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Labor Supply of Married Females in Estonia.[§]

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Abstract

In this paper we estimate the labor supply function for married females in Estonia. Particularly, we are interested in determining the elasticities of the weekly supply of hours with respect to hourly wage rates and with respect to nonlabor income. We adopt the two-step estimation procedure. In the first step, we obtain parameter estimates of the self-selection corrected wage equation. At this stage, we document the absence of the sample selection bias in our data as well as the significant negative effect of non-proficiency in the Estonian language on the hourly wage rate. In the second step, the labor supply function is estimated using the Tobit model, where the predictions from the wage equation substitute for the market wage rates for all individuals. We find that the wage elasticity of hours supplied per week is positive (0.53), while at the same time the nonlabor income effect is insignificant.

Keywords: Female Labor Supply, Transition Economics, Estonian Labor Market

JEL Classification Codes: J22, J31, P36

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1 Introduction.

In this paper we estimate an empirical labor supply model on a sample of Estonian married females in 1998. Specifically, we are interested in the effects of wage rates, non-labor income, age and other demographic characteristics on the weekly labor supply of this subsample of the Estonian population. To the best of the authors knowledge, this paper represents the first attempt to estimate a labor supply model on Estonian data.

Literature on empirical labor supply modelling is already quite mature and extensive. Classical papers on labor supply include Heckman (1974), Wales and Woodland (1980), Cogan (1981) and Blundell, Ham, and Meghir (1987) and Mroz (1987), among others. See also a recent survey of the labor supply literature in Blundell and MaCurdy (1999), Vella (1998), as well as a paper by Heckman (1993). However, the number of labor supply studies in transition economies is still quite limited. The recent paper by Saget (1999) is in fact the only empirical labor supply study for transitions economies published in a specialized journal. There are few theoretical papers on the labor supply in transition that approach the issue from the macroeconomic perspective; see Boeri (2000).

We utilize a recent census (1998) in the ongoing Estonian Labor Force Survey, that covers the labor market status of approximately 13 000 individuals. The survey is a rich dataset that records the labor market history of the sample in 1997 and also includes a part reflecting the current labor market status of the surveyed individuals. Apart from that, it contains an extensive overview of the demographic characteristics of the sampled population.

From this survey we construct a subsample of 2185 married females, who were registered in May 1998 being either employed or unemployed (seeking employment). We include a set of demographic variables for each individual, such as education, nationality, age, country of birth, marital status, size of the household, number of children, and other variables that we subsequently utilize in the empirical labor supply model.

We estimate a standard static labor supply model, which does not take into account fixed costs of work or non-linear budget constraint issues. Non-linear budget constraints is an important specification issue in the empirical labor supply literature. In Estonia, however, personal income tax is proportional, with a very small, fixed, tax-free deduction amount. Therefore, linearity of the budget-constraint in our model is unlikely to be a major specification error.

We estimate the labor supply function of the married females in Estonia as follows. In the first stage, we estimate the self-selection corrected wage equation using the two-step

Heckman procedure as well as the method of maximum likelihood. We use the estimated parameter vector to consistently predict wages for the working and non-working segments of the sample. Thus, the model that we consider in the first stage is the standard model of sample selection suggested in Heckman (1974) and Heckman (1979). In the second stage, we use the standard Tobit model due to Tobin (1958) to estimate the hours of work equation.

The paper is organized as follows: Section 2 describes the development of economic situation in Estonia and its influence on the labor market. In Section 3 we present the theoretical framework of the labor supply models. Section 4 gives description of data used in our study. Finally, Section 5 presents estimation results.[1] Conclusions summarize our findings.

2 Developments of the labor market in Estonia.

Since the time of its regained independence, Estonia, one of the republics of the former Soviet Union, has pursued extremely liberal economic policy. Through such measures as an annually balanced state budget, proportional tax system, removal of foreign trade barriers and agricultural subsidies, currency board arrangement as well as rather low level of unemployment benefits, the Estonian state relied on the work of the free market forces rather than on state intervention in restructuring of its economy. As a result the Estonian economy has undergone dramatic changes practically in all spheres, including its labor market. Hence, the purpose of the current section is to highlight the particular aspects of the labor market in the country which has been formed under the very liberal market conditions as noted above.

The developments of the labor market in Estonia has been influenced through the labor demand as well as labor supply sides of the economy. On the labor demand side, the whole structure of the Estonian economy has drastically changed during the years of transition from the planning to the market economy. We witness that the employment structure has changed correspondingly. Thus, the share of population working in the agricultural and industrial sectors has declined significantly whereas share of services has correspondingly risen. Clearly, these changes had significant human costs attached in form of rising unemployment and outflow from the labor force as significant share of people were unable to adapt to the new economic order with their skills acquired during the Soviet time being rendered redundant.

[1] All graphs and computational results were generated using OX 2.20 and GiveWin 1.30, see Doornik (1999) and Hendry and Doornik (1999).

One particular feature of the early period of the economic restructuring was that the first workers to be fired from their job were females especially in the pre-pension age, see Eamets (1993).

