither the opportunity cost of time nor ability for many Russians in the imperfect transitional labor market. First, in a situation where work hours are restricted, the opportunity cost of after-work hours can no longer be considered the wage rate at the primary job.

[16] Correlations are reported in Table 4.5.

Secondary jobs are scarce in times of high unemployment and are more likely to be filled by higher ability workers. If secondary jobs pay less per hour than primary jobs, the data will show that higher ability workers work longer hours at a lower wage rate. A simple example illustrates this.

Consider a firm using a production line technology which halves its production in response to decreased demand. The firm retains all of its workers at the same wage rate, but they work 4 hours a day instead of 8. However, it also requires some unskilled work with a lower pay scale (perhaps secretarial work) when the production line is down. In a poor economy with low personal incomes, a high marginal utility of income, and widespread involuntary unemployment, high-ability workers will accept lower paying secondary jobs, and their hourly wage will be lower even thought they are better off than those who do not have secondary work opportunities. In this situation, estimating a wage equation naïve to the restriction on hours with cross-sectional data show that the most able workers have lower hourly wages and that there is a negative elasticity of hours with respect to wages.. In the economy described, the wage rate reflects neither individual's ability nor welfare.

The second factor that contributes to the negative elasticity of work hours is the existence of young entrepreneurs willing to work long hours, investing time in learning, in exchange for a minimal monetary return. For the self-employed, deriving hourly wages by dividing total earnings by hours includes the fixed cost of start-up underestimates the returns to an hour of time. The more time the worker spends in activities at the job which do not produce short-term earnings, the lower observed hourly wages.

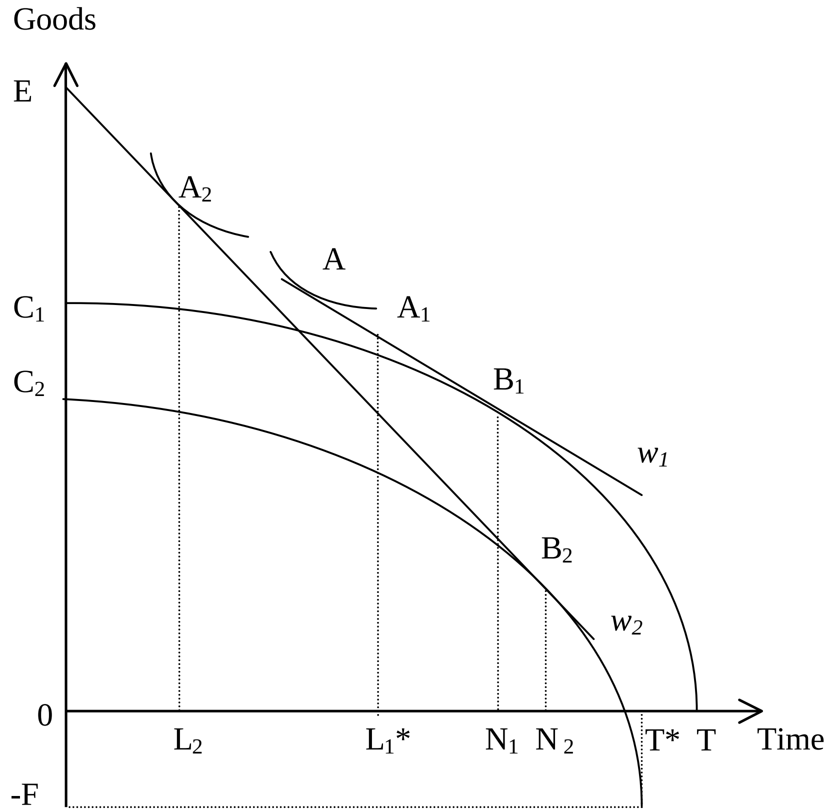
In terms of the household production model, suppose that the labor market offers two types of jobs. The individual can work up to L^* hours and be paid at hourly rate w_1, or she can set up her own business, incurring an upfront monetary cost F and time cost t. Once the costs are paid the individual can work unlimited hours at a wage rate $w_2 > w_1$. The utility function is the same, $\max U(X,N)$, but the budget and time constraints now include the restrictions above:

$$X_M + \delta F = w_{\delta+1} L_{\delta+1} + V$$
$$L_{\delta+1} + H + N + \delta t = T \qquad (4.3)$$

The parameter δ indicates the employment options. The state sector employment corresponds to δ=0, where the individual can work $L_1 <= L^*$ hours at hourly wage w_1. Private sector employment corresponds to δ=1, with market labor supply $L_2 > 0$ and hourly wage rate w_2. The person is faced with three alternative opportunity sets as depicted in Figure 4.3.

She can stay home and consume at the boundary TC_1. If she works in the state sector and wants to consume at point A, a constraint on labor supply would reduce desired consumption to point A_1 where she works at home for N_1T hours, works in the market for $L^*_1N_1$ hours at wage w_1, and consumes OL_1 units of leisure. Alternatively, at a loss of F units of goods and t units of time, the opportunity locus shifts down. A person with greater preference for goods may want to pay the setup costs and consume at point A_2, where she works long hours in the market L_2N_2, shorter hours at home N_2T^*, and enjoys less leisure OL_2.

Figure 4.3 Individual's Choices under Imperfect Labor Market with Constrained Hours and Fixed Costs



The net wage rate w_2, although higher than w_1, is unobservable. What is observable from the data on earnings and hours of work is the after fixed costs wage rate w_2*:

$$w_2^* = \frac{w_2 L_2 - F}{L_2 + t} \tag{4.4}$$

When F and t are large, the observed wage rate w_2* may be smaller that w_1, $w_2^* < w_1 < w_2$. In this case, the cross-sectional relationship between wage and hours of market work is negative, while the relationship between housework and wage may be positive - the opposite of what the classical model predicts. In this economy, longer hours of market work in the new sector may correspond to lower net hourly wages, and shorter hours of work in the old sector result in higher hourly wages.

An increase in non-work income has an effect similar to that of the classical model: it secures for the person a certain amount of market goods even if the person spends all his time in consumption. On the graph, it corresponds to a horizontal shift of the opportunity set which does not change the shape of the curve. It does not affect work at home for the employed, but increases leisure and decreases market work. For unemployed individuals, an increase in unearned income increases leisure at the expense of work at home. In both cases, higher unearned income should increase the demand for leisure.

When the preference for goods is high, the majority of people prefer to work a full day in the new sector rather than a half-day in the old sector, even though net pay does not double. The new sector labor market in this case is competitive; with access to its opportunities determined by a number of factors including individual human capital. Factors positively affecting labor supply to the new economy include better education, longer work experience in the new economy, access to start-up capital. Because of the need for flexibility and the investment of extended work hours, the new sector tends to favor the young and men.

The existence of high start-up costs implies that workers who choose jobs in the new sector will only work long hours. Workers in the old sector work only short hours because work hours are restricted. In this economy, a choice between long and short hours is equivalent to a choice between higher and lower total earnings. Thus, even though the relationship between hourly wages and market time can be negative, total earnings is be positively associated with market work and negatively associated with housework and leisure. Monthly or weekly earnings better reflect an individual's ability and labor market success than hourly wages.

4.4 Patterns of Time Use: Empirical Evidence

4.4.1 Data

The empirical analysis uses four years of data from the Russian Longitudinal Monitoring Survey collected in 1994-98. This survey, compiled by the Carolina Population Center of the University of North Carolina at Chapel Hill, is the first nationally representative household sample of Russia designed to measure the effect of Russian reforms on the well being of the population. The survey covers a wide range of issues related to economics, health and politics[17]. The total of 12 rounds of this survey are available to date, but only the selected four years, 1994, 1995, 1996, 1998, collected time use information.

The size of the sample varies across the rounds of the survey, ranging from over 10,000 individuals in 1994 to under 9,000 in 1998. Households that move out of their original residences or decline to participate in the next round, causing sample attrition, generally have higher median incomes and expenditures, are more likely to live in Moscow or St. Petersburg, and are more likely to be a single.

The survey collected data on all household members about each adult regarding his/her education, employment status, monetary and non-monetary compensations from primary, secondary and unregistered jobs, hours of work in the last 30 days, and job characteristics. The time use section questioned respondents about the time spent in the last 7 days on different categories of activities. These included market, commuting, childcare, sleep, food preparation, cleaning, laundry, and others for a total of 14 activities. Household members present at the time of the survey provided answer on their own time use and on the time use of household members who were not present for the survey.

An initial concern was the retrospective recall nature of the time use data. Recall data is of lower quality than diary surveys,. To rule out as many inconsistencies as possible, I eliminated incomplete records. The data is constrained so that total time use does not exceed available time, time on total waking activities does not exceed total

[17] More information on the survey design and coverage can be found on the RLMS website: www.cpc.unc.edu/projects/rlms/papers.htm

time minus sleep, any given waking activity does not exceed 120 hours a week, and sleep takes up 35-84 hours. From this data, I selected individuals ages 18-65.

I assume that individuals divide their time between market work, housework, childcare, leisure and sleep. Work at home includes activities for which market substitutes exist: shopping for food, cooking and washing wishes, gardening, cleaning and repairs, laundry and ironing, and helping sick household members. This measure of housework understates home production, since it does not include errands as buying non-food items or paying bills. Home production activities which are not included in the available categories are included in leisure. Leisure is time that generates utility by itself. I define it as all waking time other than housework or market work. Childcare time was recorded in the survey as total time spent with children, including time spent jointly with other household activities that are classified as housework or leisure here. I checked data to make sure the number of hours spent with children does not exceed all waking non-market time.

Out of all eligible adults, 16%- 21% of observations were eliminated in each cross-section because of missing data. After correcting for missing data, the sample consists of 25,934 observations with up to four observations for each adult. Individuals who participated in all four rounds of the survey are included into a separate sample of adults for the panel analysis. This sample contains 3,114 individuals.

