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Labour Supply of Married Women in Poland

A Microeconometric Study Based on the Polish Labour Force Survey

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Queens' College, Cambridge University

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Abstract

In this paper, the labour supply of married women in Poland is studied using the Polish Labour Force Survey of February 1993 on three competing econometric models, *viz.* Tobit, Three Regime Tobit and Heckit. It is shown that the choice of model has an influence on conclusions drawn. In particular, the Tobit model - which has been widely applied in empirical labour supply analysis - turns out to be a strikingly bad predictor. Further, there is disagreement between the models regarding the wage elasticity of hours supplied. The preferred model for predicting hours of work is the Heckit model. This shows that an increase in the wage rate will induce employees to reduce their number of hours worked. On the other hand, more women will join the labour market after a rise in the wage.

The regression models support the common view that young wives, those who have been unemployed before, or those who have low educational attainments are *ceteris paribus* much more excluded from effective labour supply than the average person. In addition, wives with young children tend to have both lower participation rates and work shorter hours. The exclusion of a large part of especially the young female population from the labour market may have serious economic costs to Poland because part of its potentially most dynamic human capital is left untrained and unemployed.

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1 Introduction

An investigation into labour supply in Poland has to take into account that, since 1990, Poland has been an economy in transition. At the macro level, the economy is characterized by institutional and economic restructuring as well as aggregate demand shocks associated with the collapse of CMEA[1] trade and the endeavour to follow conservative budgetary policies. Although the fall in output between 1989 and 1992 was at 20% on the lower end compared to other transition countries, it was nevertheless substantial. The decline of GDP preceded the sharp rise in open unemployment which reached 13.6% by the end of 1992, about double the G7 rate at the time (OECD, 1993). Although mass layoffs remained infrequent, open unemployment accelerated after 1990 and hit mainly ancillary workers, including administrative and clerical employees who are predominantly female. As the unemployment pool in Poland is characterized by very low turnover rates, and the incidence of unemployment amongst young people, females and workers with low skills is comparatively high, these groups are more likely to face long-term unemployment. This might effectively exclude them from the labour market or lead them to withdraw into non-participation.

Empirical research on labour supply of married women in Poland should therefore be aware of the theoretical deficiencies of standard labour supply analysis in neglecting the presence of involuntary unemployment.[2] This paper seeks to determine factors which influence both effective and notional labour supply in order to identify possible starting points for labour market policies. It might be of interest to policy makers to see whether there are market failures to disadvantage certain groups in the job market, *e.g.* young wives.

For married women, labour supply has to be seen in a household context, the labour market status of the husband and the presence of children potentially being decisive to a wife's labour market behaviour. Further policy implications arise from the responsiveness of labour supply to pecuniary variables such as the wage rate or non-wage income. As the transition process involves redesigning the welfare system for a market economy in the form of new tax and benefit systems, wage and income elasticities of labour supply will be important for finding optimal income tax rates and levels of income support.

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[1] Council for Mutual Economic Assistance; also abbreviated COMECON.

[2] A person is voluntarily unemployed if she chooses not to work at her perceived market wage. She is involuntarily unemployed if she wants to work but cannot find a job at the going wage, although she would be just as capable of doing the job as another person who is in employment.

Studies on western countries have come up with a wide range of estimates of the wage elasticity of female labour supply. Some studies find the elasticity significantly positive, others point more towards similarity with studies on men, *i.e.* a small or even negative elasticity. For a summary of empirical results see Killingsworth (1983, pp.111-125). Mroz's (1987) famous study concludes that the specification of the model used in estimation matters very much to the estimates obtained. We compare three statistical models using cross-sectional data on 7903 wives from the Labour Force Survey of February 1993 conducted by the Central Statistical Office (GUS) in Poland. Taking Tobit as a starting point, the Three Regime Tobit takes into account the existence of involuntary unemployment, whereas the Heckit model distinguishes explicitly between the participation and hours supplied decisions.

Section 2 depicts a stylized overview of the Polish labour market. Section 3 gives a short account of the underlying economic and econometric theories. After a brief description of the Polish Labour Force Survey and the sample in section 4, the reader is presented with the estimation results (section 5) followed by the conclusions (section 6). Some detail left out in the text can be found in the appendix.

2 The Labour Market in Poland - Some Stylized Facts

Female labour force participation in postwar Poland has been about 15 percentage points above the average of western countries, yet slightly below the average of the states in the former communist block.

Table 1: Development of the Female LFPR[1] in Poland

year	1960	1970	1980	1985	1990	1993
LFPR	66.0	72.0	72.4	73.4	67.8	69.7

Notes: 1) LFPR: labour force participation rate.

Source: OECD (1993, p.130) and Employment Observatory, Central and Eastern Europe, European Commision, Brussels 1994, No. 6 , p.35. The data are from the Central Statistical Office (GUS), Warsaw.

Communist regimes in general encouraged - and also obligated - women to work in their labour intensive and low productivity economies. These policies were supplemented by an ideology supportive of emancipation and a legal and institutional framework facilitating female labour force participation through generous maternity and child-care benefits. Furthermore, subsidized child-care facilities were provided by large work establishments and the state. Abortion was legalized in 1956 and allowed women who were ready to make use of it a greater choice regarding child-bearing. However, Kotowska (1992) argues that "females were perceived as the additional labour force" and that the legal and institutional structure did not alter the traditional understanding of the woman as a wife and mother.

The onset of transition with the Economic Transformation Programme of January 1990 coincided, at the macroeconomic level, with an adverse external environment due to the collapse of CMEA trade, an appreciating real exchange rate from 1990 to 1992 after the devaluation of 1989, and measures to contain budgetary deficits. The effect of the induced decreases in the level of effective aggregate demand and the beginning of the process of structural adjustment resulted in sharp reductions in output and the rise of open unemployment. Output in 1992 stood at 81.2%, employment at 89.9% and real wages at 67% of their 1989 levels. It should be noted that in spite of this extraordinary fall in real wages, changes in female labour force participation were less remarkable. Largely as a result of the fall in output, the (registered) unemployment rate rose from 1.5% in the first quarter of 1990 to 13.6% in the fourth quarter of 1992 (OECD, 1993; p.20).

Labour shedding has been relatively widespread in administrative units of large state-owned enterprises and in semi- or unskilled occupations in the light industry, both marked by a high concentration of female workers. The share of women in total registered unemployment has increased steadily from 42.7% in March 1990 to 52.3% in March 1993 (The World Bank, 1994). Low exit probabilities to employment are a general problem for the unemployed in Poland, with the long-term unemployed (spells longer than six months) accounting for 35.6% of total unemployment (Góra, 1994). Yet chances to find employment are particularly low for female, young and less educated people: the neglect of tertiary education under the communist regime together with the increased demand for new managers in a market economy has provided good employment prospects for those with higher education, whereas the skills of the less well educated have become partly obsolete. High redundancy payments enforced by law and union pressure have caused state-owned enterprises to reduce employment by freezing new hirings, thus impeding young people's entrance to the job market. Coopers & Lybrand (1991) report that in 1991, only 23% of job orders were for women - 77% for men, arguing that men are often thought to be more flexible than women, who by law are entitled to generous benefits should they become mothers. Moreover, women's opportunity costs of employment have risen substantially: in practice, taking maternity leave now often means loosing one's job afterwards. The monthly cost of child care, though, can go from 6% up to 20% of the average monthly wage.

These institutional factors should be borne in mind when analysing female labour supply in Poland. Table 2 contains important summary statistics from the sample.[3] The general picture is an inversely-U-shaped life-cycle profile of labour supplied. In contrast, hourly wage rates rise more or less continuously with age.

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[3] The sample consists of 7903 married women between ages 21 and 65 inclusively. For more details, see section 4 below and appendix A1.