Another particular feature of the Estonian labor market is the rather high share of non-Estonian (mainly, Russian) population concentrated in the capital city, Tallinn, and in the eastern part of the country. These people traditionally were employed in the various industries that were closely interconnected with similar enterprisers within the Soviet economic space. Clearly, after the Estonian independence and consequent reorientation of the economy from the East to the West these group of workers were particulary influenced as the previous economic ties were broken and new ones had to be created from the scratch. The situation of these people has been aggravated by the fact that to the large extend the majority of them had neither enough proficiency in the Estonian language nor have been granted the Estonian citizenship to compete successfully with native Estonians in the job market (e.g. for the public jobs). The economic disadvantages that the non-Estonians experience in the labor market has been documented in Kroncke and Smith (1999) and Smith (2001). Thus the presence of the non-negligible non-Estonian population in the country makes it more interesting to address the labor market issues in Estonia such as determinants of the labor supply decisions, amongst other things.

Turning to the labor supply issues, it is generally acknowledged that during the Soviet regime the female participation rates were as a rule much higher in the countries of the Communist block when compared to those observed in the industrialized Western countries. Notwithstanding the fact that during the last decade the female participation rates generally declined in the transition countries they still remain comparatively high, see Saget (1999) and Eamets (2001, chap. 3). In wake of general decline, the participation rates of the older females have declined to the much lower levels. Being the primary target group of employees to be fired in the first place (as mentioned above) these females has chosen to leave the labor force rather than to stay unemployed.

The important aspect to be taken into consideration when supplying labor to the market is the level and receiving length of the unemployment benefits. As discussed in Eamets and Arro (2000) the level of the unemployment benefits as measured in the percentage to the average national wage is about 7% which is the lowest amongst the candidate accession countries. The unemployment benefits are paid at the flat rate of 400 EEK per month (1 Euro = 15.64664 EEK) over the period of 6 months, which again is one of the shortest lengths with respect to the other transition countries. Clearly, this level of unemployment benefits is very much below the levels that prevail in the Western economies. This amount not only fails to provide consumption smoothing in case of the job loss, it effectively cannot cover even the subsistence expenses. As a result, there are rather huge incentives to find employment, once one losses a job.

To recapitulate, the Estonian labor market is characterized by the significant structural change caused by the liberal free market policies launched once Estonia regained its independence. As a result, most workers have been displaced from their previous jobs and have been forced to acquire new skills to match the demands of the new economic reality. Not all were able to succeed in this. As a result the participation rates of females that used to be quite high during the Soviet times have somewhat declined. In addition, the Estonian labor market is characterized by the presence of large non-native population which experiences certain disadvantages compared with native Estonians at the labor market. The other important point is that the level of the unemployment benefits is very low and thus provide very strong incentives to search for the re-employment actively.

3 Theoretical model.

In this section we outline the theoretical model whose parameters we wish to estimate. The model that we utilize in our study is a static model of labor supply. This type of labor supply model is by far the most popular in the applied literature, although it is based on rather restrictive assumptions. Namely, workers are free to choose the work hours supplied and there are no fixed costs of entering and exiting the labor market. Moreover, we assume that the husband's behavior is exogenous to the wife's decision regarding her participation in the labor market. Again, this is an entirely realistic but standard assumption for the model.

Consider the following population labor supply function

$$\ln h_i^* = a_0 + a_1 \ln w_i^* + a_2 \ln Y_i + a_3' Z_i + e_i \quad i = 1, ..., N, \tag{1}$$

which states how the amount of hours supplied to the labor market depends on such factors as the market wage rate w_i^*, nonlabor income Y_i, and a vector of other observable, individual characteristics Z_i, such as the number of teenagers and small children living in the household, the wife's labor market experience, etc. Lastly, e_i is an error term to capture unobserved individual heterogeneity. Particularly, we are interested in determining the response of work hours supplied to the variation in labor and nonlabor income.

Estimation of equation (1) is complicated by the fact that in reality we observe both the amount of hours worked and the wage rate only for those women who have jobs. Therefore for estimation purposes it is convenient to distinguish between working and non-working subpopulations. In doing so we denote individuals in the working subpopulation with indices $i = 1, ..., n$, such that individuals in nonworking subpopulation accordingly have indices $i = n{+}1, ..., N$. Now, for the sake of the argument, let us assume that in addition to observing the actual wage rates for working individuals, we know - or can consistently estimate - what the market wage for those individuals who are unemployed would be. Then equation (1) can be written in the form[2]

$$\begin{aligned} \ln h_i^* &= a_0 + a_1 \ln w_i^* + a_2 \ln Y_i + a_3' Z_i + e_i \quad i = 1, ..., N \\ \ln h_i &= d_i \cdot \ln h_i^* \\ d_i &= 1 \text{ if } \ln h_i^* > 0 \qquad i = 1, .., n \\ d_i &= 0 \text{ if } \ln h_i^* \leq 0 \qquad i = n+1, ..., N, \end{aligned} \tag{2}$$

where the observed hours of work are stored in the vector $\ln h_i$. This is the well-known Tobit model proposed by Tobin (1958) which allows us to estimate the parameters of the labor supply function even if the endogenous variable of interest is truncated as shown. The upshot of this is that had we known what the imputed wages for those who are unemployed $\ln w_i^*$, $i = n + 1, ..., N$, would be, in addition to the wages that we observe from the labor market participants $\ln w_i^*$, $i = n + 1, ..., N$, we could estimate the labor supply function as given in (2).

However, in order to estimate the model (2), we first need to calculate the imputed market wages for those who are unemployed, using the information available on the working segment of the population. Essentially, with only data available on wages for the working subpopulation, we want to determine the conditions under which we can extend the analysis (based only on the working subpopulation) to the entire population, i.e. including those who do not work. There is a huge literature stemming from the seminal articles of Gronau (1974) and Heckman (1974) that address this question. In fact, our empirical application constitutes an example of potential extrapolation bias what is normally referred to sample selectivity bias in the literature.