Weekly earnings are the sum of monthly earnings from all jobs divided by 4.3. Hourly wages are computed from monthly earnings from all jobs and monthly hours of work in all jobs. Respondents of the survey are asked work hours twice, once in the income section and again in the time use section. .Monthly earnings and hours from the income section are used in calculating the wage rate, meaning that monthly hours is not identical to 4.3 times the time spent in the labor market work last week in my time use analysis. Whenever computed rather than independently measured wages are used in estimations, a division bias may affect the quality of estimates. This is less of a concern here since the measures of hours come from a different source. Unearned income is calculated as total household income from all sources minus the individual's own income, divided by the household size.

4.4.2. Analysis of Mean Values

Each year of the survey contributed an equal share to the final sample. Every fourth individual lives in the rural area, a third of all individuals come from households with pre-school children and over a half of the sample comes from a household with a school age child. The average age is 40 years old, and 45% of the sample are men. Comparing the sample characteristics in Table 4.1, fewer than 10% of men and 17% of women are retired[18]. About 4% are students. Women are on average more educated than men: 18% of women and 16% of men have university degrees. Market participation rates declined steadily for men and women over the years of the survey. Only 55% or women and 65% of men reported that they are employed in 1998, compared to 59% and 74% in 1994. These numbers may overstate the decline in participation rate if under-reporting of income or work hours became more prevalent over time. This would result in a relatively larger loss of observations among the employed. Both earnings and per-capita household income declined over time. Curiously, own earnings are up to two times higher for the average man than for the average woman, but the opposite is true about the per-capita income of other household members.

The average time allocation numbers suggest that women work longer hours than men when work both in the market and at home is taken into account. In 1998, the average woman spent 50 hours/week on housework and market work combined while the average man spent less than 38 hours in the same activities. Men work more in the market than women, on average 30 hours compared to 23 hours for women in the same year. Women work more at home than men, over 27 hours/week, compared to less than 8 hours for men.

[18] In Russia, the retirement age is 55 for women and 60 for men, but it is common to work past retirement age.

Total hours of work at home and in the market declined steadily over the years for both men and women. Men's hours of market work declined by more than 5 hours per week, from 35 to under 30 hours. Women reduced their market involvement by less than 1.5 hours, from over 24 to fewer than 23 hours. Work at home declined by 8 hours for women (from 35 to 27 hours), and by over 3 hours for men (from 11 to less than 8 hours). Less time was allocated to all household responsibilities in 1998 compared to 1994. For instance, the average woman spent over 5 hours shopping for groceries in 1994, but only 3.2 hours in 1998. The average man spent 2 hours buying food in 1994, but only 1.2 hours in 1998. Lower food shopping hours were probably caused by improvements in food availability in the late 1990s and perhaps the expansion of the fast food industry. Similarly, the increased availability of cheap market substitutes for home-sewn clothing, imported household appliances and a growing variety of domestic services most likely account for a 1.5-hour drop for women in the time spent on laundry and sewing and the equal drop for men in household repairs. Together with a reduction in food preparation time, these are certainly welfare improving changes. It is less obvious whether the decrease in childcare time over the same period affected household welfare in any way. While the data shows a decline of over 2 hours/week in the time women spent with children and several minutes decline in the same activity for men. The share of households with small children also decreased.

Over the same period, specialization within the household remained virtually unchanged. Women continued to spend 2.5 times as many hours grocery shopping, six times as many cooking, five times more cleaning, and ten times longer sewing and laundering clothing. Leisure time increased by almost 8 hours a week for men and over 9 hours for women over the 1994-98 period. There was also a one-hour per week increase in time devoted to sleep.

Table 4.2 shows mean values for men and women by employment status. The average reported number of hours spent in the market is surprisingly high. Women work on average 42 hours and men almost 48 hours. Non-wage earners work more at home than the employed do. A , woman who is not employed on the labor market spends over 7 hours more doing housework than an employed woman, and a non-employed man spends 6 hours more doing housework than an employed man. Wage earners enjoy substantially less leisure than the non-employed. When total work in the market and at home is considered, employed women work up to 35 hours more, and employed men up to 42 hours more than their non-employed counterparts. Education appears to be an important factor determining market participation. The employed are more educated than an average person and the non-employed are less educated.

Non-employed women are on average older than the employed and they spend over 8 hours/week more in childcare than their working counterparts. They also sleep 3 hours/week longer and enjoy 14 hours more leisure per week. Employed men spend on average more time with children than unemployed men, partly because they are more likely to be married and have children than their unemployed counterparts. Women with a university education spent one hour less time with their children in 1998 then they did in 1994, whereas less educated women report an equal increase in childcare time. This might indicate that over the years larger households moved towards greater specialization so that more educated younger women supply more market labor and less educated older women provide childcare, or be symptomatic of declines in birth rates among younger Russian women.

All groups experienced an increase in free time and sleep. Non-employed men have the highest hours of leisure and sleep, followed by non-employed women. Working women enjoy the least sleep and leisure.

Comparing the sample by marital status (not reported here) reveals that employment rates are higher for the married. This is particularly true for men: in 1998: 74% of married men have positive earnings versus only 51.2% of single men. The earnings of married people are higher despite their lower hourly wages. Married men and women work longer hours in the market and consume less leisure than their single counterparts. Marital status does not change the time men spend working around the house. The total time spent on work at home and in the market is substantially higher for women, single and married, than for men. An average single woman worked almost

2 hours more than a single man for an hourly wage over 40% less. Splitting the sample by age with a cutoff at age 40 (also not shown here) reveals that the allocation of market and housework between the young and the old women remained almost unchanged: the young work a little more in the market while the old work more at home. Older women work about 4 hours more than their younger counterparts. The childcare pattern changed somewhat: although most childcare is done by younger women, older women put in 2.5 extra hours of childcare in 1998 compared to 1994, filling in for reduced time spent with children by the younger women and by men of all ages.

Table 4.3 helps compare market work hours, wages, and total earnings of the employed individuals by the four ownership categories. Over 64% of working adults report that their company is owned by the government, 14% work for a privately owned business, less than 3% of workers are employed by a firm owned at least in part by a foreign company. The rest of the individuals (19.1% of all working adults) report being self-employed, however, it is hard to distinguish true entrepreneurs from those working in small-scale activities on the informal market. Entrepreneurs are younger men and women who start up own businesses with an intention to take risk, hire workers and stay in business. These self-employed are different from older, often retired, moonlighters who engage in temporary income-generating activities like cab-driving or reselling on a local market. Higher average age of the self-employed indicates the presence of the moonlighters in that ownership category. While women dominate the state sector jobs, the private sector is more likely to employ men. Wages and weekly earnings are higher in the private sector than in the state sector, with the highest paying jobs offered by foreign owned firms. This is consistent with the evidence in the literature that foreign firms select workers with the highest abilities and offer better compensation. Private sector employees in general work longer hours in the market and shorter hours at home than the government sector workers. However, the difference in the market work is surprisingly small, 44 hours/week on average in the state sector compared to 47 hours/week in the private sector. There is no clear pattern between the time adults spend sleeping or enjoying leisure and the sector of employment. About equal share of workers, 14-16%, hold secondary jobs. As in the data from other countries, income from self-employment and secondary jobs is most likely understated. This is a problem in addition to the general difficulty of measuring wages of the self-employed because there is no good way to account for their asset ownership.

4.4.3. Mean Changes in Time Use by Employment Status

The panel feature of the data permits analysis of the mean changes in time use that occurred as a result of changes in individual employment status. I select individuals for whom there is information from at least two consecutive surveys. These are divided into four groups: those with a transition from employment to unemployment from one year to the next; those with a transition from unemployment to employment; those who remained employed; and those who remained unemployed. For each group, I compute the average change in men and women's time allocated to different activities (Table 4.4).

Among the continuously employed, housework and childcare decreased from one year to the next, market work and sleep remained unchanged, while leisure time increased, especially for women. Those who remained unemployed worked at home fewer hours a year later and even spent a little less time with their children. The shift of time away from housework and a simultaneous increase in leisure suggests that both employed and unemployed individuals substituted at least some of the time previously spent in housework for leisure.

The transition from employment to non-employment freed over 40 hours for women and almost 47 hours for men. This extra time is not allocated proportionally to housework, childcare and leisure, but rather spent mostly on leisure. Women spent 61% of the time previously occupied by market work on leisure while men spent 78% of their freed hours on leisure.

Individuals who were unemployed and became employed increased their market time mostly at the expense of leisure. Men's increase in market work from 0 to 47 hours was accompanied by a 34-hour decline in leisure, an 8-hour decline in housework, a 2.5 hour drop in childcare and a 3-hour decrease in sleep. As for the newly-employed women, their 39-hour long work week reduced leisure by only 17 hours, while the other 22 hours of extra market work came in nearly equal shares from the time previously spent in housework and childcare. A decrease in men's housework of 8 hours a week is proportionally higher than an 11-hour decrease in housework for women given that women spend over 3 times more time in this activity. The 11-hour decline in childcare time for women who become employed combined with only a 6-hour increase in childcare time by women who exit employment may signal a decrease in the quality of childcare, the simple averages do not account for a change in the number of children.

4.5 Econometric Analysis

4.5.1. Cross-Sectional Analysis

In this section, I transform the relationships from the theoretical model into equations that can be estimated. The goal is to establish an empirical link between the individual allocation of time in the home and performance in the market sector and unearned income. Since the model has two constraints, two demand relationships can be dropped. In this case it is convenient to omit the demand equations for goods and for the market time and focus only on non-market time.

