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The Labour Supply of German Single Mothers: A Bivariate Probit Model

by Matthias Staat and Gerhard Wagenhals*

The number of single parent mothers is increasing in Germany and throughout the OECD. Single parent families constituted 12.8 percent of households with children in 1985, up from 7.7 percent in 1977. The labour force participation rate of single mothers in Germany is 60 percent, high compared to married women, but low considering that they are the only potential earners in their household. In this paper we will first discuss the legal and financial institutions that affect the work decisions of single mothers and then estimate a labour supply equation for them using a bivariate probit approach.

Taxes and Social Welfare System

Under a progressive income tax, for married couples where one person has a substantially higher income than the other, "income splitting" provides a considerable tax relief. Total household income is halved and tax liability is calculated at the lower tax rate and then doubled. This major form of tax relief is not available for single parents. Hence while the general tax system favors traditional families, it ignores single parent families. There are, however, a few special provisions for single parents.

Child and Maternity Benefits

The tax burden of single parents¹ is lowered by several types of tax allowances, namely

- Child care allowance for child care expenses consisting of a flat rate of 480 DM for each child under 16 (without proof of expenses) and up to 4000 DM for the first and 2000 DM for each additional child (with proof of expenses).
- Household allowance for single parents with dependent children, up from 3000 DM in 1975 to 5616 DM in 1990.
- Child allowance, up from 216 DM in 1983 to 1512 DM in 1990; also available for married couples, for whom rates are twice as high.

In addition to these tax allowances the government will pay child maintenance if the absent parent does not pay them or does so only irregularly.

There are a number of child benefits. Child support and additional child benefits apply to all families with children 16 years or younger and are also provided for those aged 17 to 27 if they are still in school and do not earn more than 750 DM per month. They are paid regardless of age if the dependent is handicapped and unable to be self-supportive. Child benefits include

- Child support: as of July 1990 the entitlement is 50 DM for the first child, up to 130 DM for the second, up to 220 DM for the third and up to 240 DM for the fourth child.

Child benefits are not taxed, but benefits for the second child and all subsequent children are means-tested.

- Additional child benefit: introduced in 1986, the additional child benefit applies if household income is low and therefore the child allowance cannot be exploited fully. It equals up to 22 percent of the 'unused' child allowance and is given as a cash benefit.
- Child-rearing benefits: child-rearing benefits amount to 600 DM during the first 18 months after birth; they are not means-tested for the first 6 months. Part-time employment of up to 19 hours is possible under this program.

Pregnant women who stop working receive maternity benefits equal to the average pay received during the last 13 weeks before the beginning of the pregnancy. They can be claimed by all mothers who were insured in the compulsory health insurance scheme for 12 or more weeks between the 10th and the 4th month before delivery of the child.

Social Assistance

Social assistance can be claimed by anyone in need. All other means of income have to be exhausted in order to qualify. Other benefits count as unearned income, and all earnings have to be deducted in full. Single parents with children four years or older have to be available for labour force participation unless they have more than three children. There are two types of social assistance:

- Help for people unable to earn enough to cover their basic needs, including an extra need allowance for single parents with dependent children.
- Assistance in special circumstances for people who are, e.g., ill, invalid or in need of care and cannot be expected to help themselves.

Other Benefits

Low-income families may be entitled to housing benefits depending on family size, the level of rent and the level of family income. They depend on housing conditions, age of the apartment, living space and the local level of rents. As a rule, they reduce housing costs to 20 percent of total net family income.

There are two types of unemployment benefits, ordinary benefits and supplementary benefits. An ordinary benefit is paid to every unemployed worker who is capable of and willing to work and who worked in insured employment for at least 26 weeks in the three years preceding unemployment. A supplementary benefit provides financial support to unemployed workers who have exhausted their entitlement to ordinary unemployment benefits, and whose finan-

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¹ Some regulations also apply to two-parent families.

cial resources are below a specified level. They could receive, and many do receive, social assistance in addition to unemployment benefits since the latter is calculated solely on the basis of the previous wage earnings and does not take need into account.

In addition to housing assistance and unemployment other supportive measures are available, including special provisions for widows and widowers, education and training benefits, additional leave of absence for child-rearing, subsidies for child care facilities and a housebuilding allowance.

Of all these benefits, we model child care allowances, household allowances, child allowance, child support and additional child benefits as well as social assistance and housing benefits. Since ordinary and supplementary unemployment benefits both may be higher than social allowance benefits, our predictions result in a lower bound for the long run entitlement to benefits. Nonetheless, we may still overestimate actual benefits because of the seemingly low take-up rate (see section 3.3).