[2] Notice that by employing the logarithmic transformation on work hours supplied we impose an implicit assumption that a person is unemployed even if on average she worked one hour per week. Conceptually, there might be a problem with this, changing the employment status of some individuals, but as far as our sample is concerned this is an entirely harmless assumption as only a single individual reports one working hour per week.

The following model, which has been widely accepted in the literature, allows a researcher to test (and to correct if present) for the sample selectivity bias. For the entire population $i = 1, 2, ..., N$, the model consists of the wage equation (3) and the selection equation (4)

$$\ln w_i^* = \mathbf{x}_{1i}'\beta + u_i \quad i = 1, 2, ..., N \tag{3}$$

$$d_i^* = \mathbf{x}_{2i}'\gamma + v_i \quad i = 1, 2, ..., N \tag{4}$$

where $\mathbf{x}_{1i}$ and $\mathbf{x}_{2i}$ are $k_i \times 1$ vectors of exogenous variables, β and γ are vectors of parameters of conformable dimensions. Observe that we need to ensure identification of the model equations. To do so we need to allow the regressors of the selection equation $\mathbf{x}_{2i}$ to contain at least one variable that does not appear among the regressors $\mathbf{x}_{1i}$ in equation (3). In order to ensure model identification it is not uncommon to assume that the variables $\mathbf{x}_{1i}$ are contained in $\mathbf{x}_{2i}$. This is the approach adopted in Vella (1998), for example, and this is the approach we adopt in our paper. The disturbances in these equations have a joint density function $f(u_i, v_i)$ that is characterized by $E(u_i) = E(v_i) = 0$ and $E(u_i v_j) = \sigma_{ij}$ for $i = j$ and $E(u_i v_j) = 0$ for $i \neq j$.

Equation (4) captures the sample selection such that the latent endogenous variable, $\ln w_i^*$ is observed whenever the following condition is fulfilled $d_i^* > 0$. Otherwise we cannot observe the values of $\ln w_i^*$. By introducing the following dummy variable

$$\begin{aligned} d_i &= 1 \text{ if } d_i^* > 0; \\ d_i &= 0 \text{ if } d_i^* \leq 0 \end{aligned}$$

we can compactly denote the observed values of the endogenous variable, $\ln w_i^*$, as

$$\ln w_i = \ln w_i^* * d_i \quad \text{for} \quad i = 1, 2, ..., N.$$

Suppose that we want to estimate the following model using the subsample of $\ln w_i^*$ that we can observe for $i = 1, ..., n$. The corresponding regression function, conditional on the available observations, is given by

$$\begin{aligned} E(\ln w_i^* | d_i = 1) &= E(\ln w_i^* | d_i^* > 0) = E(\ln w_i^* | \mathbf{x}_{2i}'\gamma + v_i > 0) = \\ &= E(\ln w_i^* | v_i > -\mathbf{x}_{2i}'\gamma) = \mathbf{x}_{1i}'\beta + E(u_i | v_i > -\mathbf{x}_{2i}'\gamma). \end{aligned} \tag{5}$$

Notice that in this case an additional term appears in the conditional mean of $\ln w_i^*$, when compared with equation (3). Clearly, whenever the conditional expectation of u_i is zero then the parameters of equation (3) can be estimated consistently. This happens when the disturbances in the wage and selection equations are independent. However, in general, this may not be the case. Therefore, omitting the sample selection term from regression (5) constitutes the regression specification error usually referred as sample selectivity bias.

Under the assumption of joint normal distribution of the disturbances in both equations (3) and (4) with covariance matrix

$$\Sigma_{uv} = \begin{pmatrix} \sigma_u^2 & \sigma_{uv} \\ \sigma_{uv} & \sigma_v^2 \end{pmatrix} \text{ with } \sigma_v^2 = 1,$$

regression function (5) has the following form

$$E\left(\ln w_i^* | d_i = 1\right) = \mathbf{x}_{1i}'\beta + \rho\sigma_u \frac{\phi\left(\mathbf{x}_{2i}'\gamma\right)}{\Phi\left(\mathbf{x}_{2i}'\gamma\right)} = \mathbf{x}_{1i}'\beta + \theta\lambda\left(\mathbf{x}_{2i}'\gamma\right),$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are, respectively, the probability and cumulative density functions of the standard normal distribution, ρ is the correlation coefficient in the joint normal distribution of (u_i, v_i), and $\lambda = \phi\left(\mathbf{x}_{2i}'\gamma\right)/\Phi\left(\mathbf{x}_{2i}'\gamma\right)$ is the inverse Mills ratio. Notice that the variance of the disturbance in the selection equation is set to unity, as we do not observe the actual values of d_i^* but only its sign in the selection equation (4).

4 Data description.

Econometric models of labor supply in this paper are estimated using the data from Estonian Labor Force Survey 1998 (ELFS98, in shorthand). ELFS98 is an extensive dataset collected by the Statistical Office of Estonia, which covers labor market histories of 13091 individuals between the ages of 15 and 69, over the time period 1997-98. ELFS98 includes information on persons who were employed, unemployed or inactive at the time of the survey (May 1998), as well as their complete labor market histories from 1997. The survey also provides a rich subset of other demographic and personal characteristics, such as, for example, a history of marital status changes, changes in residence, as well as extensive information on other members of the household, etc.