In order to separate labor market shocks and changes in income from the effect of education, age and other factors that may influence the allocation of time, I estimate the following time demand equations separately for men and women:

$$T_k = \gamma_{0k} + \gamma_{1k} \ln W + \gamma_{2k} \mathrm{X}_3 + \varepsilon_k \qquad (4.5)$$

where *k* indexes nonmarket activities (housework, sleep, childcare and leisure), *W* is hourly wage rate or earnings for workers and imputed values for the non-employed, , X_3 is a vector of other explanatory variables and ε is the i.i.d. random error. Characteristics included in X_3 are education, age, age squared, the presence of children, the number of preschool and school-age children, marital status, the number of disabled and unemployed adults in the household, rural or urban status, residence in a house compared to an apartment, land ownership and the year of the survey.

First, I run the time use regressions (4.5) in the sample of employed individuals using observed hourly wages as an explanatory variable. The parameter estimates in Table 4.6 imply that higher wages reduce women's housework and have no significant effect on men's housework. There is no significant relationship between wages and childcare time for either men or women. Sleep appears to increase with wages for women, but not for men. Leisure time increases steeply with wages for all individuals. The positive effect of wages on sleep and absence of an effect on men's housework is in contrast to the empirical evidence found in the literature. The strong positive effect of wages on leisure is the opposite of what one would expect in a country where residents struggle to survive. Thus the estimates confirm the suspicion that observed wages are a biased measure of the opportunity cost of time and worker's ability in an imperfect labor market.

In search of a better measure of labor market opportunities, I explore the relationship between the employed worker's labor supply and his/her allocation of time at home. For employed individuals, I estimate the relationship between hours of market work and hours of housework, childcare, sleep and leisure:

$$T_k = \gamma_{0k} + \gamma_{1k} T_w + \gamma_{2k} \mathrm{X}_3 + \varepsilon_k \qquad (4.6)$$

Parameter estimates in Table 4.7 show a highly significant negative relationship between market time and each of the non-market time uses, with the largest and strongest effect on leisure. An extra hour of work for wage reduces women's leisure by 43 minutes and men's leisure by 53 min. Extra work reduces women's housework and childcare time three times more than it reduces men's time in similar activities.

The theoretical model suggests that jobs with longer hours of work are most likely to be in the private sector. Longer hours of market work then may be positively correlated with individual's abilities. On the other hand, higher productivity implies fewer hours are needed to complete the same task. Therefore, hours supplied to the market, like individual's observable wages, are perhaps not a good approximation of the worker's ability and the opportunity cost of time. The combination of market time and wages – the worker's total labor earnings – should solve the problem, according to the model. The model predicts a negative relationship between earnings and time for all non-market activities and a positive relationship between unearned income and leisure.

For those who are not employed, I estimate potential earnings using information on employed individuals. Following Heckman's technique to correct for possible selection bias, I first estimate a probit equation for the probability of labor force participation:

$$p = \alpha_0 + \alpha_1 X_1 + \eta \qquad (4.7)$$

where p is the probability that wages are observed; X_1 is the vector of determinants of the employment status detailed below; and η is a normally distributed error term. Second, the inverse Mills ratio is calculated and included in the reduced weekly earnings equation:

$$\ln w = \beta_0 + \beta_1 \lambda + \beta_3 X_2 + \upsilon \qquad (4.8)$$

where the dependent variable is the log of total weekly earnings; λ is the inverse Mills ratio; X_2 is the vector of determinants of earnings; and ν is an i.i.d. random variable. The estimates of the earnings equation are used to calculate implicit earnings for the non-employed as average weekly rates for persons of similar age, education, family composition and region of residence. Recent literature has been critical of Heckman correction method, claiming that it may actually introduce additional errors. Alternate regressions performed without using the Heckman procedure yielded similar results.

Finally, I use the implicit earnings for the non-employed and the predicted earnings for the employed to estimate the time use equations (4.5).

4.5.2 Discussion of the Cross-Sectional Parameter Estimates

Market participation is explained by the variables in vector X_1: education, age, age squared, unearned income, the presence of preschool and school-age children in the household, the number of disabled and unemployed household members, student, retirement and marital status, land ownership and the local unemployment rate.

Separate probit estimates of the labor force participation function (4.7) for men and women (Table 4.8) reveal that education, family size, land ownership and the presence of other household members in bad health have significant positive effects on market labor force participation. Higher local unemployment rates, the presence of children and unemployed household members, and being retired, a student or in bad health decreases the probability of labor market participation for men and women. Higher unearned income is negatively related to the probability of being employed for men and women. Age and marital status contribute differently to men and women's labor market participation. Married men are more likely to work for wage while married women are less likely to do so. Women's participation profile is concave in age, but the age profile for men is flat. Evidence of flattening of the age-earnings profile for men in transition was reported in the recent literature. This occurred because the earnings of young men increased relative to the earnings of the old.

The individual earnings equation (4.8) explains earnings in terms of the following variables in X_2: education, age, age squared, unearned income, ownership type of workplace, (there are four exclusive ownership types: state, private, foreign or self), dummy variables for ten occupational categories (legislators/managers, professionals, associate professionals, clerks, service workers, skilled agricultural workers, crafts and trades, machine operators, unskilled occupations and military personnel), dummy variables for multiple job holders, house owners, good growers, those who report wage arrears, region of residence and the year of the survey. This equation is identified through the inclusion of occupational dummies, arrears, employer's ownership, ownership of assets, and exclusion of the household composition and student/retired status.

Estimates presented in Table 4.9 show that the coefficient estimate on the inverse Mills ratio is significant and negative. This indicates that selection bias may be present in the data, with higher unobservable ability corresponding to a higher probability of employment and higher earnings. Given the effect of education on market participation, its effect on earnings is modest. A college degree increases earning by 20% for women and 24% for men. The age profile of earnings is concave for men and women. The wage arrears dummy is one of the most meaningful explanatory variables. Workers whose salaries were not paid in full report 40% lower earnings. Employees in the private sector have higher earnings than workers in the government sector. Employees of foreign firms have salaries up to 44% higher than others.

Women's earnings are positively related to unearned income while men's earnings are unaffected by the per-capita income of other household members. The occupational dummies indicate that managers are the highest earning group, as expected. Geographical differences also explain a great share of the earnings variability Urban residents have higher wages than their rural counterparts. Men from Moscow and St. Petersburg and women from the northwest of Russia have the highest earnings in the country. The year 1998 dummy shows a precipitous, , drop of up to 53% in earnings between 1996 and 1998. However, this may be due to the devaluation of the currency in this period.

Using the reported coefficients, I predict average earnings for the employed and unemployed in the full sample of adults. Next, I use the predicted values to estimate the equations (4.5) that relate non-market time to earnings, unearned income and other household characteristics.

Table 4.10 shows the parameter estimates separately for men and women. The housework regressions show that higher earnings are negatively associated with time spent on non-market activities, with the exception of men's housework. Men spent on average just over an hour a day on this activity in 1998. In response to higher earnings, women reduce both housework and childcare equally. The effect of higher earnings on men's childcare is smaller than for women. Earnings have a negative effect on sleep which is stronger for women and small and barely significant for men. Leisure is the time use category most affected by a change in earnings for both men and women. Overall, changes in earnings have a larger impact on women's allocation of time than on men's.

The estimated coefficient on the log of earnings divided by the level of earnings gives an idea of the magnitude of the earnings effect. It turns out to be rather small. Calculated at the average earnings in 1998, a 10% increase in women's earnings is accompanied by only an 11 minute decrease in weekly work at home, a 10 minute decrease in time spent with children, a 4 minute decrease in sleep and a 16 minute decrease in leisure. The effect is even smaller for men.

Unearned income significantly increases the demand for non-market time in all group. Only men's childcare is not affected by the income of other household members and even decreases slightly when others' incomes increase. Women increase work at home and time spent with children more and decrease leisure less than men as others' income increases.

The housework profile is concave in age. College educated women spend just under an hour less per week in housework than other women, while more educated men spend almost an hour more time in housework than other men. Married women spend almost 5.5 hours longer working around the house than single women, while married men spend 2 hours less in these activities compared to single men. The presence of children in the household adds almost 2 hours to a woman's housework and subtracts about an hour from men's housework. An additional preschool child increases a woman's unpaid labor supply by over 2.5 hours a week, and adds just over half an hour to a man's unpaid household labor. A school-aged child adds only an hour to a woman's work at home and 20 minutes to the men's similar work. Disabled adults add more hours to housework than small children for men and women. The increase is four times larger for women than for men, supporting the idea that women have a primary responsibility to care for the sick. The presence of other unemployed adults, curiously, has a small positive effect on the time men and women work at home. So do living in a rural location, owning land and owning a house. Of particular note is the decline in hours spent doing housework for men and especially women. The average woman spent 8 hours less doing housework in 1998 than she did in 1994, while the average man spent 3.5 hours less.

Time spent in childcare is determined almost exclusively by the age and number of children. Younger children affect it positively, while having school-age children somewhat reduces it for men and women. While men's time spent with in childcare does not vary by education, college-educated women spend over 1.5 hours a week more with their children than less educated women. Gronau and Hamermesh (2002) find similar evidence of an increase in childcare time with increased education in data from Israel and the US. The positive coefficients on regional dummies suggest that urban parents spend more time on childcare than rural ones or that rural parents are able to combine childcare with other housework more than urban parents.

Sleep is affected by household composition and by age. The age profile of sleep is convex. Married men and women sleep up to 30 minutes less per week than their single counterparts. Children reduce their parents' time spent sleeping, while the presence of other non-working adults adds to sleep hours. Land owners who grow their own food sleep less than those who do not engage in this activity. The observed pattern of male-female sleep differences and of the effect of children is similar to results found by Biddle and Hamermesh (1990).