Table 2: Some Summary Statistics

age in years	participation[1] rate in %	unemployment rate in %	average net hourly wage rate in US$	average number of hours worked
21-25	47.6	50.0	0.80	39.0
26-30	60.2	31.4	0.89	37.8
31-35	74.5	24.0	0.90	38.6
36-40	82.2	19.7	0.90	39.9
41-45	82.4	15.4	0.92	40.4
46-50	72.7	14.7	0.96	39.3
51-55	48.0	12.5	0.97	39.1
56-60	14.9	18.2	1.04	35.6
61-65	04.6	14.8	0.96	27.7
total	59.5	20.4	0.92	39.2

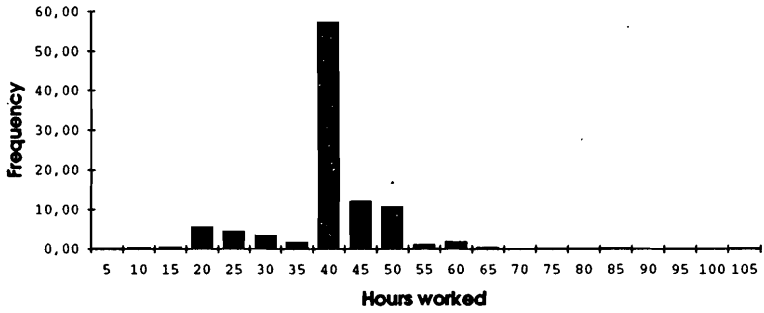
Notes: 1) Participants are workers and the unemployed. See section 4 for the definition of unemployment in the Polish Labour Force Survey.

2) The difference to table 1 in the participation rate is explained by the different data sources.
Source: The Polish Labour Force Survey of February 1993; own calculations.

What strikes the eye are unemployment rates way in excess of the mean for young women up to their mid thirties, especially the rate of 50% for married women in their early twenties. The scarcity of jobs in the macroeconomy seems to be very unequally distributed across the economically active as sketched above.

The current situation on the Polish labour market has implications for the application of standard labour supply analysis. On the one hand, search unemployment can be expected to be of considerable importance, *i.e.* women not wanting to work at their *current* offered wage. In that case, they do not supply labour. On the other hand, it will be difficult to deny the existence of unemployment which is involuntary, where a woman does supply labour at the going wage, yet cannot find a job. Besides, many non-participants might in fact want to work, were they not discouraged by the scarcity of jobs. There can be other forms of restriction of choice, *e.g.* insufficiently developed labour markets because of the lack of geographical mobility due to housing shortages and local labour offices not being well equipped to place the unemployed into new jobs. Sometimes, people can only get part-time jobs although they would like to work longer hours (underemployment) or they have to work say 40 hours by contract although they would rather have a part-time job (overemployment). Nevertheless, the availability of differing contracts can justify to model labour supply in terms of free choice over the number of hours worked as is done in this paper. The figure below shows the frequency distribution of hours worked by workers in the sample:

Figure 1: Frequency Distribution of Hours Worked by Workers[4]



Although the mass of the distribution falls on 40 hours a week, we register a considerable variation in the number of hours worked. So there is some justification to accept free choice on hours of work as a working hypothesis, but credence might also be given to the view that institutional factors have a significant influence on effective hours supplied: for example, there are relatively few part timers compared to western countries (see Untiedt, 1992; p.81, for West Germany).

3 Econometric Models of the Labour Supply of Married Females

Empirical research on labour supply is dominated by neoclassical assumptions of utility-maximizing agents who, in addition, are often assumed to operate in perfectly competitive markets. Even if it is granted that these assumptions are operational in developed market economies, one may find them less valid for economies in transition like Poland, where market imperfections are most likely to violate the axioms of the neoclassical economist. Conversely, decisions will have to be made in labour market policy, and the neoclassical system provides the most widely accepted and practised way of going about labour supply analysis. For these reasons, the neoclassical approach will be used here.

We generally classify empirical labour supply research into first and second generation studies (Killingsworth, 1983). First generation research can be timed from about the 1930s to the early 1970s and is characterized by applying OLS estimation to rather arbitrarily specified supply functions, that is to say specifications are not related to utility theory. Second generation research is distinguished by relating directly to utility theory and attempting to remedy the econometric defaults of OLS

[4] The numbers on the x-axis refer to the upper limit of the interval, *i.e.* 40 means 35<hours worked≤40. This is also valid for the histograms below.

estimation by making use of Maximum Likelihood methods or sample selectivity correction *à la* Heckman (1979). Most recently, third generation models have been developed applying dynamic models to panel data. Here we use cross-sectional, second generation specifications.

Starting from the static semi-log specification of the labour supply function used in most empirical applications, we define a latent labour supply index for individual i:

$$H_i^* = \alpha_0 + \alpha_1 \ln w_i + \alpha_2 \overline{m}_i + \alpha' x_i^* + u_{Hi} = x_i'\beta + u_{Hi} \qquad (1)^5$$

where w is the net hourly wage rate, $\overline{m}$ refers to exogenous (non-wage) income and x* is a set of control variables (*e.g.* age, education). The minimum of hours supplied being constrained to zero, desired hours supplied H_i are then given by

$$H_i = x_i\beta + u_{Hi} \quad \text{if} \quad H_i^* \geq 0 \Leftrightarrow u_{Hi} \geq -x_i\beta \qquad (2a)$$

$$H_i = 0 \quad \text{if} \quad H_i^* \leq 0 \Leftrightarrow u_{Hi} \leq -x_i\beta \qquad (2b)$$

One can either estimate (2a) for workers only, or estimate (2a) with (2b) with H_i for nonworkers set to zero. In the former case, the model suffers from selection bias as truncating the sample on the dependent variable induces a correlation between the exogenous variables and the error term. The latter method commits a specification error by setting negative values of the latent variable - whose expectation is given by $x_i\beta$ - equal to zero. Moreover, when estimating participation probabilities with a binomial dependent variable, the most severe problem with OLS is that predicted probabilities can lie outside the interval [0,1].[6] The deficiencies of OLS in emprircal labour supply models have - broadly speaking - been remedied in second generation research in either of two ways: Tobin's (1958) Maximum Likelihood or Heckman's (1979) two stage method. Equations (2) and the assumption $u_{Hi} \sim N(0, \sigma_H^2)$ render the following probabilities (Pr) and densities (f) (see next page):

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[5] In the following, the transform operator will be ignored.

[6] Further problems with OLS are non-normal and heteroskedastic disturbances, see Greene (1993, p.637) and Gujarati (1995, p.541ff.). In the hours equation, truncation of the dependent variable at zero leads to a downward bias in the estimated coefficients; that is why many second generation researchers found higher elasticities than in first generation work (see section 5 below).

$$\Pr[\text{i works}] = \Pr\left(\frac{u_{Hi}}{\sigma_H} > \frac{-x_i\beta}{\sigma_H}\right) = \Phi\left(\frac{x_i\beta}{\sigma_H}\right)$$

$$f[\text{i works } H_i \text{ hours}] = f\left(\frac{u_{Hi}}{\sigma_H} = \frac{H_i - x_i\beta}{\sigma_H}\right) = \frac{1}{\sigma_H}\phi\left(\frac{H_i - x_i\beta}{\sigma_H}\right)$$

$$\Pr[\text{i does not work}] = \Pr\left(\frac{u_{Hi}}{\sigma_H} \leq \frac{-x_i\beta}{\sigma_H}\right) = 1 - \Phi\left(\frac{x_i\beta}{\sigma_H}\right)$$

where ϕ and Φ denote the densitity and distribution function of the standard normal distribution, respectively. Empirical analysis will be based on the following statistical models.

3.1 Estimation Methods

Model 1. Tobit: all unemployment voluntary

Given the probabilities above, under independent drawings the likelihood of the sample is

$$\ell_1(\beta, \sigma_H | X) = \prod_{H_i > 0} \frac{1}{\sigma_H}\phi\left(\frac{H_i - x_i\beta}{\sigma_H}\right) \prod_{H_i = 0} 1 - \Phi\left(\frac{x_i\beta}{\sigma_H}\right). \qquad (3)$$

Maximizing ℓ_1 with respect to β and σ_H gives Tobit estimates of β and σ_H.

Model 2. Three Regime Tobit: all unemployment involuntary

Rationing in the labour market can lead to a situation where

$H_i = 0$ although $H_i^* > 0$ at the perceived wage.

Here, although the person does supply labour at her perceived wage, notional labour supply cannot be made effective. In the Tobit model, it is assumed that unemployment is voluntary, that is to say the unemployed do not want to work at their perceived offered wage. To incorporate involuntary unemployment into the standard analysis of labour supply, Blundell, Ham and Meghir (1986) suggested estimating a Three Regime Tobit, which is a version of Cragg's Double Hurdle model (Cragg, 1971). The first hurdle is that the desired number of hours worked be positive: $H_i^* > 0$. The second hurdle constitutes the probability of being rationed to zero hours in that case. It will depend on a range of macro- and microeconomic factors (cf. table 4 below). So we define a second latent index E_i, this time related to employment opportunities:

$E_i = z_i\theta + u_{Ei}$ assuming $u_{Ei} \sim N(0, \sigma_E^2)$.