In labor supply modelling we utilize part of the ELFS98 data that corresponds to the current labor market status of the included individuals. We select the subsample of the survey that contains married females who are either employed or unemployed in May 1998, i.e. those who actively participate in the labor market at the time of the survey. Altogether, 2185 married females pass our selection criteria. In this subsample 1976 females were employed whereas remaining 209 were unemployed. The following variables that characterize the chosen subpopulation are considered in our study: number of children in the family, place of residence, work experience, age, education, knowledge of the Estonian language, and nonlabor income.

The chosen observable characteristics are quite standard in the literature on labour supply. We take a closer look at those. The variables *smallkids* and *teen* denote the number of children of age less than or equal to 6, and of age between 7 and 19, respectively. The dummy variables *tallinn*, *town*, and *rural* denote whether a given individual was living either in Tallinn, in other towns, or in rural areas at the time the survey was conducted. The variable *exper* denotes woman's working experience calculated as the total number of years since her first job. The age dummies *age1524*, *age2549*, and *age5069* indicate that an individual belongs to the age groups 15-24, 25-49, and 50-69, respectively. The education dummies *basiceduc*, *secondeduc*, and *highereduc* correspond to the educational level equivalent to eight years of school, ten years of school and/or vocational training, and university education. The variable *nonlaborincm* denotes the nonlabour income that a woman enjoys, divided by 1000. It is calculated as monthly household income less the individual's own earnings.

Finally, we would like to investigate the effects of ethnicity on labor market participation features, as there is a number of ethnic minorities living in the country. Unfortunately, we cannot determine the ethnic origin of the respondents directly, since the question of ethnic origin was not included in the survey questionnaire. We have chosen instead of controlling for one's ethnic origin to distinguish between those individuals who are fluent in the Estonian language and those who are not. Given that Estonian is the sole official state language, knowledge of Estonian may be an important factor in determining the decision to participate in the labor market, as well as in determining the type of job (i.e. pay scale) available to those choose to be employed. The dummy variable *notspeakestonian* is thus used to control for proficiency in the state official language.

The two variables *aver_hours* and *last_salary* are central to our analysis. The first of these denotes reported average work hours supplied per week, while the second denotes weekly salary. The variable *last_salary* is calculated by diving the monthly wage received for a given month by four. Figure 1 plots estimated frequency distributions of the weekly labor supply (in hours) and weekly salaries of working individuals. It is seen that work hours supplied per week are concentrated around the average value of 40 hours per week. Clearly, institutions play a major role in determining how many hours can be supplied on a weekly basis. In fact, out of 1996 employed women, 1250 report a 40-hour average work week. Mean weekly salary of employed individuals is estimated to be 524.44 EEK.

We construct the measure of the hourly wage rate as the ratio of *last_salary* to *aver_hours*.

Table 1: Descriptive statistics. Discrete variables.

Variable		Employed	Unemployed	Total
children				
smallkids				
	0	1692(0.86)	144(0.70)	1837
	1	248(0.12)	53(0.26)	301
	2	33(0.02)	11(0.04)	44
	3	3(0.00)[1]	1(0.00)	4
teen				
	0	997(0.50)	87(0.42)	1085
	1	505(0.26)	60(0.29)	565
	2	364(0.18)	42(0.20)	406
	3	96(0.06)	15(0.07)	111
	4	11(0.00)	5(0.02)	16
	5	3(0.00)	0	3
residence				
tallinn		225(0.11)	22(0.10)	248
town		1009(0.51)	92(0.44)	1011
rural		742(0.38)	95(0.46)	837
age				
age1524		63(0.03)	18(0.09)	81
age2549		1391(0.70)	166(0.80)	1557
age5069		522(0.27)	25(0.11)	548
ethnicity				
notspeakestonian		498(0.25)	65(0.31)	563
education				
basiceduc		184(0.09)	30(0.15)	214
secondeduc		1413(0.71)	164(0.8)	1578
highereduc		379(0.2)	15(0.05)	394

[1]Indicates that the corresponding share is less than 1%.

Table 2: Descriptive statistics. Continuous variables.

Variable	Employed		Unemployed	
	mean	st. dev.	mean	st. dev.
nonlaborincm[1]	4.6590	3.3882	3.6719	3.1224
exper	22.949	10.888	18.852	9.9502
aver_hours	40.240	9.6345		
last_salary	524.70	339.69		

[1]divided by 1000.

We use this approximation of the hourly wage rate since we do not observe the actual values of the wage paid per hour. The mean of the calculated hourly wage rate measure is 13.32 EEK. Figure 2 depicts the histogram, estimated density and fitted normal density to the logarithmic transformation of the calculated measure of the average hourly wage rate. There are two main points to observe: first, there is considerably larger variation in the hourly wage rate than in average work hours supplied per week; and secondly, the estimated density seems to be quite close to the fitted normal density.

Before presenting the results of the formal econometric analysis, it is instructive to compare the socio-economic characteristics of employed and unemployed Estonian women. For this purpose we use Tables 1 and 2 which contain the descriptive statistics of the variables of our subsample. This preliminary analysis should hopefully indicate what results we should expect from an application of the analytical econometric methods.