Leisure represents all waking non-market time which is not spent in housework. More educated men enjoy over 3.5 hours less leisure than other men. Women's leisure does not change with the level of education. Married men enjoy almost 7 hours less free time than single men and married women almost 8 hours less leisure than single women. Women with children enjoy 13 hours less leisure time per week than women with no children, while men who have children have 4.5 hours less for leisure. An additional pre-school age child reduces mother's leisure by more than 9 hours and father's leisure by over 6.5 hours, but school age children have a positive effect on both parents' leisure. A disabled relative living in the household requires as many extra hours of work from men and women as a small child. On the other hand, having an unemployed adult in the household adds almost 7 hours to a woman's leisure and 8.5 hours to a man's. Land and house owners and rural residents have less leisure. The effect is particularly strong for women who live in a house. Time devoted to additional housework takes 4 hours off total women's leisure. Men from rural areas they have almost 6 hours less free time than their urban counterparts.

4.5.3 Panel Data Analysis

The cross sectional evidence above shows a negative relationship between earnings and non-market time, as well as a positive relationship between unearned income and non-market time. It remains to be seen if these relationships hold for each person and are not due to unobservable individual heterogeneity in the data. The latter would be possible if, for example, higher ability individuals had a strong preference for market work and disliked non-market time, while low ability individuals had a preference for non-market time. For each individual, the income effect may still dominate so that an increase in earnings would result in shorter market hours and a higher demand for non-market time. To ensure that this income effect does not exist, I estimate the following panel analogue of equation (4.5):

$$T_{it} = \alpha_{1i} + \gamma_t + \alpha_2 \ln W_{it} + \beta \ \mathrm{X}_{3it} + \varepsilon_{it} \qquad (4.9)$$

where α's are individual specific fixed effects, γ's are time specific effects, and ε_{it} are individual and time independent errors.

The estimates in Table 4.11, part A, are similar overall to the cross-sectional estimates. Consistent with the predictions of the model, earnings are negatively related to housework, leisure, childcare and sleep, while unearned income is positively related to the demand for non-market time. Some of the associations are stronger in the panel data and some are weaker. The decrease in women's leisure as a result of a unit increase in earnings is estimated to be larger than in the cross-sectional sample. The parameter implies that a 10% rise in earnings from its average in 1998 results in a 51 minute drop in leisure. The estimated effect of earnings on women's childcare time and sleep is smaller in the panel data than in cross-sectional analysis. Leisure appears to be the major source of disposable time, as it is the activity that adjusts the most to changes in earnings and unearned income. Men's housework, sleep and time spent with children are unaffected by unearned income. For women, sleep actually decreases with income, while leisure increases by more than in the cross-sectional sample.

In addition to equation (4.9), I estimate two similar regressions using employment status and hours of market work instead of earnings (parts B and C of the table). Employment status and market labor supply are important determinants of the individual's allocation of time in the home sector. Variation in work hours explains 55% of the variation in leisure among men and 25% among women's. An extra hour of market work comes almost exclusively from leisure for men and mostly from leisure for women. In response to better market opportunities in terms of higher earnings and longer work hours, women are willing to substantially cut down not only on leisure but also on housework and childcare. More involvement in the labor market is also accompanied by a small reduction in sleep for men and women.

4.6 Conclusion

In Russia, the assumption of a near-perfect labor market breaks down. Market work hours are constrained in the traditional, state-run sector of the economy, and there are high fixed costs to entry into the private sector in terms of time and initial capital. Cross-section data show that these frictions reduce the elasticity of hours with respect to wages. Indeed, these elasticities are negative in the Russian Longitudinal Survey, reflecting the prevalence of older individuals who work only part-time in the government sector and younger entrepreneurs who work long hours in the new private sector. Russian cross-sectional data cannot be interpreted through a synthetic life-cycle approach, since the decision making environment facing those currently old in their youth is fundamentally different from that facing those who are young today.

The model developed in this chapter claims that earnings are a better measure of success in the labor market than wages. It predicts a negative relationship between earnings and non-market time and a positive relationship between unearned income and non-market time. Evidence from cross-sectional and panel data support the model.

The use of an individual's non-market time largely depends on his/her status in the market sector. For non-employed men and women, a switch to employment and the corresponding increase in market time occurs mostly at the expense of leisure. Once employed, men respond to better market opportunities by increasing market time and further reducing leisure. Employed women also cut down on housework and childcare. Because highly educated working mothers increased their market time at the expense of childcare, it is possible that the quality of childcare may have gone down. Men do not decrease their housework and childcare by as much as women in response to higher earnings. This may mean that job creation for men might have a larger positive impact on family welfare than job creation for women.

As the Russian economy develops, I expect that constraints on hours worked in the government sector and the fixed costs in the private sector will be reduced, making the economy more similar to those of the industrialized countries. If the RLMS resumes its time use section in the future, it will be interesting to see how the development of the labor and capital markets will eventually align individual observable wages with the opportunity cost of time. In this case we can expect that the analysis of the allocation of time in Russia will start to resemble the classical case.

Table 4.1 Sample Means by Year of the Survey and by Gender

	WOMEN				MEN			
	1994	1995	1996	1998	1994	1995	1996	1998
Number of observations	3702	3525	3439	3573	3097	2881	2819	2898
Age	40.8	40.7	40.6	40.6	40.1	40.0	39.5	39.2
Employed	0.59	0.58	0.57	0.55	0.74	0.73	0.70	0.65
College degree	0.19	0.18	0.18	0.18	0.18	0.16	0.16	0.16
No high school	0.21	0.17	0.16	0.14	0.24	0.20	0.19	0.18
Household size	3.6	3.7	3.6	3.6	3.7	3.7	3.7	3.7
Number of children age 0-6	0.35	0.33	0.32	0.30	0.34	0.32	0.31	0.29
Number of children age 7-17	0.57	0.59	0.59	0.62	0.58	0.60	0.62	0.63
Monthly earnings	363	299	303	203	718	552	529	340
Per capita other income	563	422	395	318	493	380	377	310
Rural area	0.23	0.23	0.24	0.25	0.24	0.25	0.26	0.26
Student	0.04	0.03	0.04	0.05	0.03	0.03	0.04	0.05
Retired	0.17	0.18	0.17	0.16	0.10	0.10	0.09	0.09
Disabled	0.04	0.04	0.03	0.02	0.01	0.02	0.01	0.01
Weekly time use:								
Market work	24.3	24.9	24.4	22.9	35.2	35.5	34.0	29.9
Housework	35.2	32.4	30.5	27.2	11.0	9.9	9.8	7.8
including Shopping for food	5.1	4.2	3.5	3.3	2.0	1.3	1.2	1.2
Cooking	15.5	13.5	13.3	12.6	2.5	2.0	1.9	2.1
Gardening	1.9	3.6	3.4	1.6	2.6	4.6	4.6	2.7
Cleaning/repairs	6.6	6.0	5.6	5.1	2.7	1.1	1.0	0.9
Laundry/ironing	5.0	4.3	3.9	3.5	0.4	0.3	0.4	0.3
Help family	1.6	1.1	1.3	1.3	0.9	0.6	0.8	0.6
Childcare	15.8	13.5	14.2	13.7	5.9	5.0	5.2	5.5
Sleep	52.9	53.5	53.6	54.1	53.5	54.0	54.0	54.4
Leisure	42.6	46.0	47.4	51.9	62.7	63.8	65.2	70.5

Table 4.2. Sample Means by Employment Status and Gender.

	WOMEN		MEN	
	Non-employed	Employed	Non-employed	Employed
Number of observations	6096	8143	3463	8232
Age	42.1	39.6	41.6	38.9
College degree	0.11	0.24	0.09	0.20
No high school	0.28	0.09	0.32	0.16
Household size	3.7	3.6	3.6	3.8
Number of children age 0-6	0.42	0.25	0.25	0.34
Number of children age 7-17	0.46	0.70	0.47	0.66
Monthly total earnings	-	511	-	764
Per capita other income	449	409	442	370
Hourly wage	-	19.1	-	28.6
Weekly time use:				
Market work	-	42.2	-	47.8
Housework	35.6	28.2	13.8	7.9
including Shopping for food	4.3	3.8	1.8	1.3
Cooking	15.1	12.8	3.1	1.8
Gardening	3.8	1.8	5.6	2.7
Cleaning/repairs	6.4	5.4	1.8	1.3
Laundry/ironing	4.7	3.8	0.4	0.3
Help family	1.6	1.2	1.0	0.6
Childcare	19.0	10.8	5.2	5.5
Sleep	55.3	52.2	56.8	52.8
Leisure	60.7	36.7	92.4	54.2

Table 4.3 Means by Sector of Employment in the Sample of Employed Adults

	Government (64.3%)	Private (14.1%)	Foreign (2.5%)	Self-Employed (19.1%)
Number of observations	8270	1811	317	2455
Age	39.3	36.2	36.9	41.6
Male	0.46	0.53	0.54	0.54
Second	0.15	0.16	0.14	0.14
Wage	26.2	36.6	56.0	36.7
Monthly earnings	705	925	1212	1043
Market work	44.1	47.3	46.2	46.5
Housework	18.9	14.9	15.2	18.4
Childcare	8.4	8.1	8.0	7.6
Sleep	52.3	52.4	53.3	52.2
Leisure	45.5	46.2	46.3	44.2

Table 4.4 Average Changes in Time Use by Changes in Employment Status

	Employed-Employed	Non Emp-Non Emp	Non Emp-Employed	Employed-Non Emp
WOMEN				
Market work	0.2		39.4	-40.5
Housework	-2.3	-3.8	-11.1	6.2
Childcare	-1.1	-0.8	-10.2	7.4
Sleep	0.3	0.5	-1.6	2.0
Leisure	2.6	3.7	-17.1	24.8
N obs	4156	2632	670	721
MEN				
Market work	-0.5		47.1	-46.8
Housework	-1.1	-1.1	-8.2	5.8
Childcare	-0.4	-0.6	-2.5	2.0
Sleep	0.4	0.9	-3.0	2.5
Leisure	1.5	0.8	-33.5	36.6
N obs	3953	1184	481	636

Note. – Sample of individuals observed in at least two years. Time use is in hours per week.