Woman i is employed if $H_i^* > 0$ and $E_i > 0$ and involuntarily unemployed otherwise. Hence,

$$\begin{aligned} \Pr[\text{i is employed}] &= \Pr_i^E = \Phi\left(\frac{z_i\theta}{\sigma_E}\right) \\ \Pr[\text{i is unemployed}] &= 1 - \Pr_i^E = 1 - \Phi\left(\frac{z_i\theta}{\sigma_E}\right) \end{aligned} \qquad (4)$$

Under the (strong) assumption of independence between u_{Hi} and u_{Ei}, the likelihoods for individuals to report positive or zero hours are given by:

$$\begin{aligned} f(H_i = h_i > 0) &= \Phi\left(\frac{z_i\theta}{\sigma_E}\right)\frac{1}{\sigma_H}\phi\left(\frac{H_i - x_i\beta}{\sigma_H}\right) \\ \Pr(H_i = 0 \text{ as unemployed}) &= \left(1 - \Phi\left(\frac{z_i\theta}{\sigma_E}\right)\right)\Phi\left(\frac{x_i\beta}{\sigma_H}\right) \\ \Pr(H_i = 0 \text{ as non-participant}) &= 1 - \Phi\left(\frac{x_i\beta}{\sigma_H}\right). \end{aligned}$$

The likelihood function for the sample given independence of observations is (5):

$$\ell_2\left(\beta, \sigma_H, \frac{\theta}{\sigma_E} \mid X, Z\right) = \prod_{H_i>0} \Phi\left(\frac{z_i\theta}{\sigma_E}\right)\frac{1}{\sigma}\phi\left(\frac{H_i - x_i\beta}{\sigma_H}\right) \prod_{U}\left(1 - \Phi\left(\frac{z_i\theta}{\sigma_E}\right)\right)\Phi\left(\frac{x_i\beta}{\sigma_H}\right) \prod_{NP} 1 - \Phi\left(\frac{x_i\beta}{\sigma_H}\right).$$

An asymptotically consistent way of estimating ℓ_2, which is carried out here, is to use a two-stage method by finding an estimate of $\Pr_i^E$ by way of a Probit model - as in (4) - and then substituting it into ℓ_2 for $\Phi\left(\frac{z_i\theta}{\sigma_E}\right)$.

Model 3. Heckit *all unemployment voluntary*

A common drawback of both the Tobit and the Three Regime Tobit models is that they impose the expected value $E(H_i)$ to fall continuously to zero as the wage declines towards the reservation wage. In the presence of substantial fixed costs to employment, however, the labour supply schedule will be discontinuous. Some child-care, transportation or time costs may, for example, be fixed. For this reason, the

Heckit model allows the underlying indices for the participation and hours supplied decisions to differ, although it is not made explicit where this potential difference originates from. Fixed costs as illustrated here are one example which is often named in the literature (Cogan 1981, Mroz 1987). The fact that very few people work less than say 15 hours a week might also arise from leisure being a bad if one works only a few hours. Similarly, empirical evidence suggesting discontinuity might still be consistent with continuity if certain nonlinearities not allowed for in our specification are present.

Heckit estimation consists of a two-stage procedure.[7] Heckman (1979) shows that the problem of sample selectivity in OLS can be overcome by including the inverse Mills ratio λ_i (see below) as an additional regessor in (2a) which is then estimated by OLS. In the first stage, an estimate of λ_i is obtained by running a probit regression on participation - (P). Maximizing the likelihood

$$\ell_3\left(\frac{\beta_P}{\sigma_P}|X\right)= \prod_{H_i>0}\Phi\left(x_i\frac{\beta_P}{\sigma_P}\right)\prod_{H_i=0}1-\Phi\left(x_i\frac{\beta_P}{\sigma_P}\right) \qquad (6)$$

provides probabilities of participation. An estimate of the inverse Mills ratio is then defined by:

$$\hat{\lambda}_i=\frac{\phi\left(x_i\frac{\hat{\beta}_P}{\sigma_P}\right)}{\Phi\left(x_i\frac{\hat{\beta}_P}{\sigma_P}\right)}.$$

It should be noted that maximizing (6) gives estimates of $\frac{\beta_P}{\sigma_P}$ from which neither numerator nor denominator can be identified. In the second stage, OLS is run on

$$H_i=x_i\beta+\left(\frac{\sigma_{PH}}{\sigma_H}\right)\hat{\lambda}_i+u_{Hi} \qquad \text{to obtain } \hat{\beta}. \qquad \sigma_{PH}=\text{cov}(u_P,u_H)$$

Here, weighted least squares (WLS) will be applied using Huber's formula to calculate robust standard errors (Stata corporation, 1993; Vol.2, pp.405-414). Note

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[7] While Killingsworth (1983, p.156f.) uses the term Heckit to describe a FIML estimation in a system of wages and hours being simultaneously determined, Berndt (1990, p.627ff.) and this paper take Heckit to mean a multi-stage estimation procedure which allows for discontinuity in the labour supply schedule.

that as $\hat{\beta}_p$ and $\hat{\beta}$ (as well as σ_P and σ_H) are not constrained to be equal, (1) is not generally valid any more as H_i^* becomes potentially discontinuous at $H_i^*=0$. Equality would mean that $\frac{\sigma_{PH}}{\sigma_H} = \sigma_H$.

3.2 Wage and Income Responses

One can distinguish between

$E(H_i^*)$	the expected value of the latent variable, not of interest here.
$E(H_i)$	the expected value of the desired number of hours supplied.
$E(H_i \mid H_i^* > 0)$	the expected value of the desired number of hours given these are positive

As the lowest value H_i can take is 0, the relationship between $E(H_i)$ and $E(H_i \mid H_i^* > 0)$ is given by: $E(H_i) = E(H_i \mid H_i^* > 0).Pr(H_i^* > 0)$. Differentiating with respect to x_k:

$$\underbrace{\frac{\partial E(H)}{\partial x_k}}_{\text{total effect}} = \underbrace{Pr(H^* > 0)\frac{\partial E(H|H^* > 0)}{\partial x_k}}_{\text{effect due to change in hours worked}} + \underbrace{E(H|H^* > 0)\frac{\partial Pr(H^* > 0)}{\partial x_k}}_{\text{effect through change in participation probability}}$$

Formulae for the calculation of the respective elasticities in the three models are provided in appendix A2.

3.3 The Exogeneity of Wages

In all models, the wage rate could be specified endogenously and instrumented out as often found in other work. Given the regressors in the wage equation are all exogenous, the problem of simultaneous equation bias is avoided in the hours equation. If the instrument for the wage, namely the predicted wage from a reduced-form wage equation, is employed for the whole sample, *i.e.* workers as well as non-workers, we get the model on the following page:

$$\ln w_i = \gamma z_i^* + \varepsilon_i \qquad (7a)$$

$$H_i = \alpha_0 + \alpha_1 \ln \hat{w}_i + \alpha_2 \overline{m}_i + \alpha x_i^* + u_{Hi} \quad \text{if} \quad H_i^* > 0 \qquad (7b)$$

$$H_i = 0 \quad \text{if} \quad H_i^* \leq 0 \qquad (7c)$$

This way, estimates of perceived wages for non-workers are obtained. For estimation purposes, (1) should then read

$$H_i^* = \alpha_0 + \alpha_1 \ln \hat{w}_i + \alpha_2 \overline{m}_i + \alpha x_i^* + u_{Hi} = x_i^{**} \beta + u_{Hi} \qquad (1)^*$$

where $\ln \hat{w}_i$ is obtained from (7a). However, although producing consistent estimates, instrumental variable (IV) estimation might cause serious problems. Especially if the wage equation (7a) predicts the actual wage badly, *i.e.* if the R^2 is low as common in cross-sectional analysis, the correlation beween the actual and the predicted wage will be very low and the IV estimates highly inefficient. Here, as a practical solution to this problem, predicted wages, $\ln \hat{w}_i$, will be used only for non-workers to obtain estimates of their perceived wage rates. Note that this is "not directly applicable to the case of labor market search where the wage is unknown to the individual before she enters the market." (Heckman, 1974; p.682). Estimation of the reduced form wage function (7a) will allow for other factors apart from purely human capital to influence the wage structure (Steiner and Bellmann, 1994). Furthermore, potential sample selectivity bias shall be taken into account by inclusion of the inverse Mills ratio using the same procedure as for hours supplied in the Heckit model.