The first noticeable result is that the share of employed women who do not have younger children is larger than that of unemployed women, 0.86 versus 0.70. A similar, but less pronounced, picture arises when we compare the shares of employed and unemployed women that do not have teenage children, 0.50 versus 0.42. Maternity care apparently exerts a negative influence on the probability of being employed. As regards place of residence, we find that for rural areas the proportion of unemployed individuals is slightly larger than that of employed individuals (0.46 versus 0.38). Regarding the age groups, the data suggest that the proportion of unemployed individuals in the oldest group, age 50-69, is substantially smaller than that of employed individuals (0.11 versus 0.27). Also it appears that individuals lacking proficiency in the Estonian language are less likely to find jobs, as the proportion of these individuals among the unemployed is slightly larger than that among the employed. It appears as well that people with higher education have better chances of finding employment, since the proportion of unemployed individuals with a higher education is four times smaller than that of employed individuals with the corresponding level of education (0.05 versus 0.20). In addition, from Table 2 we can infer that the average nonlabor income of employed individuals is larger than that of unemployed persons. And perhaps not surprisingly, it seems that individuals who have jobs have greater work experience when compared to their unemployed counterparts.

In summary, after examination of the descriptive statistics presented in Tables 1 and 2 we arrive at tentative conclusions. The following factors reduce the chances for employment: the incidence of younger children and teenage children in the family, residing in rural areas, lacking proficiency in the official state language (Estonian), having lower educational attainment, and finally, having less work experience. It remains to be seen whether these preliminary conclusions, exclusively based on the sample descriptive statistics, are corroborated by the formal econometric analysis undertaken in the next section.

5 Estimation results.

In this section we present the estimation results of the models described in Section 3. Whenever appropriate, we also compare our estimation results with that obtained in Saget (1999) for Hungarian married females, in particular, as well as obtained in other studies, such as Gerfin (1996), Martins (2001), Melenberg and van Soest (1993), and Callan and van Soest (1994) for German and Swiss, Portuguese, Dutch, and Irish married females, respectively.

5.1 Wage equation estimation results.

We estimate the wage equation by the Heckman two-step procedure and the Maximum Likelihood method. As seen from Section 3, estimation of the wage equation (3) has to be combined with estimation of the selection equation (4). Tables 3 and 4 contain the parameter estimates for both equations of interest. One striking result is that the point estimates of the coefficients are nearly the same in both equations. We interpret this as an indication that our model is correctly specified. Notice that in these regressions the effect of education is measured with respect to individuals with basic education. The effect of place of residence is measured against those living in provincial towns, i.e. not in the capital, Tallinn. The impact of age is evaluated using the 15-24 age group as the benchmark.

It seems natural to begin with a description of the results obtained from the estimation of the selection equation. Actually, the parameter estimates of the selection equation are of interest on their own, as they provide us with information on which factors are likely to influence the participation decision of an individual.

5.1.1 Selection equation.

Consider the parameter estimates of the selection equation displayed in Table 3. As expected, the incidence of younger and teenage children significantly lowers the probability of participation in the labor market, with the more pronounced effect in households with younger children. This is compatible with results reported in Gerfin (1996) for Swiss and German married woman, in Callan and van Soest (1994) for Irish married women, and in Melenberg and van Soest (1993) for Dutch married women. In contrast, Saget (1999) and Martins (2001) report that for Hungarian and Portuguese married women, having children does not have a major impact on the decision to work. Also, according to our estimation results, the age dummies came out to be significant, indicating that there is a higher probability for the older person to be employed. The other important observation is that more highly-educated individuals seem to have better employment possibilities compared with those who have only basic education. This strong positive result is compatible with the results reported for Portuguese women in Martins (2001), whereas it contrasts the results reported for Swiss women in Gerfin (1996).

It is also interesting to note the positive and highly significant coefficient on nonlabor income. The probable explanation lies in the high participation rates of Estonian women in the labor market, which combined with the rather intuitive observation that women who are more highly-educated and who thus command higher salaries tend to have spouses with matching characteristics. Also, it is probably the case that members of well-to-do families have better social contacts, which facilitates better access to higher-paid jobs. This finding is in sharp contrast to the results reported for Portuguese, Swiss, German and Hungarian married women, where the negative (and, in general, significant) coefficient on nonlabor income is reported in the references above. Last but not least is the interesting result that those individuals who lack proficiency in the Estonian language have a significantly lower probability of being employed. The effect of ethnicity on the probability of supplying labor to the market can be compared to the study of Saget (1999), who similarly reports that being of Gypsy origin significantly reduces the probability of participation in the Hungarian labor market. On the other hand, the estimation of Gerfin (1996) suggests that women of foreign origin are more likely to supply their labor in the Swiss labor market.

Table 3: Selection equation.

	Heckman first step			MLE		
Variable	$\widehat{\gamma}$	st. dev.	Z-ratio	$\widehat{\gamma}$	st. dev.	Z-ratio
const	**0.799**[1]	0.222	3.591	**0.777**	0.224	3.464
teen	**-0.113**	0.0449	-2.510	**-0.110**	0.045	-2.432
smallkids	**-0.403**	0.086	-4.652	**-0.402**	0.086	-4.642
exper	-0.019	0.018	-1.017	-0.019	0.018	-1.065
exper2	0.0005	0.0004	1.132	0.0005	0.0004	1.165
nonlaborincm	**0.153**	0.044	3.428	**0.158**	0.045	3.481
age2549	**0.507**	0.212	2.393	**0.532**	0.214	2.487
age5069	**0.625**	0.270	2.315	**0.652**	0.272	2.397
secondeduc	**0.272**	0.124	2.190	**0.272**	0.124	2.1817
highereduc	**0.727**	0.173	4.204	**0.729**	0.173	4.208
tallinn	-0.130	0.132	-0.987	-0.128	0.132	-0.963
rural	-0.149	0.092	-1.622	-0.149	0.092	-1.623
notspeakestonian	**-0.272**	0.097	-2.792	**-0.275**	0.097	-2.818

[1] Bold font denotes significance of the estimate at the 5% level.