Data

Sample Selection

Our sample of single mothers was based on households classified as single parent households in waves A to G (1984 to 1990) of the SOEP. Household classification was generated by researchers at the Deutsches Institut für Wirtschaftsforschung (DIW), Berlin, since it was not directly asked in the survey. The DIW created household categories that are mutually exclusive. When sorting households whose characteristics suggest placement into more than one category, a somewhat arbitrary decision had to be made. Hence it is possible that single parents may be misclassified, for example in multi-generation households.

Line 4 of the table below refers to the selection based on this variable.

Only households with single parents as household heads were considered. As a result, the sample generated has a thinner tail at the lower end of the age distribution when compared to a sample previously generated with a different strategy². Also, the average wage observed among the employed was slightly higher.

We then enforced further restrictions on marital status of the head and additional information on children (line 6), age of the head, the youngest and the oldest child (lines 7 to 9). Restrictions on the age of the children were enforced to exclude households with a potential second earner. A second selection that excluded all households in which one or more children were working³ but not in professional training yielded virtually the same sample. Finally, observations with incomplete or inconsistent information were deleted.

Further restrictions would have been desirable, such as excluding foreigners and widows. Given our small sample size, this was not feasible. Comparing line 4 of Table 1 with the representative figures given in the introduction shows that the SOEP slightly undersamples single parent households.

The breakdown of sociodemographic factors by participation status contains no surprises: young women and mothers of very young children have the low participation rates. Part-time employment rises with the level of school-

² Women selected here have given birth to at least one child and were not living with a husband. If the children were found to be living in the mother's household, the observation was labelled eligible.

³ Due to the German apprenticeship system, we can expect a number of children to classify themselves as full-time employed who are, however, barely earning their fixed costs of work. They are therefore not second earners.

Table 1

Selection of Sample Cases

Year	1984	1985	1986	1987	1988	1989	1990
all females with valid interview	6 238	5 631	5 378	5 308	5 068	4 930	4 828
households with valid interview	5 921	5 322	5 090	5 026	4 814	4 690	4640
single parent households	321	288	278	276	270		
eligible households	253	234	218	211	213	195	179
household head aged 58 or less	209	194	182	174	178	158	142
oldest child aged 27 or younger	202	187	178	170	171	150	135
youngest child aged 21 or younger	181	167	154	142	128	118	101
after deleting missing values	150	157	129	119	110	102	85

ing. Widows have the lowest participation rates of all marital states. The observed hours of work per week in our sample show two distinct peaks at around 20 and 40 hours. This supports our treatment of labour force participation as a discrete choice problem.

Representative data⁴ for the composition of the group of single mothers show the following change over time. In 1970, 39 percent were widowed, 33 percent divorced, 18 percent single, 10 percent separated. For 1985 the numbers are 19 percent widowed, 46 percent divorced, 20 percent single, 16 percent separated. The average number of children in lone parent households is 1.3, only 5.3 percent had 3 or more children (Fischer and Hauser 1988).

Welfare Participation and the Take-up Issue

Table 2 contrasts observed with predicted welfare entitlement benefits and shows how difficult it is to simulate welfare entitlement. Part of the difference can be explained by the fact that we do not take alimony payments into account because we have no way of assessing what these payments would look like in the labour market state that we do not observe. For instance, only 112 women who do not participate in the labour market state that they receive social assistance, whereas according to our simulation all 331 non-participants would be entitled to social assistance. This also means that none of the widows receives a widow pension sufficient to support her fully. The same is true for housing benefits where 142 women who do not participate state that they receive it, whereas our simulation predicts 328 of these women would receive housing benefits.

We concentrate on comparing social and households benefits by single parents to the claims by the rest of the households in the SOEP. Table 3 shows the number of women who claimed either of these benefits and contrasts this to the total number of claims in the sample. Single mothers claim a disproportionate share of social assistance. Households headed by single parents constituted 5 percent of all households in the panel, and even fewer of the households in our sample. But more than 10 percent of all claims of social assistance in our sample came from single parent households.

Simulation of Budget Constraints

We first predict gross yearly income for part-time and full-time work. Entitlement to housing benefit is calculated based on income as well as number and age of children⁵. All renters⁶ are entitled to receive housing benefit if they don't work, 87 percent if they work part-time and 41 percent of the

⁴ For a discussion of related questions in the US, see Blank and Card (1991).

⁵ We cannot measure alimony payments since we only have information on total alimony received, i.e. for mother and children, by the household in the observed labour market participation state. We cannot, however, infer from this what the entitlement in any other state would be.

⁶ Homeowners are disregarded here since there is scope for discretion in whether to grant them housing benefit or not and it is rather unusual for them to receive it. The quality of the apartment determines the amount of the housing benefit received as well but for lack of information we choose to calculate it on the basis of a standard quality for all observations.