4 The Polish Labour Force Survey and the Sample Design

The Labour Force Survey (LFS) of the Central Statistical Office (GUS) of Poland is based on a stratified sample of households and carried out once a quarter. Sampling takes place in two stages, the first being the selection of territorial statistical units from which then in the second stage housing units are picked. After its start in May 1992, the Labour Force Survey was conducted on the same sample until February 1993. Subsequently, the sample has been partly rotated. For a general description of the Polish LFS see Szarkowski and Witkowski (1994).

This study uses data from the survey of February 1993 in which 45,871 individuals aged 15 or over give information on both their economic activities and their personal characteristics (such as age, marital status, educational attainment, assignment to a disability group and the like). According to International Labour Organization

recommendations, individuals are categorized into one of three labour market states: employment, unemployment or inactivity. People count as unemployed if they did not work during the reference week, yet said that they were actively searching for employment and ready to take up a job in the following week.

The sample investigated in this paper consists of 7309 married women between 21 and 65 years of age[8]. Unfortunately, self-employed as well as "unpaid family workers" do not state their net earnings so that they had to be excluded from the sample. All variables in the sample have been constructed by the author from the questionnaire answers of the LFS using the econometric package STATA.

A drawback of the survey is that it contains no information on non-wage income of the household. Modelling the family in labour supply models has often taken the form of the "male chauvinist" model (Berndt 1990; Merz 1989; Mroz 1987; Untiedt 1992) where the wife takes her husband's income as exogenous. This seems a sensible practical solution, especially for Polish society which, as the evidence in section 2 points to, still seems very male-dominated. Given this specification of the family, the effects of changes in the earnings of the husband can be treated like income effects, and the estimate of the income effect in this paper must be entirely based on the husband's income. Although non-wage income of households in Poland is at the moment likely to be far less important than in western countries, this lack of information seems severe enough to take estimated income effects with a grain of salt.

5 Estimation Results

Below, the results of estimating the set of equations (7) as described in section 3.3 are presented. Apart from the key variables wage and husband's earnings, we allow characteristics such as age, education, children or occupation to affect labour supply. The sample means of all the variables are reported in appendix A3.

To identify the coefficients in the labour supply function at least one variable in the wage equation should not be included in the labour supply equation (Killingsworth 1983, p.154f. footnote 14). Yet as we do not use IV estimation here, but employ predicted wages only for non-workers, an identification problem is less likely to arise. In any case, the earnings function (reported in appendix 4) includes the number of children (to allow for differing tax rates), the industry, private sector and unemployed before dummies as well as the voivodship[9] unemployment rate, which are not included in the labour supply function. This can be justified on the grounds that these variables will not have a direct effect on preferences, but rather an indirect one

[8] The appendix explains how we get down to that number.

[9] Poland is administratively divided into 49 voivodships.

through the wage rate. Additionally, in the Heckit model (table 5) identification follows entirely from the nonlinearity of the inverse Mills ratio, which might be problematic; it turns out, however, that we get sensible and significant estimates.

Table 3 states the results of the Tobit and Three Regime Tobit estimates (models 1 and 2). The employment function for the Three Regime Tobit is presented in table 4. Finally, table 5 contains the Heckit results (model 3). Base categories are given in parentheses. The wage variable for nonworkers is the predicted wage from the reduced-form wage equation (7a). The estimates of its coefficients are reported in appendix A4. In order to find an estimate for the inverse Mills ratio in the wage equation, a reduced form Probit on participation (employed - not employed) has been estimated, though it is not reported here. For the Heckit model, a Probit including the (predicted) wage is estimated in order to obtain participation responses to wage changes. The estimation of the Probit, Tobit and Heckit models can be carried out relatively simply in STATA. The Three Regime Tobit, on the other hand, demands considerable programming and computing effort. Due to the mistake which has been discovered in some Pentium processors, the final result was checked on a 486 machine and turned out to be exactly the same. Moreover, various starting vectors have been specified and all converged to the same maximum, so that we can with some confidence assume to have found the global maximum of the likelihood function.[10]

In what follows, we provide a discussion of the estimates presented in tables 3-5. After a short description of the evidence from the basic Tobit model 1, a number of variables will be picked out to discuss the differences to the other models 2 and 3. It is worth noting that in table 3, coefficients refer to H* which is not of direct interest here. So for discontinuous variables, the induced differences in $E(H|H^*>0)$ are given when they assume value 1 instead of 0 to make direct comparisons with the Heckit (hours) model. Calculations of changes in E(H) and $Pr(H^*>0)$, though not undertaken here, would all be based on the underlying index H* and hence the reported coefficients. For wage and income variables elasticities will be given in table 6.

[10] The maximizer used by STATA is a modified Newton-Raphson method (Stata corporation, 1993; Vol. 3, p.430f.

Table 3: Estimates of the Tobit and Three Regime Tobit Models
Dependent variable: hours worked

Variable	Tobit			Three Regime Tobit		
	Coeff.	Change in E(H|H*>0)[1]	|t|	Coeff.	Change in E(H|H*>0)[1]	|t|
ln hourly wage	12.44		8.41	3.40		2.98
age (years) between (36 and 45)						
21 and 25	-21.38	-6.31	9.43	-11.93	-5.00	7.08
26 and 35	-3.91	-1.38	3.41	-2.75	-1.29	3.03
46 and 55	-7.59	-2.57	6.37	-8.05	-3.54	8.67
56 and 65	-49.35	-11.34	26.55	-46.23	-13.00	33.17
education (primary)						
higher	8.9	3.57	4.02	9.14	4.96	5.31
post-secondary	11.28	4.64	5.24	9.53	5.20	5.67
secondary general	5.16	1.99	2.99	7.61	4.06	5.54
secondary vocational	9.72	3.93	6.61	10.10	5.54	8.80
basic vocational	3.77	1.43	3.08	4.33	2.21	4.58
less than primary	-15.54	-4.86	2.41	-12.05	-5.03	2.69
number of children between age						
0 and 2	-28.89	-7.95	17.79	-27.46	-9.51	23.47
3 and 10	-8.40	-2.81	13.75	-5.78	-2.61	12.45
11 and 18	-0.05		0.09	0.42		1.01
assigned to a disability group	-49.21	-11.33	24.76	-43.64	-12.61	31.50
occupation (blue-collar)						
top management	-10.24		1.01	15.04	8.73	1.89
middle management	4.16	1.57	1.75	2.98		1.60
lower management	4.41	1.69	1.65	1.97		0.90
professional	2.39		1.57	-0.59		0.50
simple white-collar	2.77	1.04	2.38	1.73	0.86	1.90

Table 3: (continued)

Variable	Tobit			Three Regime Tobit		
	Coeff.	Change in E(H|H*>0)[1]	|t|	Coeff.	Change in E(H|H*>0)[1]	|t|
place of residence (rural)						
100,000 inhabitants or more	0.59		0.56	1.49	0.74	1.81
20,000 to 99,999	1.73		1.53	2.13	1.06	2.43
19,999 or less	4.53	1.74	3.56	4.87	2.51	4.91
husband's characteristics (regular job)						
earnings (US$)	-0.03		6.06	-0.02		4.34
occasional job	2.12		0.66	3.50		1.41
unemployed	-5.09	-1.77	3.60	4.27	2.18	3.82
inactive	-7.56	-2.56	5.77	-5.96	-2.68	5.91
constant	-3.60		1.03	22.03		8.19
log likelihood	-20,072			-20,314		
pseudo-R^2	0.09			0.11		
$\hat{\sigma}$	29.15			22.42		
number of individuals	7903			7903		

Notes: 1) These columns approximately state the difference in the expected value of hours worked for workers when a person is in the named category rather than the base by adding 1 to the corresponding variable, *i.e.* $\hat{\beta}_k + \hat{\sigma}_H \frac{\phi(x_{+1}\hat{\beta}/\hat{\sigma}_H)}{\Phi(x_{+1}\hat{\beta}/\hat{\sigma}_H)} - \hat{\sigma}_H \frac{\phi(x_{mean}\hat{\beta}/\hat{\sigma}_H)}{\Phi(x_{mean}\hat{\beta}/\hat{\sigma}_H)}$. All other variables are evaluated at their means. Only coefficients significant at the 10% level are interpreted.