According to the estimation results in our paper, work experience and place of residence do not have any significant effect on the probability of being employed. This seems a little contradictory, as we would expect that work experience would increase the chances of finding employment. Similarly, we would expect that living in the capital, Tallinn, would have a positive influence on the chances of being employed, as the largest share of the country's economic activity in Estonia is situated in Tallinn.

5.1.2 Wage equation.

Table 4 contains the estimates of the wage equation. First, note that the standard errors reported from the Heckman method are slightly higher that those estimated by the method of maximum likelihood, as the latter method is more efficient. Notice the positive significant coefficient on nonlabor income. The tentative conclusion is that individuals who have higher nonlabor income tend to have higher wages. This result is corroborated by the selection

Table 4: Wage equation.

	Heckman second step			MLE		
Variable	coef.	st. dev.	Z-ratio	coef.	st. dev.	Z-ratio
const	**2.055**[1]	0.120	17.120	**2.163**	0.065	33.181
exper	0.003	0.007	0.494	0.0008	0.004	0.215
exper2	-0.00014	0.0002	-0.744	-0.0001	0.00008	-1.502
nonlaborincm	**0.140**	0.020	6.690	**0.133**	0.013	10.103
secondeduc	**0.173**	0.054	3.264	**0.157**	0.038	4.136
highereduc	**0.613**	0.074	8.199	**0.584**	0.045	12.839
tallinn	**0.109**	0.051	2.122	**0.127**	0.034	3.661
rural	**-0.106**	0.036	-2.878	**-0.092**	0.024	-3.755
notspeakestonian	**-0.184**	0.040	-4.575	**-0.174**	0.0266	-6.556
λ	0.280	0.211	1.324	0.114	0.160	0.715
$\widehat{\sigma}$	0.456	-	-	**0.463**	0.008	57.553

[1] Bold font denotes significance of the estimate at the 5% level.

equation estimation results, where we found that higher nonlabor income increases chances of participation in the labor market.

Unsurprisingly, there are quite high positive returns to education, reflecting the stylized fact that those who have more human capital tend to earn more.

As regards place of residence, it seems that people living in the capital are paid better than people living elsewhere in the country. This is the expected result, as in general higher wages in the capital are required to compensate for higher costs of living. It also seems that the lowest wages are paid to individuals living in rural areas.

Finally, it seems that individuals who do not speak the Estonian language experience severe economic disadvantage compared to those who are proficient in the language. According to our estimation results, individuals who do not speak the Estonian language earn on average 16% less than the individuals who know the language, holding other characteristics constant.

It is interesting to note that work experience does not have any significant impact on the wage rate. The likely explanation lies in the tremendous structural change that the Estonian economy underwent in the aftermath of the collapse of the Soviet Union. Our estimation results indicate that this structural change has rendered the experience accumulated during the Soviet regime largely redundant.

Also, notice that we do not detect the presence of sample selection bias, as the inverse of the Mills ratio coefficient turned out to be insignificant according to both estimation methods. Thus our findings are similar to those of Saget (1999), who reports an absence of sample selection bias in the Hungarian labor market data. One can explain this finding with relatively high female participation rates in the countries of the post-Communist block compared to the those present in the Western economies.

5.2 Labor supply equation estimation results.

Given the estimation results of the wage equation, i.e. an absence of sample selection bias, we re-estimated the wage equation without the sample selection term. The fitted values of the wage rate calculated for the entire population[3] were then inserted into the labor supply equation. We denote the fitted values of the wage rate as *Fitwagerate*.

The estimation results of the Tobit model are displayed in Table 5. As the table shows, there is a positive and significant coefficient on the hourly wage rate. In fact, due to the chosen so-called log-log specification of the labour supply equation we can directly read off the population wage elasticity, which we calculate as the corresponding slope coefficient multiplied by the factor $\Phi\left(\mathbf{x}_i'\alpha/\sigma\right)$, where the variables in $\mathbf{x}_i$ are estimated at their sample mean values and where $\Phi(\cdot)$ denotes the standard normal cumulative density function, see Wooldridge (2000) for description on calculation of the partial effects in the Tobit model. Thus, our point estimate of the weekly supply of hours with respect to the hourly wage rate is 0.53, which is largely in line with the results of other studies of similar models, see Killingsworth (1983) for a comprehensive review. Moreover, it is of interest to compare our estimate of the wage elasticity of Estonian married females to that reported for another transition country, Hungary, see Saget (1999). She reports that the wage elasticity of Hungarian married females is 1.81. Our estimate of the wage elasticity is much lower.

In keeping with the findings of Saget (1999) we find that the coefficient estimate of the nonlabor income variable is insignificant. The other result that corresponds to the stylized fact is that the incidence of younger and teenage children negatively influences the amount

[3]The main reason for substituting the actual wage rates observed for the working subpopulation for their estimates from the wage equation lies in the way we calculated the measure of the hourly wage rate. Recall from Section 4 that it is obtained as a ratio of the total weekly salary to the weekly supply of hours. Thus, by regressing the latter variable on the fitted values of the wage rate we avoid the appearance of the endogenous variable among the regressors in equation (2).

Table 5: Labour supply equation.