Table 4.5 Correlations in the Sample of Employed Individuals

	Hourly wage	Weekly earnings	Market work	House work	Child care	Sleep	Leisure
Hourly wage	1.00	0.27*	-0.10*	-0.04*	0.01	0.02**	0.08*
Weekly earnings	0.27*	1.00	0.14*	-0.14*	-0.04*	-0.02	0.02**
Market work	-0.10*	0.14*	1.00	-0.16*	-0.11*	-0.09*	-0.48*
Housework	-0.04*	-0.14*	-0.16*	1.00	0.24*	-0.12*	-0.60*
Childcare	0.01	-0.04*	-0.11*	0.24*	1.00	-0.04*	-0.51*
Sleep	0.02**	-0.02	-0.09*	-0.12*	-0.04*	1.00	-0.14*
Leisure	0.08*	0.02**	-0.48*	-0.60*	-0.51*	-0.14*	1.00

Note. – The sample of employed contains N=12,853

* highly significant, Prob<0.0001
**less significant, Prob<0.05

Table 4.6 Parameter Estimates of the Time Use Equations for the Employed Men and Women with Observed Wages as an Explanatory Variable

	WOMEN				MEN			
	House work	Child care	Sleep	Leisure	House work	Child care	Sleep	Leisure
Intercept	-0.72	3.90	58.79*	68.54*	3.54*	4.37*	55.81*	56.29*
Log hourly wage	-0.63*	0.20	0.29*	2.77*	-0.11	-0.17	0.12	3.15*
Log per cap other inc	0.29*	0.14	0.07	-0.21	0.12	-0.10	0.02	-0.01
College degree	-1.89*	0.16	-0.35	2.46*	0.57	-0.20	-0.95*	-3.38*
Age	1.04*	0.00	-0.32*	-1.49*	0.25*	-0.08	-0.14*	-0.52*
Age-squared/100	-1.02*	-0.11	0.30*	1.72*	-0.19*	0.02	0.14	0.69
Married	3.74*	1.15*	-0.14	-4.04*	-1.90*	2.10*	0.16	-0.57
Presence of children	2.10*	7.86*	0.27	-7.37*	-1.04*	3.89*	-0.94*	-2.96*
# children <7	1.49*	10.91*	-0.79*	-8.43*	1.00*	5.08*	-0.10	-5.58*
# children 7-17	1.24*	0.23	-0.62*	-1.00*	0.25	-0.08	0.13	-0.11
On leave	3.52*	0.96	1.46*	4.28*	0.75	0.89	2.43*	7.90*
Number other disab	7.29*	2.40*	-0.30	-6.13*	1.13	1.20*	-0.91	-1.79
Number other unemp	-1.04*	-1.51*	0.03	1.05*	-1.47*	-0.76*	0.47*	0.75*
Own land	1.00*	-0.71	-0.21	0.33	0.94*	-0.59*	-0.41	0.90
Live in a house	3.10*	0.18	0.20	-2.83*	0.75*	-0.92*	0.36	1.02
Rural area	4.15*	-0.65	0.01	-0.82	2.42*	-0.51	0.66*	-1.32
Year=1995	-1.67*	-1.15*	0.37	1.27	-1.58*	-0.37	0.27	1.23
Year=1996	-4.02*	-0.54	0.81*	2.40*	-1.93*	-0.28	0.31	1.09
Year=1998	-6.36*	0.20	1.14*	6.23*	-3.16*	0.62	0.27	5.49*
R-squared	0.14	0.24	0.03	0.13	0.05	0.21	0.01	0.07

Note.- Sample of employed adults. Hourly wage are calculated from total monthly earnings and monthly hours of work in all jobs.

* significant at a 5% level

Table 4.7. Parameter Estimates of the Time Use Equations for the Employed Men and Women with Market Time as an Explanatory Variable

	WOMEN				MEN			
	House Work	Child care	Sleep	Leisure	House work	Child Care	Sleep	Leisure
Intercept	2.03	7.63*	60.67*	97.20*	4.34*	5.12*	58.01*	100.1*
Market work hours	-0.11*	-0.10*	-0.04*	-0.71*	-0.03*	-0.03*	-0.05*	-0.88*
Log per cap other inc	0.21	0.12	0.07	-0.32*	0.12	-0.11	0.01	-0.01
College degree	-2.30*	0.07	-0.31	2.32*	0.61*	-0.17	-0.78*	0.14
Age	1.09*	0.08	-0.28*	-0.91*	0.26*	-0.07	-0.12	-0.07
Age-squared/100	-1.02*	-0.20	0.25*	1.00*	-0.20*	0.01	0.11	0.08
Married	3.69*	1.09*	-0.17	-4.45*	-1.91*	2.08*	0.17	-0.31
Presence of children	1.79*	7.64*	0.19	-8.83*	-1.03*	3.90*	-0.89*	-1.98*
Number children <7	1.49*	10.87*	-0.81*	-8.73*	1.01*	5.09*	-0.10	-5.63*
Number children 7-17	1.35*	0.29	-0.60*	-0.58	0.25	-0.08	0.12	-0.25
On leave	1.99	-0.04	1.16*	-2.05	0.32	0.39	1.85*	-2.39*
Number other disabled	7.07*	2.16*	-0.41	-7.87*	1.15	1.22*	-0.88	-1.44
Number other unemp	-0.89*	-1.41*	0.07	1.76*	-1.44*	-0.73*	0.52*	1.61*
Own land	1.01*	-0.77*	-0.26	-0.19	0.94*	-0.58*	-0.45*	0.10
Live in a house	3.37*	0.21	0.16	-2.97*	0.75*	-0.90*	0.30	-0.34
Rural area	4.18*	-0.91	-0.17	-3.16*	2.50*	-0.38	0.62*	-2.66*
Year=1995	-1.36*	-1.02*	0.38	1.87*	-1.52*	-0.29	0.30	1.49*
Year=1996	-3.75*	-0.40	0.83*	3.13*	-1.86*	-0.20	0.35	1.71*
Year=1998	-6.07*	0.05	0.97*	4.50*	-3.13*	0.68*	0.13	2.35*
R-squared	0.15	0.25	0.03	0.34	0.06	0.21	0.02	0.54

Note.- Sample of employed adults. Market time is the number of hours spent working in all jobs, primary and secondary.

* significant at a 5% level

Table 4.8 Participation Equation. Probit Estimates

	WOMEN			MEN		
	Coef	Chi-sq	Prob	Coef	Chi-sq	Prob
Intercept	-0.42	4.6	0.03	1.34	43.8	<.0001
No high school	-0.12	5.2	0.02	-0.12	5.8	0.02
Vocational degree	0.09	3.9	0.05	0.09	3.8	0.05
Technical degree	0.34	68.0	<.0001	0.24	19.8	<.0001
College degree	0.44	87.0	<.0001	0.46	69.3	<.0001
Age	0.09	80.8	<.0001	0.00	0.0	0.88
Age-squared/100	-0.07	32.8	<.0001	0.01	1.1	0.29
Married	-0.25	52.3	<.0001	0.51	158.1	<.0001
Household size	0.34	560.0	<.0001	0.30	346.1	<.0001
Presence children <7	-0.75	383.7	<.0001	-0.11	6.2	0.01
Presence children 7-17	-0.51	181.0	<.0001	-0.53	154.3	<.0001
Number disabled	0.47	38.2	<.0001	0.25	13.3	0.00
Number unemployed	-1.08	2149.1	<.0001	-0.94	1470	<.0001
Log other inc per cap	-0.15	174.6	<.0001	-0.16	169.3	<.0001
Student	-1.10	141.2	<.0001	-1.26	196.2	<.0001
Retired	-2.88	1039.9	<.0001	-2.43	588.0	<.0001
Disabled	-0.76	24.7	<.0001	-1.57	55.6	<.0001
Own land	0.12	13.5	0.00	0.14	14.8	0.00
Unemployment rate	-0.98	42.9	<.0001	-1.25	65.5	<.0001
N obs: Non-employed		8143			8232	
N obs: Employed		6095			3463	
Log Likelihood		-4821			-3836	

Note. - Dependent variable: Probability of Being Employed

Table 4.9 Coefficient Estimates of the Earnings Equations

	WOMEN		MEN	
	coef	t-stat	coef	t-stat
Intercept	4.77	31.1	6.04	38.0
Inverse Mills ratio	-0.11	-3.1	-0.09	-2.0
No high school	-0.15	-3.6	-0.08	-2.1
Vocational degree	-0.07	-2.0	-0.05	-1.5
Technical degree	0.05	1.7	0.08	2.1
College degree	0.20	5.6	0.24	5.7
Age	0.06	9.9	0.05	7.1
Age-squared/100	-0.08	-10.1	-0.07	-7.7
Own a car	0.17	6.8	0.29	11.1
Own a house	-0.09	-2.7	-0.19	-5.5
Moonlights	0.12	3.5	0.09	3.0
Grows food	-0.13	-5.7	-0.13	-4.9
Reports wage arrears	-0.40	-18.0	-0.42	-17.5
Private sector primary job	0.20	6.4	0.13	3.9
Foreign-owned prim job	0.44	6.7	0.37	5.3
Self-employed	0.27	10.1	0.18	6.1
Legislation, manager	0.79	8.2	0.48	5.9
Professional	0.48	6.9	0.22	3.5
Technical and associate prof	0.38	5.6	0.33	5.0
Clerk	0.34	4.8	-0.09	-0.8
Service and market worker	0.38	5.3	0.29	4.0
Skilled agricultural worker	0.37	1.1	-0.03	-0.2
Craft and related trades	0.47	6.0	0.17	2.9
Machine operator, assembler	0.52	6.7	0.24	4.0
Unskilled occupations	0.10	1.5	-0.10	-1.5
Log income others per capita	0.03	4.9	0.01	0.7
Rural area	-0.28	-9.3	-0.46	-13.2
Northwest	0.16	3.3	-0.15	-2.7
Central	-0.29	-7.8	-0.41	-9.6
Ural	-0.22	-5.8	-0.32	-7.0
Volga	-0.44	-11.4	-0.60	-13.3
Caucasus	-0.27	-6.0	-0.34	-6.6
East Siberia	0.04	0.8	-0.10	-1.9
West Siberia	0.13	3.0	-0.08	-1.6
Year = 1995	-0.14	-5.4	-0.20	-6.6
Year = 1996	-0.01	-0.5	-0.08	-2.7
Year = 1998	-0.41	-14.4	-0.53	-16.3
R-squared	0.30		0.31	

Note. – Dependent variable: Log of Weekly Earnings. Sample of employed adults
Base categories for dummy variables: secondary school diploma for education, state for employer ownership, military for occupational category, Moscow/St.Petersburg for geographical region, 1994 for survey year.