2) In all models here and below, we reject the hypothesis that all slope coefficients are equal to zero. Note that the pseudo-R^2 which is defined as $1-\log(\ell-\ell_0)$- where ℓ_0 is the restricted likelihood with all slope parameters set to zero - has no intuitive interpretation as the conventional R^2 (unless it equals 0 - no explanatory power - or 1 - perfect fit).

3) The fact that the log likelihood in the Three Regime Tobit is smaller than the one in the Tobit should not be disconcerting: first, the Tobit is not nested in the Three Regime Tobit and second, the Three Regime Tobit has been estimated by a two-stage procedure (see section 3).

Table 4: Estimates of Employment Probabilities for Participants in the Three Regime Tobit Model

Dependent variable: employed (1) - unemployed (0)

Variable	Probit		
	Coeff.= $\hat{\theta}/\sigma_E$	% change[1]	|t|
age (years) between (36 and 45)			
21 and 25	-0.8647	-30.7	8.13
26 and 35	-0.3572	-11.3	6.51
46 and 55	0.1245	3.2	1.86
56 and 65	0.0202		0.14
education (primary)			
higher	0.7419	14.1	5.18
post-secondary	0.4731	10.4	3.60
secondary general	-0.0097		0.10
secondary vocational	0.2207	5.5	2.75
basic vocational	0.0284		0.42
less than primary	-0.4393		0.94
assigned to a disability group	-0.7405	-25.8	5.13
occupation (blue-collar)			
top management	-1.0966	-39.9	2.32
middle management	0.3877	8.9	2.46
lower management	0.3226	7.7	1.82
professional	0.2626	6.4	2.91
simple white-collar	0.0948		1.33

Table 4: (continued)

Variable	Probit Coeff.= $\hat{\theta}/\sigma_E$	% change[1]	|t|
industry (industry)			
construction	-0.3931	-12.5	2.75
agriculture & forestry	-0.4641	-15.1	4.02
transport	0.1655		1.10
communication	0.6237	12.6	2.89
trade	-0.1554	-4.6	1.98
other in the material sphere	0.0991		0.38
housing & community services	0.7716	14.4	4.09
science, education & arts	0.3058	7.3	3.47
health care & social aid	0.3799	8.8	4.13
tourism, leisure & sport	0.0396		0.24
public administration, justice & political and social organisations	0.2753	6.7	2.23
finance & insurance	0.3048	7.3	1.78
unemployed before	-1.0330	-37.4	15.40
place of residence (rural)			
100,000 inhabitants or more	-0.0852		1.35
20,000 to 99,999	-0.0405		0.60
19,999 or less	0.0671		0.90
voivodship unemployment rate	0.0245		4.13
husband unemployed	-0.3883	-12.7	6.07
constant	1.2165		10.05
log likelihood	-1,929		
pseudo-R^2	0.19		
number of individuals	4703		

Note: 1) This column approximately states the percentage change in the probabilitiy of being in employment when in the named category rather than the base, *viz.* $\Phi\left(z_{+1}(\hat{\theta}/\sigma_E)\right) - \Phi\left(z_{mean}(\hat{\theta}/\sigma_E)\right)$.

All other variables are evaluated at their means. The probability of finding employment evaluated at the sample mean is 80.5%. Only coefficients significant at the 10% level are interpreted.

Table 5: Estimates of the Heckit Model

Dependent variables:

Probit: employed (1) - not employed [either unemployed or inactive] (0)

WLS: hours worked (for workers only)

Variable	Participation (Probit)			Hours (WLS)	
	Coeff.= $\hat{\beta}_P / \sigma_P$	% change[1]	|t|	Coeff.	|t|
ln hourly wage	1.2268		15.74	-8.30	15.88
age (years) between (36 and 45)					
21 and 25	-0.7284	-28.0	7.86	-2.25	2.42
26 and 35	-0.1312	-5.2	2.56	-1.43	3.97
46 and 55	-0.3639	-14.4	6.74	-0.66	1.82
56 and 65	-1.7707	-51.8	23.58	-6.40	4.76
education (primary)					
higher	0.2519	9.6	2.41	-0.07	0.09
post-secondary	0.4661	16.9	4.65	-1.50	2.04
secondary generval	0.0151		0.20	2.00	3.74
secondary vocational	0.2318	8.8	3.69	2.00	3.95
basic vocational	0.0687		1.35	0.84	2.15
less than primary	-0.4807	-19.0	1.87	2.55	0.65
number of children between age					
0 and 2	-1.0813	-38.8	16.45	-2.33	2.88
3 and 10	-0.3419	-13.6	12.98	-0.64	2.44
11 and 18	0.0079		0.33	-0.08	0.53
assigned to a disability group	-1.5641	-48.9	20.97	-11.65	7.67
occupation (blue-collar)					
top management	-0.9804	-36.0	2.33	8.85	3.52
middle management	0.0370		0.32	3.80	6.05
lower management	0.0494		0.38	3.51	5.56
professional	0.0710		1.05	-0.13	0.31
simple white-collar	0.0987	3.8	1.98	0.83	2.52

Table 5: (continued)

Variable	Participation (Probit)			Hours (WLS)	
	Coeff.= $\hat{\beta}_P / \sigma_P$	% change[1]	|t|	Coeff.	|t|
place of residence (rural)					
100,000 inhabitants or more	-0.0395		0.85	0.35	1.03
20,000 to 99,999	0.0366		0.75	0.23	0.62
19,999 or less	0.2081	8.0	3.72	-0.62	1.67
husband's characteristics (regular job)					
earnings (US$)	-0.0017		8.01	0.01	5.33
occasional job	0.0098		0.07	2.54	2.44
unemployed	-0.2954	-11.7	4.80	2.08	4.94
inactive	-0.3614	-14.3	6.44	0.99	2.16
inverse Mills ratio				1.62	2.09
constant	-1.9100		11.02	56.46	46.46
log likelihood	-3,603				
pseudo-R^2 / R^2	0.34			0.26	
$\hat{\sigma}$	not identified			7.53	
number of individuals	7903			3742	

Notes: 1) This column approximately states the percentage change in the probabilitiy of participating (being employed) when in the named category rather than the base, *viz.* $\Phi\left(x_{+1}\,(\hat{\beta}_P / \sigma_P)\right) - \Phi\left(x_{mean}\,(\hat{\beta}_P / \sigma_P)\right)$. All other variables are evaluated at their means. The predicted participation probability at the sample mean equals 57.3%. Only coefficients significant at the 10% level are interpreted.

2) Variations in the expected value of hours supplied across categories are approximately given by the coefficients neglecting induced changes in the inverse Mills ratio.

5.1 The Tobit Estimates (Table 3)

According to the estimated Tobit model, the higher the wage rate, the more labour is supplied. The youngest wives show a very large negative coefficient, a result which will be referred to again further down. Hours supplied (as well as participation) peak between ages 36 and 45, which seems reasonable, as the major child-rearing period is over then and accumulated human capital will pay off by generating higher wages in the life cycle. As to elder wives, reservation wages are likely to rise as retirement becomes possible and the rate of human capital depreciation can be expected to overtake the rate of accumulation.

On a rough scale, women with at least secondary education supply more labour than the groups with lower educational attainments.

Children and disabilities have expected effects. Only children aged between 11 and 18 do not diminish labour supply significantly which is not surprising as one hopes they can take care of themselves.

The occupation dummies, except for simple white-collar jobs, are not significant at the 5% level; having included occupation in the wage equation, its effects probably work mainly through that channel. The results are consistent with the common view that blue-collar jobs carry less job satisfaction than white-collar ones and that most managers work longer than people further down the hierarchy. Whether the evidence on top managers, although insignificant, supports the hypothesis that they are enjoying a leisurely lifestyle will be taken up below.

The places of residence which seem to make a significant difference to rural are the ones with less than 20,000 inhabitants where women work more.

The impact on the wife's labour market behaviour of her husband being unemployed or just temporarily employed is discussed in terms of an added- versus a discouraged-worker effect in the literature. As Lundberg (1985) points out, static labour supply models do not take account of the transitory nature of the added-worker effect. Therefore, we cannot discuss the added-worker effect in a strict sense based on a static model.

If the husband has only an occasional job, the wife supplies on average more labour suggesting an "added-worker effect" - though it is not significant. Not so when the husband is unemployed or inactive, when significantly less labour is supplied.