Tobit model.			
Variable	coef.	st. dev.	Z-ratio
const	**1.795**[1]	0.334	5.371
exper	**0.020102**	0.0098801	2.0346
exper2	-0.0003	0.0002	-1.491
nonlaborincm	0.036	0.039	0.921
smallkids	**-0.351**	0.066	-5.257
teen	**-0.080**	0.030	-2.659
Fitwagerate	**0.537**	0.135	3.959
$\widehat{\sigma}$	**1.440**	0.047	30.209

[1] Bold font denotes significance of the estimate at the 5% level.

of work hours supplied to the labor market. It is, however, interesting to note that Saget (1999) reports that the incidence of teenage children in the household seems to induce the wife to supply more hours of work, which is contrary to what we find in case of Estonia.

Finally, it seems that an increase in labour market experience has a positive effect on the amount of work hours supplied to the labor market.

6 Conclusions.

In this paper we estimate the labor supply model for married females in Estonia. For this purpose we use the data contained in the Estonian Labor Force Survey for the year of 1998.

Particularly, we are interested in determining how work hours supplied per week varies with the hourly wage rate and the nonlabor income. To this end, we estimate the labor supply equation according to the following procedure. First, we estimate the wage equation by allowing for possible sample selection bias. In doing so, complementary to estimation of the wage equation, we estimate the selection equation. We use the estimates of the parameter vector of the wage equation to calculate the imputed hourly wage rates for the entire population. Secondly, we use the Tobit model to estimate the labor supply equation, using the imputed hourly wage rate in place of the unobserved actual hourly wage rates.

We arrive at a number of interesting conclusions. First of all, the population elasticity of work hours supplied per week with respect to the hourly wage rate is estimated to be 0.53, which is largely in line with that reported for other studies – see Killingsworth (1983) for a survey. However, this estimate is somewhat lower than the one reported for Hungary in Saget (1999).

We find that nonlabor income has an insignificant effect on the weekly labor supply of married Estonian women. Also, this finding agrees with that reached in Saget (1999) in the case of Hungary, though it somewhat contradicts the evidence from the literature, where a negative nonlabor income elasticity is normally reported.

Our study reinforces the international evidence that the presence of both younger and teenage children in the household lowers female labor supply. In our labor supply equation, both coefficients are negative and significant, even at the 1% significance level.

Next, examine the estimation results of the wage equation. Here the important finding is that we do not detect the presence of sample selectivity bias in our data. A similar conclusion has been reached in Saget (1999), but in general, the results are contrary to what is reported in other studies.

Furthermore, it seems safe to conclude that the estimation results of the wage equation accords with a number of the stylized facts. Firstly, individuals with higher educations tend to have higher wages. Secondly, the wage rate in the capital, Tallinn, is higher on average than those in other parts of the country. This should reflect the fact that the costs of living in the capital are normally higher than in the rest of the country, as well as the fact that the capital area has been the primary subject of economic reforms, which brought better and higher-paid jobs to the inhabitants of Tallinn.

One conclusion that deserves special attention is that individuals who do not speak the Estonian language on average tend to earn around 16% less per hour than individuals who are proficient in the language, other things being equal. Thus it seems that individuals without knowledge of the Estonian language experience severe disadvantages in accessing highly paid jobs.

Finally, consider the estimation results of the selection equation. This equation helps us to determine to what extent the different factors influence an individual's decision to participate in the labor market. In accordance with our expectations, the incidence of younger and teenage children in the household as well as a poor knowledge of the Estonian language, lower the probability of participation in the labor market, whereas such factors as higher educational attainment and being older increase the probability of participation in the labor market. It is interesting to note the positive and significant coefficient on nonlabor income. This implies, somewhat contrary to what is normally found in studies of Western countries, that as labor income earned by other members of the household increases, the probability of participation in the labor market also increases. A likely explanation lies in the job-unemployment polarization phenomenon when for those who is a member of a family with higher income takes it is easier to find a job as a reflection of the good social as well as economic situation of the family.

In closing, we would like to make a policy suggestion and to propose some potential directions for future research, as the work done in this field is far from being exhaustive. Since the findings of this paper indicate that a lack of proficiency in the Estonian language is a serious handicap to participation in the labor market (i.e. it results in both un- and underemployment among the non-Estonian ethnic population), a simple solution would be for the Estonian state to exert more effort in correcting this problem by providing the necessary language training.

Of course, an all-encompassing task for future research, which would make it possible to monitor recent developments in the Estonian labor supply in general, would be to estimate the parameters of the labor supply function using traditional and more recent methods on all available data since the outset of the transition, for both males and females.