Table 4.10. Parameter Estimates of the Time Use Equations with Imputed Earnings as an Explanatory Variable

	WOMEN				MEN			
	House work	Child care	Sleep	Leisure	House work	Child care	Sleep	Leisure
Intercept	13.1 *	28.3*	68.3*	138.9*	3.5	7.83*	61.22*	121.6*
Log estim earnings	-3.74*	-3.65*	-1.24*	-5.38*	-0.15	-1.00*	-0.35*	-4.45*
Log per cap income	0.62*	0.50*	0.19*	0.76*	0.40*	-0.07	0.15*	1.35*
College degree	-0.87*	1.61*	-0.43*	1.05	0.92*	-0.05	-1.06*	-3.69*
Age	1.37*	-0.15	-0.37*	-2.99*	0.16*	0.05	-0.28*	-1.70*
Age-squared/100	-1.37*	0.01	0.37*	3.62*	-0.01	-0.08	0.30*	2.10*
Married	5.41*	3.82*	-0.24	-7.79*	-1.98*	2.05*	-0.52*	-6.81*
Presence of children	1.88*	13.79*	0.08	-13.05*	-0.96*	4.51*	-0.57*	-4.49*
# children <7	2.62*	11.81*	-0.65*	-9.34*	0.58*	4.59*	-0.45*	-6.68*
# children 7-17	1.00*	-2.66*	-0.44*	2.55*	0.32	-0.50*	0.31*	1.72*
# other disabled	5.98*	1.28*	-0.14	-9.37*	1.41*	0.38	-0.20	-4.27*
# other unemployed	1.00*	-0.19	0.77*	6.82*	0.27*	-0.37*	1.29*	8.48*
Own land	0.96*	-2.03*	-0.97*	-1.70*	0.62*	-0.74*	-1.00*	-2.05*
Live in a house	2.86*	-1.15*	-0.41*	-4.10*	1.16*	-0.55*	0.11	-1.08
Rural area	2.38*	-3.20*	-0.15	-1.74*	3.11*	-1.08*	0.43	-5.72*
Year=1995	-2.20*	-1.60*	0.37*	0.99	-1.38*	-0.75*	0.40	-0.73
Year=1996	-3.55*	-0.32	0.58*	2.35*	-1.37*	-0.44	0.30	0.70
Year=1998	-7.96*	-1.79*	0.46*	3.48*	-3.45*	-0.28	0.44	2.74*
R-squared	0.14	0.28	0.05	0.24	0.06	0.17	0.04	0.20

Note.- Sample of employed and non-employed adults. Weekly earnings are predicted using parameter estimates of the earnings function in table 4.8, which in turn uses Heckman bias correction technique. Predicted wages obtained without Heckman's correction result in similar estimates of the time use equations.

* significant at a 5% level.

Table 4.11 Panel Estimates of the Time Use Equations

A. Time use regressions with estimated weekly earnings on the right hand side

	House	Child	Leisure	Sleep	House	Child	Leisure	Sleep
	WOMEN				MEN			
Weekly earnings	-3.85*	-2.58	-17.3*	-0.75	-0.13	-1.57	-4.80*	-0.39
Log per cap other inc	0.58	0.75*	1.31*	-0.31*	0.45	0.12	1.56*	0.06
# children age <7	-1.37	7.62*	-0.82	0.24	2.16*	4.33*	-1.94	1.08
# children 7-17	-0.51	1.99	2.64	1.34*	1.85*	2.71*	1.02	0.76
Presence of children	3.98*	7.61*	-10.45*	-0.37	-0.63	0.57	2.28	-0.22
Household size	-0.75	-1.97*	-1.70*	-0.44	-0.89*	-0.53	-4.16*	-0.75*
Number disabled	0.87	1.73*	5.33*	1.30*	1.00*	1.05*	9.61*	1.62*
Number other unempl	1.34	0.59	1.55	0.76	-2.52	-0.20	0.28	-0.92
Married	7.35*	0.46	-8.87*	1.95*	-0.64	-0.80	-0.48	0.83
R-squared	0.03	0.05	0.08	0.03	0.01	0.04	0.09	0.02

B. Time use regressions with employment status on the right hand side

	House	Child	Leisure	Sleep	House	Child	Leisure	Sleep
	WOMEN				MEN			
Employment status	-9.56*	-13.1*	-19.5*	-1.49*	-6.35*	-2.61*	-34.2*	-2.12*
Log per cap other inc	0.13	0.19	0.22	-0.39*	0.17	0.02	0.12	-0.06
# children age <7	-2.29	6.23*	-2.30	0.10	1.43	3.97*	-6.03*	0.92
# children 7-17	-1.90	0.07	-0.19	1.13*	0.85	2.24*	-4.51*	0.52
Presence of children	3.74*	7.31*	-11.1*	-0.41	-1.05	0.42	0.06	-0.38
Household size	0.26	-0.53	0.10	-0.29	-0.06	-0.20	0.30	-0.44
Number disabled	-1.55*	-1.77*	1.04	0.93*	-0.78	0.38	0.18	0.94*
Number other unempl	1.19	0.49	0.86	0.73	-2.39	-0.12	1.05	-0.93
Married	7.34*	0.39	-8.66*	1.95*	-0.60	-0.72	-0.11	0.75
R-squared	0.06	0.10	0.12	0.03	0.05	0.04	0.29	0.03

C. Time use regressions with hours of work on the right hand side

	House	Child	Leisure	Sleep	House	Child	Leisure	Sleep
	WOMEN				MEN			
Market work hours	-0.16*	-0.19*	-0.63*	-0.03*	-0.09*	-0.04*	-0.82*	-0.04*
Log per cap other inc	0.24	0.40	-0.04	-0.38*	0.23	0.03	-0.32	-0.06
# children age 7	-2.12	6.66*	-3.66*	0.08	1.66	4.03*	-6.65*	0.94
# children 7-17	-1.46	0.88	-1.08	1.14*	1.29	2.38*	-4.19*	0.60
Presence of children	4.07*	7.73*	-10.1*	-0.36	-0.81	0.51	0.75	-0.32
Household size	-0.05	-1.11*	0.96	-0.30	-0.33	-0.27	0.93	-0.47
Number disabled	-0.63	-0.14	-0.37	0.98*	-0.20	0.52	-1.16	1.00*
Number other unempl	0.95	0.21	-0.07	0.68	-2.22	-0.03	3.03	-0.85
Married	7.33*	0.39	-8.91*	1.94*	-0.54	-0.69	0.53	0.78
R-squared	0.10	0.08	0.25	0.03	0.04	0.04	0.55	0.03

Note.- Samples of individuals who participated in each of the four rounds of the survey.

Chapter 5

Conclusions

This thesis presented and empirically tested three utility theoretic models of the household behavior. It made several theoretical and empirical contributions to the literature on the economics of the household.

Economists disagree with regard to the source of economies in food, sometimes arguing that lower per capita food expenditure in larger households is inconsistent with utility maximization. I tested the simplest model of household economies, the Barten model, by selecting data that satisfy the assumptions of the model. Two controversial predictions of the model were tested: (1) the share of the good that is more private relative to the other good increases with family size even though the food share in total expenditures overwhelmingly decreases with family size in the data; and, (2) the elasticity of food share with respect to household size is negative and larger in value for poorer households while it is larger in value but positive in the data. I showed that the food share increases with family size with respect to a good known to be more private than food (shelter), and decreases with family size with respect to a more public good (clothing and transportation), as predicted by the Barten model. The inconsistency concerning the second prediction of the Barten model is resolved in separate regressions for households from different income groups within the same country and avoiding comparisons among different countries.

The Barten model does not incorporate time as a choice variable and does not resolve the food consumption puzzle: Why do utility maximizing households choose to reduce their expenditure on food as household size grows and per capita income stays the same? The Batren model however gives a useful insight suggesting that food is less private than the composite of all other goods in the household budget. The public component of food most likely comes from food preparation time. While testing the Barten model, I found some preliminary support of this idea in household expenditure data from the U.S., South Africa and Russia. In each country, “food consumed away from home" decreases with family size as larger households possibly substitute towards eating home-cooked meals.

Chapter 3 extended the model of household economies of scale to incorporate food preparation time. According to this model, household decisions depend on the relative prices of market-purchased inputs and the time needed to prepare meals, and that these relative prices are affected by household size. The model of household economies in purchased food and in food preparation time is able to explain the food consumption paradox. To take advantage of relatively cheaper time, optimizing households choose more time-intensive food production technologies in response to an increase in household size while keeping constant or even increasing per capita food consumption.