5.2 The Employment Function in the Three Regime Tobit (Table 4)

According to the estimated employment function in the Three Regime Tobit, the probability of being employed rather than unemployed for the 'mean person' is estimated to be 80.5%. Very likely to be employed rather than unemployed are women with high educational attainments or a white-collar job training. Experience in certain industries, especially communications or housing & community services, is also of considerable advantage. The other side of the picture is that for wives under 25 the probalility of holding a job falls to 50%. Very likely to be unemployed are also women with less than a primary education, the disabled, top managers, workers in the argricultural and - presumably because of seasonal factors - construction sectors. Wives whose husbands are unemployed or who themselves have been unemployed in the past have no good chances of being in employment, either.

5.3 The Tobit, Three Regime Tobit and Heckit Models Compared (Tables 3 to 5)

The primary focus of interest in the literature on labour supply is the labour supply response to changes in the wage rate and income (here approximated by husband's earnings). We consider these elasticities across our three models.

• wage and "income" elasticities: Table 6 gives elasticities of hours worked [both as E(H) and E(H|H*>0)] with repect to the wage rate and the net earnings of the husband. All elasticies are evaluated at sample means. When considering the overall effect on labour supply, namely E(H), which includes both changes in participation probabilities and hours worked for workers, we get the same qualitative evidence for all models. The wage elasticities are all positive but none of them is very large compared to other studies.[11] The largest is the one in the Heckit model which says that a 1% increase in the net hourly wage rate raises the expected value of hours supplied by 0.66% at the margin.

That all "income" elastiticies are negative would point to the common supposition that leisure is a normal good. The values given are all within the range of studies on western countries.

[11] For a wide selection of other researchers' results, see Killingsworth (1983) or Killingsworth and Heckman (1986).

Table 6: Wage (Uncompensated) and "Income" (Husband's Earnings) Elasticities

	Tobit *model 1*	Three Regime Tobit *model 2*	Heckit *model 3*
$\eta_{E(H),w}$	0.53	0.15	0.66
$\eta_{E(H),\overline{m}}$	-0.02	-0.01	-0.13
$\eta_{E(H\|H^*>0),w}$	0.19	0.07	-0.18
$\eta_{E(H\|H^*>0),\overline{m}}$	-0.07	-0.05	0.04

The elasticitiy for hours worked by workers, E(H|H*>0), turns negative in the Heckit model. Referring back to table 5, we see that although attracting more wives into work, a higher wage rate decreases the number of hours supplied by workers. As said in section 3 and above, backward-bending labour supply behaviour is not unknown in the literature on western countries and it is also compatible with utility theory. But as we know that the pure substitution effect must be positive, backward-bending behaviour can only come from a sufficiently high negative income effect. Yet seeing that the effect of a rise in husband's earnings is positive in the Heckit model, our previous doubts about this variable rendering insufficient information on the income effect have finally been substantiated. On the other hand, a positive coefficient on husband's income should not be disquieting. Other factors than purely economic might play their role. Similar results are found by Merz (1989) for West Germany.

How do our results compare with the literature on western countries? As to wage elasticities, the qualitative results of first generation studies are that female labour supply is more (and positively) elastic with respect to the wage rate than male labour supply which is seen as rather inelastic, possibly showing a negative elasticity. There is, however, no agreement on the values of these elasicities which disperse widely for both sexes across studies (see Killingsworth, 1983; p.111ff. for an overview). For females, a representative uncompensated elasticity from those studies would probably be 1, but numbers like 0.2 or 1.6 are also common.

Killingsworth (1983; p.206) argues that second generation studies point to an even larger wage elasticity for females than first generation research, a result which seems consistent with the predictions of econometric theory (see footnote 6). He further

concludes that studies using the Heckit (two-stage) model by allowing the labour supply schedule to be discontinuous come up with smaller elasticities than those which presume continuity, such as the Tobit or Three Regime Tobit models (p.185ff. in Killingsworth, 1983). However, Nakamura, Nakamura and Cullen (1979), using a Heckit specification, disagree with Killingsworth (1983) by finding the uncompensated wage elasticity of hours of work for Canadian women to be negative, *i.e.* similar to the one for men. This is also the conclusion drawn from our sample.

Other areas of fundamental importance in constructing policies aimed at labour supply involve aspects of age, occupation, the employment status of the husband, education, children etc. Below, we focus on the first three of these to draw out the distinctions between our three models.

• age: Looking at the results on age groups of the Three Regime Tobit in table 3 we find that although the expected value of hours worked for workers, $E(H|H^*>0)$, is only 5 hours lower for married women in their early twenties than for the reference group, this model gives only a slightly different picture than the Tobit model where that difference is 6 hours.

The Heckit model in table 5, by contrast, reduces that gap to only 2 hours and suggests that the major way in which this age group supplies less labour is by a significantly lower participation rate. Both the Tobit and the Three Regime Tobit mingle those two aspects of labour supply into one coefficient. As far as this particular group is concerned, allowing for the fact that its members are amongst the most likely to be unemployed only seems to make a slight difference to the standard Tobit model. Allowing for a discontinuous labour supply schedule, however, creates more of a contrast.

• occupation: Even if none of the occupations turn out to be significant at the 5% level in the Three Regime Tobit, we can nevertheless argue that when looking at the coefficient of top management the advantage of this model over the ordinary Tobit is clearly apparent. Rather than suggesting that this group works less hours than the rest, the Three Regime Tobit (as the Heckit model) makes the more reasonable prediction that women in those positions supply the largest amount of hours. We know that top managers are very likely to be unemployed. Though maybe astonishing at first thought, this should not seem surprising just after the collapse of communism in Poland. Top managers, mostly heads of state-owned enterprises or social and political organisations are seen to carry particular responsibility for the communist past, so their heads rolled, whereas middle and lower managers can bring their scarce skills (see section 2) to the market. Indeed, as table 4 makes clear, those two groups are the most likely to be employed.

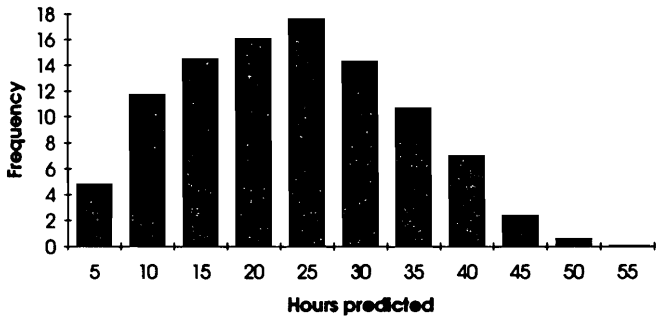
• husband's employment status: Conclusions diverge across the different model specifications when the husband is unemployed (or inactive). Table 4 (employment

function) tells us that wives with unemployed husbands are more likely to be unemployed themselves. This could be due to similar preferenes and opportunities amongst married couples, but it may also be the case that employers discriminate against those wives with the suspicion they are added workers and will quit their jobs as soon as their husbands find employment. The Three Regime Tobit - contrary to the Tobit - indeed points to an "added-worker effect". In the Heckit model, we see again that the participation response ("discouraged worker") differs from the hours worked response ("added worker").

5.4 Choosing a Preferred Model

If one is to ask which of the three estimation procedures should be regarded as preferred, the previous discussion might point to the Heckit model. Indeed, we can test for continuity of the labour supply schedule, which implies equality of the β-coefficients in the Probit and WLS regressions of Heckit. Dividing the WLS β-estimates by the estimate of σ (=7.53) and testing whether in the Probit regression the the $(\hat{\beta}_k / \hat{\sigma}_H)$-coefficients are equal to the respective ratios $(\beta_P \hat{/} \sigma_P)$, we get a chi-squared(28) statistic of 92,556, which clearly rejects continuity. This result is consistent with significant fixed costs to employment, which might arise, for example, through - relative to the average wage - very high child-care costs in Poland (see section 2). Yet it is also consistent with the consumption of leisure reaching a satiation point when hours of work are very low, so leisure becomes a bad. The figures below show the distribution of predicted hours worked by (predicted) workers in the three models. The appendix A5 gives plots of actual against predicted hours of work.