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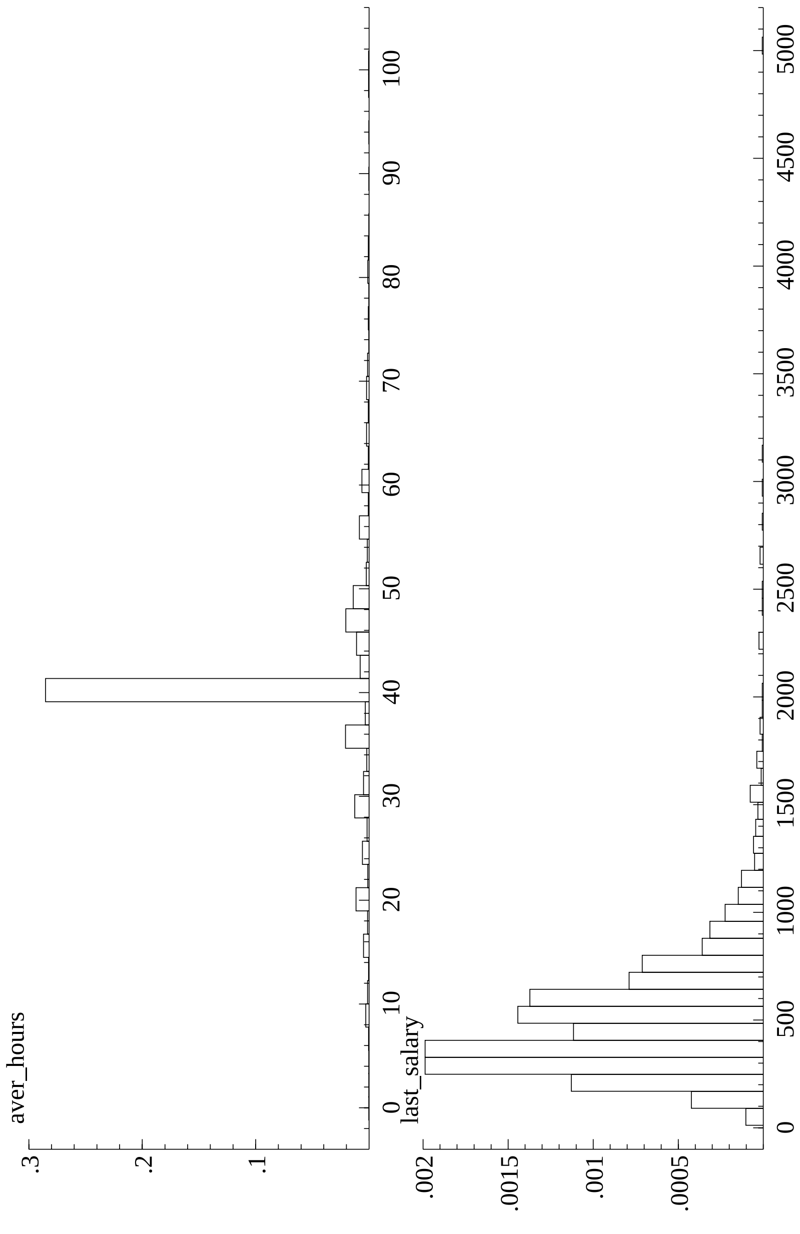

Figure 1: Empirical frequency distribution of average weekly labour supply of hours *aver_hours* and average weekly salary *last_salary*.

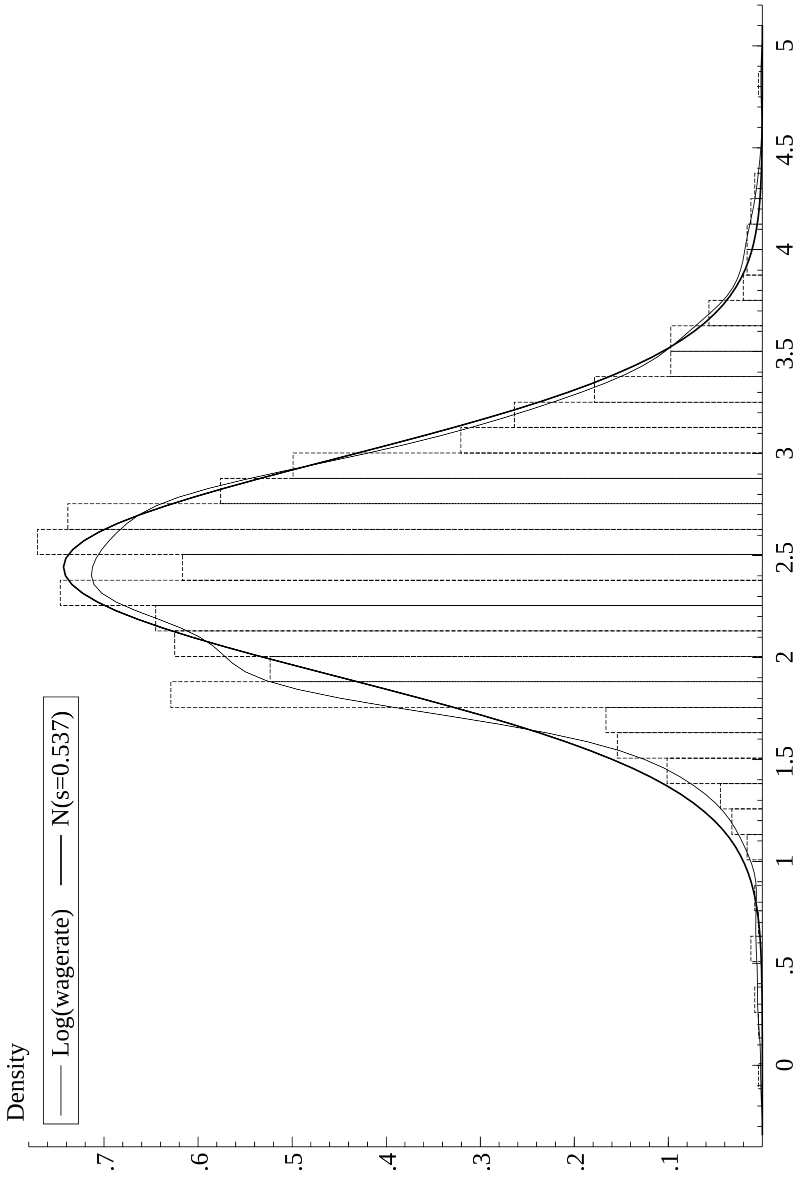

Figure 2: Measure of the average hourly wage rate *Lwagerate*, logarithmic transformation: Empirical frequency distribution, estimated density, fitted normal density .