I estimated in the data from Russia that economies in time are proportionally larger than the economies in expenditures on purchased food. On average, doubling the size of household reduces per capita food expenditure by over 30% and per capita preparation time by about 75% in households with two and more people. However, because of intra-household specialization, women typical experience much lower time savings from household food production than men for the very reason that women specialize in food production. By getting married, a single man economizes up to 6 hours per week in food-related activities. But a woman, once married, enjoys no time saving at all. Furthermore, a woman with one or more children spends more time preparing food than a woman with no children. I find that larger households choose more time intensive meals at the same level of food consumption so that per capita expenditures on food decline with household size. There is some evidence that the quality of meals is unaffected by changes in household size.

The most important conclusion of my food-related research is that the household economies in food-related time are potentially large and important in household decisions. Not accounting for these economies may result in under-estimation of the household food consumption and overall welfare of larger households.

The research of household economies of scale in food consumption can be extended in several directions.

First, the model of household economies of scale in expenditures and time is useful for studying the nature of household economies in non-food, for example housing and house maintenance, childcare and household transportation. This model can be extended to include more than two goods to examine in a richer system how economies in food affect consumption of other commodities.

Second, it would be useful to estimate the household per capita demand equations for purchased food and food-related time in the data from other countries. The concern with estimates from Russia is that the level of the country's income and development may be important in the household allocation of money and time. The elasticity of substitution between time and goods in household production most likely depends on absolute rather than relative levels of income of the respondents. Higher-income households place higher value on time and may be less willing to substitute time for market-purchased goods. Evidence from richer countries should help generalize some of the findings of this study.

Third, more reliable nutrition data would provide additional insights into how the quantity and quality of food is affected by household size.

Fourth, it would be interesting to explore the labor market implications of household economies of scale in food and other goods. Due to sharing of expenses and specializing labor individuals from larger households free themselves extra time that can be spent in leisure activities or added to the time spent working in the labor market. Possible labor supply implications of the household economies of scale may be examined in the context of the model developed in the thesis.

While the link between household size and labor supply may be a good subject for a future research, this thesis examined a related issue of how shocks in the labor market affect the allocation of time in the home sector. Transitions to and from employment and changes in returns to human capital are linked to individuals' time allocation decisions in the home sector via their effect on the opportunity cost of time. In a perfect labor market the worker's hourly wage reflects the worker's ability and measures the opportunity cost of an extra hour spent in housework, childcare, pure leisure or even sleep. In an imperfect labor market, such as the one in Russia, wages may represent neither the opportunity cost of non-market time nor the individual's ability level. I describe this phenomenon in a two-sectoral model of the Russian labor market. Restricted hours of work in the state sector and high fixed costs of entry in the private sector are introduced into the model. These imperfections are shown to reduce the wage elasticity of labor supply in a cross-section of individuals and create a wedge between the individual's opportunity cost of time and observed hourly wages. The analysis suggests that earnings may be a better approximation of worker's well-being than wages. The model predicts a negative relationship between earnings and non-market time and a positive relationship between unearned income and non-market time.

The Russian example points out the importance of knowledge of the labor market conditions for understanding individuals' allocation of time to different activities at home. Because in an imperfect labor market average hourly wages may be a biased measure of the worker's ability and the individual's opportunity cost of time, inferences based on computed wage rates from developing countries should be interpreted cautiously.

Cross-sectional and panel analysis of the time use data showed that the Russian population overall enjoyed more leisure during transition to the market economy than before. The use of an individual's non-market time largely depended on his/her status in the market sector. For non-employed men and women, a switch to employment and the corresponding increase in market time occurred mostly at the expense of leisure. However there in an important difference between men and women in their response to changes in the labor market. Men's housework and childcare time varied little in response to employment shocks while women's work at home adjusted more to the labor market outcomes. Once employed, men responded to better market opportunities by further increasing market time and further reducing leisure while employed women also cut down on housework and childcare. Since highly educated working mothers increased their market time at the expense of childcare, it is possible that the quality of childcare may have gone down. The analysis implies that a job loss by a man has a larger negative effect on household welfare than a job loss by a woman, everything else held equal.

The study of the allocation of non-market time may be improved if the decision-maker is assumed to be part of a household allocating his/her time simultaneously with other household members.

Another possible extension is to examine the trend of declining housework time over the years. New household appliances are most likely the source of the time savings for men and women. Since RLMS collects information on household ownership of appliances, it would be interesting to estimate how much time households save when they purchase a washer, a refrigerator or a vacuum cleaner.

Appendix 1

A. United States

The U.S. data come from the 1990 Consumer Expenditure Survey (CEX). CEX contains detailed expenditure and demographics data on over 20,000 households. The survey is a rotating panel, where about 20% of household are replaced every quarter, and each household may have up to four records of data. We essentially followed the data selection and regression structure described in Deaton and Paxson (1998). Several households with no working-age adults or with non-positive total expenditure are excluded from the analysis. Households with non-positive total after-tax income are also dropped from the instrumental variable regressions, reducing the number of observations from 20,504 to 18,838. The summary expenditure is total expenditure minus personal insurance, pension payments, and purchase of new vehicles. Weights are provided by the Bureau of Labor Statistics. Food includes food eaten at home and food eaten out, and excludes alcohol.

All regressions include the following controls: the ratios of numbers of members in various age and sex categories (males and females 0-5, 6-11, 12-17, 18-64, and 65 and over) to total household size; dummies for the quarter of the interview; urban versus rural residence; race of the reference person; whether the household lives in public housing; whether the household receives food stamps; and the fraction of adults aged 18 and over who are wage earners. All instrumental variable regressions fit the logarithm of total (or food and shelter, food and clothing, food and transportation) per capita expenditure with the logarithm of per capita after-tax income.

Average household budget shares: food, 22.6%; shelter, 22.7%; transportation, 22.6%; clothing, 5.7%; other, 26.4%.

B. South Africa

The South African data are drawn from the South Africa Integrated Household Survey 1994 collected by the World Bank and the University of Cape Town. The survey interviewed about 9,000 households. We excluded non-native African households, those with no adult member, and those with zero expenditure. The final sample has 6,485 observations; 96 of those report zero income, and therefore they are dropped from the instrumental variable estimations. Total monthly expenditure includes the value of home produced items. The value of home food production is imputed using average prices. We use weights provided by the survey. The regressions include controls for the ratio to household size of the number of males and females ages 0-5, 6-15, 16-59, and 60 and older; dummies for the 14 provinces of residence; rural/urban/metropolitan status; the fraction of adults engaged in regular employment, casual employment, self-employment and employment in agriculture. Adults are persons 16 and older. Finally, a dummy for households that had a substantial outlay on a durable good in the month of the survey is also included.

Average household budget shares: food, 54.6%; shelter, 10.2%; transportation, 4.5%; clothing, 4.3%; and other, 26.4%.

C. Russia

The Russian data comes from the second wave of The Russia Longitudinal Monitoring Survey (RLMS) collected in four rounds over 1992-1998. This data set is the first national probability sample of the Russian population. It contains information on household income, expenditure, and composition, as well as individual characteristics of each household member, such as demographics, participation in the labor market, time use, etc. RLMS 1994-98 surveyed over 3,700 households in each round, with the same household participating one to four times. The survey provides weights and geographical location of the household in one of 8 broadly defined regions: metropolitan Moscow and St. Petersburg, North and North West, Central, Volga, Urals, Northern Caucasus, West Siberia, and East Siberia. We excluded households who have no members over 18 years old, and who report negative or zero total expenditures or zero food expenditures. The resulting data set contains 14,478 observations.

Total expenditures on goods and services are adjusted for inflation and expressed in July 1992 prices. Food consumption includes alcohol (3.5% of all food), food cash purchases, and the imputed value of home-produced food items, the value of which is calculated using average commodity prices in the region to account for 19.5\% of all reported food consumption.

Regressions include controls for the ratio to household size of children under 7 years of age, children 7-18, men and women of working age, and men and women past working age. We also include the ratio of household members employed in agriculture, since agricultural work may require more calories, and for the reason peculiar to Russia that agricultural workers are more likely to receive their wages in the form of agricultural goods for home consumption. A dummy for whether the household grows food on its own plot of land captures the likely higher food consumption for families with the plot. Dummies for the round of the survey reflect the common effect of changes in relative prices during transition, the most notable of which is the rise in the price of housing relative to everything else. Dummies for the geographical area are included to adjust for the effect of the distance form Moscow, since price shifts are likely to take place faster in the regions located closer to Moscow.

Average household budget shares: food, 68.4%; shelter, 6.2%; transportation, 3.0%; clothing, 6.5%; and other, 15.9%.