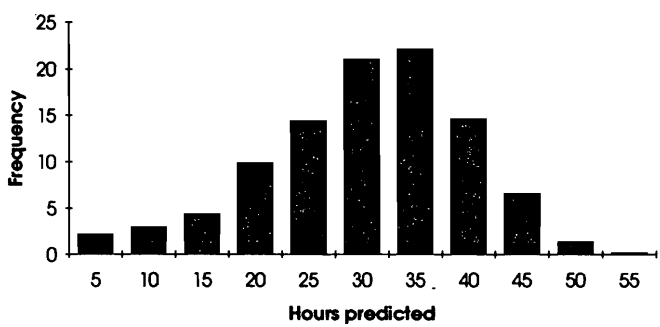
Figure 2: Predicted hours worked by predicted workers: Tobit



It can hardly be overemphasized how badly the Tobit model, which is commonly employed in labour supply analysis (Merz 1989, Untiedt 1992), predicts the distribution of hours worked. Comparing figures 1 (in section 2) and 2 we see that about 60% of all women work around 40 hours, *i.e.* full-time, yet in the Tobit model the largest mass of the distribution falls on part-time work.

The Three Regime Tobit comes a bit closer to reality, yet in essence, the same problems apply as to the Tobit model as can be seen from figure 3.

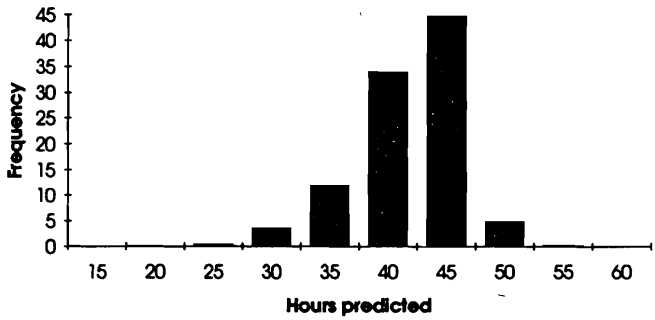
Figure 3: Predicted hours worked by predicted workers: Three Regime Tobit



The advantage of the Heckit model lies in the fact that it distinguishes explicitly between the participation and hours worked decisions. The two Tobit models only allow one coefficient to describe both decisions. Hence with a considerable variation in participation rates, too great a variation in hours worked is unjustifiably predicted through the channel of this single coefficient. The Heckit model does a much better

job in predicting hours of work than the two Tobit models as can be seen from figure 4 below:

Figure 4: Predicted hours worked by workers: Heckit



Yet it is deficient in two ways: first, it compresses the actual distribution (figure 1) too much by neglecting part-timers below 25 hours and second, it cannot explain the high frequency of hours worked in the 35-40 hours interval. As to the latter point, there probably are institutional factors at work restricting choice over hours of work and which unfortunately have been left unexplained in all our models. A further inquiry into institutional constraints on working hours might be desirable.

If one is just interested whether a person is working, the Three Regime Tobit outshines the other models in terms of predictive performance with a hit rate[12] of 88%, 78% and 76% for the Three Regime Tobit, Probit (Heckit) and Tobit model, respectively.[13]

[12] The hit rate for each model is defined as the ratio (number of correct predictions=2608+3401 for the Tobit model) / (total number of women in the sample=7903).

[13] But note that we have not formally tested whether those differences are statistically significant.

Table 7: Predictive Performance

	actual	
predicted	non-workers	workers
	Tobit	
non-workers	2608	341
workers	1553	3401
	Three Regime Tobit	
non-workers	3550	347
workers	611	3395
	Probit (Heckit)	
non-workers	3103	709
workers	1058	3033
total	4161	3742

Again, we note that the standard Tobit model seems to be the least preferred in this particular sample. In sum, we pick the Three Regime Tobit for predicting effective participation, but the Heckit model for estimating hours of work.

6 Conclusion

The analysis of female labour supply in Poland is sensitive to the estimation method employed. Nevertheless, some general conclusions can be drawn:

(i) Effectively, young wives supply considerably less labour than most other age groups. This is mainly due to lower participation rates and lower chances of finding employment, and only to a lesser extent because of fewer hours worked. The changes in the availability of child care since the transition to a market economy, together with employers' preferences for employing men, provide an explanation for this finding.

(ii) The same conclusions can be drawn for wives with less than primary education. It should also be pointed out that women who have been unemployed in the past or have unemployed husbands are also very likely to be unemployed. What is worrying is that the above groups are seen to be highly disadvantaged in the Polish labour market. Apart from the social discord implied, the effective exclusion of a large part of the young generation from the labour market may have serious economic costs to Poland because part of its potentially most dynamic human capital is left untrained and unemployed.

(iii) Continuity of the labour supply schedule under the semi-log specification is strongly rejected. This can have various causes. If the semi-log function constitutes a serious misspecification, the labour supply schedule might still be continuous, but have a very different functional form. Alternatively, the result is consistent with the presence of fixed costs to employment, which are likely to have increased in Poland after 1990, *e.g.* through rising costs of child care. Further, the fact that one might gain utility from working (provided only few hours are worked) is also consistent with the rejection of continuity. In this case leisure would be a bad. Allowing for discontinuity renders a negative wage elasticity of hours worked for workers in employment.

(iv) Following from what has been said under (iii), the information in the Tobit as well as in the Three Regime Tobit is rather unhelpful for analysing hours worked, as the distinct participation and hours worked decisions are mingled into one coefficient. If one is interested, though, whether a woman is likely to be in employment, because she intends to participate (hurdle 1) and is able to find a job (hurdle 2), the Three Regime Tobit delivers a good predictor. The Heckit model is preferred for predicting hours worked by workers, although its predictive power is not very impressive.

(v) Given the fact that the Tobit is a standard model used in labour supply analysis and for policy advice (Merz 1989, Untiedt 1992), its empirical deficiencies in terms of predictive performance can hardly be overemphasized.

(vi) Macroeconomic policies geared towards relieving the scarcity of jobs are probably necessary, but not sufficient for allowing the disadvantaged groups

mentioned in (i) and (ii) to become more active on the labour market. Microeconomic incentives such as improved child-care facilities, programmes for getting the long-term unemployed back into employment as well as measures to promote employment of young people are also called for. Yet it should be emphasized that microeconomic policies by themselves can probably only lead to a - albeit more equal - redistribution of the scarcity of jobs, as long as that scarcity is not eliminated by a more favourable macroeconomic environment.

Appendix

A1 The Sample

Number of Individuals Included

In order to find the husband of a wife in the survey, the wife either has to be the household head or be married to the household head. The number of married women between ages 21 and 65 in the survey amounts to 13096.

We subtract wives whose husband was not found,	11964
who are self-employed,	10215
unpaid family workers,	9837
whose husbands do not fall into the previous two categories,	8711
who have not worked the usual amount of hours in the reference week	8374
or who have other relevant missing variables.	7903

Husband's Earnings

As neither the inactive nor the unemployed give information on their income, the value of this variable has been set equal to the unemployment benefit which is 36% of the average wage in the previous quarter. As workers state their earnings from the preceding October the averge wage of July 1992, which according to The World Bank (1994) was PLZ 2,946,100, was taken to determine the unemployment benefit. Although the minimum pension is only about 80% of the unemployment benefit, some pensioners can be expected to receive a much higher pension. Unfortunately, one does not know who they are, so this rather crude measure has been employed. The exchange rate for the dollar as of October 12th, 1992 was PLZ 14,207.6 to $1 (Financial Times, 13 October 1992).

A2 Wage and "Income" Elasticities

$$\eta_{H,x_k} = \frac{\partial H}{\partial x_k}\frac{x_k}{H}.$$

As $\partial x_k = x_k . \partial \ln x_k$, we can write $\eta_{H,x_k} = \frac{\partial H}{\partial \ln x_k}\frac{1}{H}$.

$$\underbrace{\frac{\partial E(H)}{\partial x_k}}_{\text{total effect}} = \underbrace{\Pr(H^* > 0)\frac{\partial E(H|H^* > 0)}{\partial x_k}}_{\text{effect due to change in hours worked}} + \underbrace{E(H|H^* > 0)\frac{\partial \Pr(H^* > 0)}{\partial x_k}}_{\text{effect through change in participation probability}}.$$

Models 1 / 2 Tobit / Three Regime Tobit	*Model 3 Heckit*[14]
$E(H) = X\beta\Phi\left(\frac{X\beta}{\sigma}\right) + \sigma\phi\left(\frac{X\beta}{\sigma}\right).$	$E(H) = \left(X\beta + \frac{\sigma_{PH}}{\sigma_H}\lambda\right)\Phi\left(X\frac{\beta_P}{\sigma_P}\right)$
$\frac{\partial E(H)}{\partial x_k} = \beta_k \Phi\left(\frac{X\beta}{\sigma}\right).$	$\frac{\partial E(H)}{\partial x_k} = \Phi\left(X\frac{\beta_P}{\sigma_P}\right)\beta_k + \left(X\beta + \frac{\sigma_{PH}}{\sigma_H}\lambda\right)\frac{\beta_{P,k}}{\sigma_P}\phi\left(X\frac{\beta_P}{\sigma_P}\right)$
$E(H\|H^* > 0) = X\beta + \sigma\frac{\phi(X\beta/\sigma)}{\Phi(X\beta/\sigma)}.$	$E(H\|H^* > 0) = X\beta + \frac{\sigma_{PH}}{\sigma_H}\lambda$
$\frac{\partial E(H\|H^* > 0)}{\partial x_k} = \beta_k\left[1 - \frac{X\beta}{\sigma}\frac{\phi(X\beta/\sigma)}{\Phi(X\beta/\sigma)} - \left(\frac{\phi(X\beta/\sigma)}{\Phi(X\beta/\sigma)}\right)^2\right]$	$\frac{\partial E(H\|H^* > 0)}{\partial x_k} = \beta_k$
$\Pr(H^* > 0) = \Phi\left(\frac{X\beta}{\sigma}\right).$	$\Pr(H^* > 0) = \Phi\left(X\frac{\beta_P}{\sigma_P}\right)$
$\frac{\partial \Pr(H^* > 0)}{\partial x_k} = \frac{\beta_k}{\sigma}\phi\left(\frac{X\beta}{\sigma}\right)$	$\frac{\partial \Pr(H^* > 0)}{\partial x_k} = \frac{\beta_{P,k}}{\sigma_P}\phi\left(X\frac{\beta_P}{\sigma_P}\right)$

[14] For simplicity of calculation, the effects on hours worked via changes in the inverse Mills ratio have been ignored following common practice (*e.g.* Untiedt, 1992).

A3 Table: Variables used and their sample means

Variable	*Mean*
employed	0.47
participating (incl. unemployed)	0.60
ln net hourly wage rate	1.17
hours worked (incl. 0)	18.58
hours worked (excl. 0)	39.20
age (years) between	
21 and 25	0.05
26 and 35	0.24
36 and 45	0.33
46 and 55	0.20
56 and 65	0.19
education	
higher	0.08
post-secondary	0.05
secondary general	0.10
secondary vocational	0.23
basic vocational	0.23
primary	0.29
less than primary	0.02
number of children between age	
0 and 2	0.09
3 and 10	0.50
11 and 18	0.54
assigned to a disability group	0.14
occupation	
top management	0.002
middle management	0.03
lower management	0.03
professional[1]	0.25
simple white-collar	0.29
blue-collar	0.40

A3 Table: (continued)

Variable	*Mean*
industry	
industry	0.29
construction	0.02
agriculture & forestry	0.07
transport	0.03
communication	0.02
trade	0.16
other in the material sphere	0.01
housing & community services	0.02
science, education & arts	0.16
health care & social aid	0.13
tourism, leisure & sport	0.02
public administration, justice & political and social organisations	0.05
finance & insurance	0.02
private sector	0.29
unemployed before	0.07
voivodship unemployment rate (%)	14.52
place of residence	
100,000 inhabitants or more	0.35
20,000 to 99,999	0.23
19,999 or less	0.15
rural	0.28
husbands characteristics	
monthly earnings (US$)	212.57
regular job	0.62
occasional job	0.01
unemployed	0.10
inactive	0.27
number of individuals	7903

Notes: 1) Professionals include scientists, journalists, lawyers, medical practitioners etc.

2) The figure for the voivodship unemployment rate includes men as well as women and uses information from the whole survey.

A4 Table: Reduced-Form Wage equation estimates for all models[1]

Dependent variable: ln net hourly earnings

Variable	Heckit, Tobit & Three-Regime Tobit		
	Coeff.	% change[2]	ltl
number of children[3]	0.0009		0.15
age (years) between (36 and 45)			
21 and 25	-0.0673		1.52
26 and 35	-0.0480	-4.7	3.34
46 and 55	0.0271	2.7	1.72
56 and 65	0.0019		0.04
education (primary)			
higher	0.6318	88.1	21.81
post-secondary	0.3400	40.5	11.85
secondary general	0.2199	24.6	9.51
secondary vocational	0.2180	24.4	10.12
basic vocational	0.0776	8.1	4.57
less than primary	0.0322		0.34
assigned to a disability group	-0.1083	-10.3	1.82
occupation (blue-collar)			
top management	0.3003	35.0	3.34
middle management	0.2606	29.8	7.72
lower management	0.2366	26.7	6.68
professional	0.2030	22.5	9.80
simple white-collar	0.0186		1.15

A4 Table: (continued)

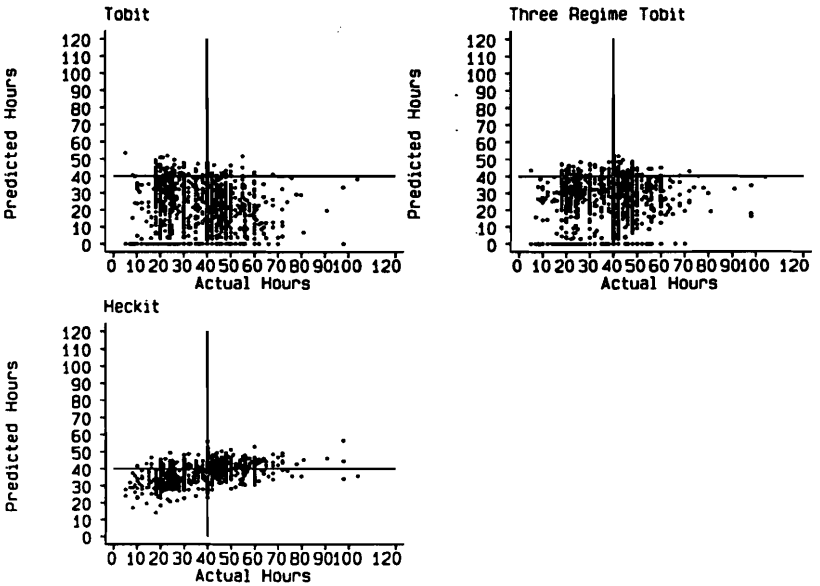
Variable	Heckit, Tobit & Three-Regime Tobit		
	Coeff.	% change[2]	|t|
industry (industry)			
construction	-0.0860	-8.2	2.23
agriculture & forestry	-0.1455	-13.5	4.79
transport	-0.0621	-6.0	2.21
communication	0.1089	12.5	3.53
trade	-0.1037	-9.9	5.10
other in the material sphere	0.0006		0.01
housing & community services	-0.0155		0.50
science, education & arts	0.0588	6.1	3.15
health care & social aid	-0.1153	-10.9	6.50
tourism, leisure & sport	-0.0156		0.35
public administration, justice & political and social organisations	0.0365		1.49
finance & insurance	0.1937	21.4	5.22
private sector	0.0274	2.8	1.81
unemployed before	-0.1078	-10.2	3.91
place of residence (rural)			
100,000 inhabitants or more	0.0672	7.0	4.76
20,000 to 99,999	0.0206		1.41
19,999 or less	0.0102		0.63
voivodship unemployment rate	-0.0032		2.28
inverse mills ratio	0.0499		1.71
constant	2.1730		66.24
R^2	0.48		
$\hat{\sigma}$	0.31		
number of individuals	3742		

Notes: 1) Note that the sample selectivity correction undertaken here by means of calculating the inverse Mills ratio from a standard reduced form Probit model (which is not reported here) can only be seen as an approximate selectivity correction in the case of the Three Regime Tobit, as the Probit does not allow for involuntary unemployment. However, this does not do much harm, as the inverse Mills ratio here is only significant at the 10% level. Running this regression without selectivity correction renders almost the same results.

2) This column states the difference in the wage rate with respect to the base category in percent. It is given by (exp[coefficient]-1).100. Only coefficients significant at the 10% level are interpreted.

3) The the number of children is included to make a rough adjustment for differing tax rates (Steiner and Bellmann, 1994).

A5 Figures: Plot of Actual against Predicted Hours Worked (for Workers)



These graphs may suggest that none of the models have any significant explanatory power. However, for each model, the null hypothesis of joint insignificance of the slope coefficients is rejected at the 1% significance level. The tests used here are an F-test for the Heckit model and likelihood-ratio tests for the Tobit and Three Regime Tobit models.

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