Appendix 2

This is how elasticities of demand for inputs with respect to household size in equation (3.12) and (3.13) are derived:

$$\varepsilon_{x_1 n} = \frac{d \ln \frac{x}{n}}{d \ln n} = \frac{\partial \ln \phi_1(n)}{\partial \ln n} + \frac{\partial \ln \psi_{11}(n)}{\partial \ln n} - 2 +$$

$$+ \frac{1}{g_{x_1}} \left(\frac{\partial g_{x_1}}{\partial p_1^*} \frac{\partial \left(\frac{p_1 \phi_1(n) \psi_{11}(n)}{n^2} \right)}{\partial \ln n} + \frac{\partial g_{x_1}}{\partial p_2^*} \frac{\partial \left(\frac{p_2 \phi_2(n) \psi_{12}(n)}{n^2} \right)}{\partial \ln n} + \frac{\partial g_{x_1}}{\partial w_1^*} \frac{\partial \left(\frac{w \ \phi_1(n) \psi_{21}(n)}{n^2} \right)}{\partial \ln n} + \right.$$

$$\left. + \frac{\partial g_{x_1}}{\partial w_2^*} \frac{\partial \left(\frac{w \ \phi_2(n) \psi_{22}(n)}{n^2} \right)}{\partial \ln n} + \frac{\partial g_{x_1}}{\partial (I/n)} \frac{\partial (I/n)}{\partial \ln n} \right) =$$

$$= -(\sigma_1 + \gamma_{11})(1 + \varepsilon_{x_1 p_1}) - (\sigma_2 + \gamma_{12})\varepsilon_{x_1 p_2} - (\sigma_1 + \gamma_{21})\varepsilon_{x_1 w_1} - (\sigma_2 + \gamma_{22})\varepsilon_{x_1 w_2} - \varepsilon_{x_1 I}$$

$$\varepsilon_{t_1 n} = \frac{d \ln \frac{t}{n}}{d \ln n} = \frac{\partial \ln \phi_1(n)}{\partial \ln n} + \frac{\partial \ln \psi_{21}(n)}{\partial \ln n} - 2 +$$

$$+ \frac{1}{g_{t_1}} \left(\frac{\partial g_{t_1}}{\partial p_1^*} \frac{\partial \left(\frac{p_1 \phi_1(n) \psi_{11}(n)}{n^2} \right)}{\partial \ln n} + \frac{\partial g_{t_1}}{\partial p_2^*} \frac{\partial \left(\frac{p_2 \phi_2(n) \psi_{12}(n)}{n^2} \right)}{\partial \ln n} + \frac{\partial g_{t_1}}{\partial w_1^*} \frac{\partial \left(\frac{w \ \phi_1(n) \psi_{21}(n)}{n^2} \right)}{\partial \ln n} + \right.$$

$$\left. + \frac{\partial g_{t_1}}{\partial w_2^*} \frac{\partial \left(\frac{w \ \phi_2(n) \psi_{22}(n)}{n^2} \right)}{\partial \ln n} + \frac{\partial g_{t_1}}{\partial (I/n)} \frac{\partial (I/n)}{\partial \ln n} \right) =$$

$$= -(\sigma_1 + \gamma_{21})(1 + \varepsilon_{t_1 p_1}) - (\sigma_2 + \gamma_{12})\varepsilon_{t_1 p_2} - (\sigma_1 + \gamma_{21})\varepsilon_{t_1 w_1} - (\sigma_2 + \gamma_{22})\varepsilon_{t_1 w_2} - \varepsilon_{t_1 I}$$

Bibliography

Aguiar, Mark and Erik Hurst, "Consumption vs. Expenditure", National Bureau of Economic Research, Working Paper No. 10307, February 2004.

Anderson, Heather and Farshid Vahid, "On the Correspondence between Individual and Aggregate Food Consumption Functions: Evidence from the USA and the Netherlands," *Journal of Applied Econometrics*, 1997, vol. 12, issue 5: 477-98.

Barnes, Roberta, and Gillingham, Robert. "Demographic Effects in Demand Analysis: Estimation of the Quadratic Expenditure System Using Microdata," *Review of Economics and Statistics*, 66 (November 1984): 591- 601.

Barten, Anton. "Family Composition, Prices, and Expenditure Patterns." In *Economic Analysis for National Economic Planning*, edited by Peter Hart, Gordon Mills and John Whitaker. London: Butterworth, 1964.

Browning, Martin. "Children and Household Economic Behavior." *Journal of Economic Literature* 30 (September 1992): 1434-75.

Becker, Gary S., "A Theory of the Allocation of Time," *The Economic Journal* 75 (September 1965), 493-517.

____ , "Human Capital, Effort and the Sexual Division of Labor," *Journal of Labor Economics*, January 1985, 3(1), S33-S57.

Benhabib, J., Rogerson, R., Wright, R., "Homework in Macroeconomics: Household Production and Aggregate Fluctuations," *Journal of Political Economy*, 99 (December 1991): 1166-87.

Bhattacharya, Jayanta , Thomas DeLiere, Steven Haider, Janet Currie, "Heat or Eat? Cold Weather Shocles and Nutrition in Poor American Families," National Bureau of Economic Research, Working Paper No. 9004, June 2002.

Biddle, J., Hamermesh, D., "Sleep and the Allocation of Time," *Journal of Political Economy*, vol. 98, no 5, pt 1, 1990.

Blanchard, O., Kremer, M., "Disorganization," *Quarterly Journal of Economics*, Vol 62, Issue 4, (November 1997).

Brainerd, E., "Winners and Losers in Russian Transition," *American Economic Review*, 88(5), 1094-1116, 1998.

____ , "Women in Transition: Changes in Gender Wage Differentials in Eastern Europe and the Former Soviet Union," *Industrial and Labor Relations Review*, Vol.54, No.1, 2000.

Deaton, Angus S., and Muellbauer, John. *Economics and Consumer Behavior*. Cambridge: Cambridge University Press, 1980.

———. "On Measuring Child Costs: With Applications to Poor Countries." *Journal of Political Economy* 94 (August 1986): 720–44.

____ , and Paxson, Christina. "Economies of Scale, Household Size, and the Demand for Food." *Journal of Political Economy* 106 (October 1998): 897–930.

Earle J., Sabirianova K., "Understanding Wage Arrears in Russia," Working paper no.139. Stockholm Institute of Transition Economics, Stockholm School of Economics, 1999.

Ellat, Y., Zinnes, C., "The Evolution of the Shadow Economy in Transition Countries: Consequences for the Economic Growth and Donor Assistance," Harvard Institute for International Development, CAER II Discussion paper No 83, (September 2000).

Foley, M., "Labor Market Dynamics in Russia," Yale University Center discussion paper no. 780, 1997.

____ , "Determinants of Unemployment Duration in Russia," Yale University Center discussion paper no. 779, 1997.

Gan, Li and Victoria Vernon, Testing the Barten Model of Economies of Scale in Household consumption: Toward Resolving a Paradox by Deaton and Paxson", *Journal of Political Economy*, vol.111, no 6, 2003.

Gibson, John , "Why Does the Engel Method Work? Food Demand, Economies of Size and Household Survey Methods," Working Paper, Department of Economics, University of Waikato, New Zealand, 2002.

Graham, J., Green, K.,"Estimating the Parameters of a Household Production Function with Joint Products," *The Review of Economics and Statistics*, 1984.

Gregory, P., Kohlhase, J., "The Earnings of Soviet Workers: Evidence from the Soviet Interview Project," *The Review of Economics and Statistics*, 70(1), 23-35, 1988.

Gronau, Reuben, "The Allocation of Time of Israeli Women," *Journal of Political Economy*, vol. 84, no 4, pt 2, 1976.

____ , "Leisure, Home Production, and Work – The Theory of the Allocation of Time Revisited," *Journal of Political Economy*, vol 85, no 6, 1977.

____ and Daniel Hamermesh, "The Demand for Variety: a Household Production Perspective," National Bureau of Economic Research, Working Paper No. 8509, 2001.

____ and ____ , "Time vs Goods: The Value of Measuring Household Production Technologies," National Bureau of Economic Research, Working Paper No. 9650, 2003.

Hersch, J., "Marriage, Home Production and Earnings," Harvard Law School. Law-Econ Discussion Paper No 275.

Kiker, B., Mendes de Oliveira, M., "Optimal Allocation of Time and Estimation of Market Wage Functions," *The Journal of Human Resources*, 27,3, 1991.

Kooreman, P., Kapteyn, A., "A Disaggregated Analysis of the Allocation of Time within the Household," *Journal of Political Economy*. Vol 95, no.2, 1997.

Lehmann, H., Wadsworth, J., Acquisti, A.,"Grime and Punishment: Job Insecurity and Wage Arrears in the Russian Federation," *Journal of Comparative Economics* 27, 595-617 (1999).

Mroz, T.,D., Mancini and B.Popkin, "Monitoring Economic Conditions in the Russian Federation: The Russia Longitudinal Monitoring Survey 1992-2000," Report submitted to the US Agency for International Development. Carolina Population Center, University of North Carolina at Chapel Hill, 2001.

Lanjouw, Peter, and Ravallion, Martin. “Poverty and Household Size.” *Economic Journal* 105 (November 1995): 1415–34.

Muellbauer, John. “Testing the Barten Model of Household Composition Effects and the Cost of Children.” *Economic Journal* 87 (September 1977): 460–87.

Nelson, Julie A. “Household Economies of Scale in Consumption: Theory and Evidence.” *Econometrica* 56 (November 1988): 1301–14.

Nesterova, D., Sabirianova, K., “Investment in Human Capital under Economic Transformation in Russia,” Working paper 99/04, East European Research Consortium, 1998.

Newell, A., Reilly,B., “The Gender Wage Gap in Russia: Some Empirical Evidence,” *Labor Economics*, 3, 337-356, 1996.

Pollak, Robert A., and Wales, Terence J. “Demographic Variables in Demand Analysis.” *Econometrica* 49 (November 1981): 1533–51.

Sabirianova, K., “The Great Human Capital Reallocation: An Empirical Analysis of Occupational Mobility in Transitional Russia,” Manuscript. University of Kentucky, 2002.

Solberg, E., Wong, D., “Family Time Use. Leisure, Home Production, Market Work, and Work Related Travel”. *The Journal of Human Resources*, 27,3, 1991.

VITA

Victoria Konstantinova Vernon was born in Kharkov, Ukraine, on January 8, 1973, the daughter of Vladimir Konstantinov and Larisa Konstantinova. She graduated from Kharkov State University in 1995 with a diploma in Mathematical Economics. In 1995 she entered the Graduate School at Indiana University in Bloomington. After earning the degree of Master of Arts in Economics in 1997, she started Graduate School at the Department of Economics at the University of Texas at Austin. During 2003-04 she was employed as Economics instructor by the Fashion Institute of Technology in New York City.

Permanent address: 13 Collinwood Rd
Maplewood, NJ 07040

This dissertation was typed by the author.