Table 2

Observed and Simulated Benefit Labour Market Entitlements by Participation State
number of the entitled in parentheses

observed participation status	no participation	part-time	full-time
observed social assistance	601 DM (112)	399 DM (15)	550 DM (9)
observed housing benefits	201 DM (142)	184 DM (32)	119 DM (34)
simulated benefits			
social assistance (non-part.)	1 167 DM (331)	1 220 DM (139)	1 134 DM (382)
social assistance (part-time)	360 DM (292)	417 DM (110)	314 DM (329)
social assistance (full-time)	186 DM (48)	207 DM (24)	211 DM (46)
housing benefit (non-part.)	279 DM (328)	227 DM (139)	260 DM (382)
housing benefit (part-time)	224 DM (276)	196 DM (96)	229 DM (320)
housing benefit (full-time)	103 DM (185)	104 DM (51)	85 DM (112)
child benefit	128 DM (231)	129 DM (92)	71 DM (112)
supplementary child benefit	33 DM (133)	30 DM (73)	26 DM (144)

Table 3

Take-Up of Social Benefits per Year

Year	1984	1985	1986	1987	1988	1989	1990
social assistance							
number of recipients	27	25	22	19	13	17	12
total number of claims	119	120	116	112	104	114	104
average amount [DM]	533	514	684	568	597	580	580
housing benefits							
number of recipients	35	42	29	35	26	25	23
total number of claims	324	307	278	318	329	279	281
average amount [DM]	164	151	184	181	205	211	238

full-time employed receive some housing amount. Social assistance is calculated taking housing benefit into account. All women in the sample are entitled to some payments if they do not work, 86 percent of the part-time employed, and 14 percent of those working full-time⁷. Child support entitlements do not differ across work status, and a few women receive additional child benefits, above 25 DM, if they do not work. Taxation of widow's pensions is disregarded; in practice, it is negligible⁸. To fully describe the financial consequences resulting from a status change we would have to include at least the child care cost associated with working as well as other fixed costs. We are not able to do this presently.

The budget set that is typical for a woman who makes slightly more than the average of 17 DM gross hourly wage, pays an average 480 DM in rent, and has no other income shows that in more than three-fourths of all cases the income associated with part-time work is like not working at all. In fact, this poverty trap makes labour supply for a wide range⁹ of hours implausible (see Deaton and Muellbauer 1980, p. 282, figure 11.4). This negative return to work in the low hours region is due to the reduction of social benefits.

But we find that 41 percent of full-time employees receive a housing benefit which is gradually reduced as income rises. This causes a slight kink around 40 hours, indicating that even with middle incomes the tax on work for a woman includes benefits withdrawn as well as normal taxation.

Empirical Model and Results

To measure labour supply based on the non-convex budget sets in our sample, Hausman (1980) and Moffitt (1986) argue that explicit utility comparisons are necessary. The endogenous wages problem they discuss can be reduced by assuming that the work choice is made bet-

ween a number of different discrete states and not continuously along a budget line.

Here we assume that the work choice is made to either not participate, work part-time or work full-time. We use a bivariate probit model for estimation. This can be interpreted as a model of the full-time vs. part-time decision corrected for the selectivity bias arising from unobserved factors that determine the participation decision as well. This estimator was introduced by van de Veen and van Praag (1981).

More formally, a woman chooses between the three states s of participation: $s=0$ for no participation, $s=1$ for part-time participation and $s=2$ for full-time participation. Her preferences are represented by a strictly quasi-concave differentiable utility function

$$U_s = u_s(y_s, h_s; X)$$

which depends on net income y_s , hours worked h_s (in states) and a vector of personal characteristics X . Net income is

$$y_s = w h_s + m - T_s$$

with gross wage w , unearned income m and tax liability

$$T_s = T(w h_s + m) - B_s$$

i.e., taxes net of benefits B_s . We proceed by assuming an index function model with two unobservables P^* and F^* .

⁸ This is compatible with what is found in the data when we compare working widows to those who do not work as well as with tax regulations. There is no contradiction with what was stated about the taxing of pensions in above; pension schemes have changed very often over the past few years, as well as the tax rules on pensions. We would also consider a 20 percent flat rate a reasonable approximation.

⁹ For women with 1 child this is around 15 hours, for women with more children this is 25 hours.

Table 4

Wage Equation

Variable	Coefficient	t-ratio
Constant	0.88296	1.742
AUSL	-0.09436	-2.029
AGE__10	0.81472	3.383
ASQ__1000	-9.24450	-3.180
REAL	0.20659	4.113
ABITUR	0.62154	10.641
LAMBDA	-0.07834	-1.039

The probabilities of labour force participation P and of working full time F are

$$P^* = X'\gamma + \beta_{0y0} + \beta_{1y1} + \beta_{2y2} + v$$

$$P = 1 \text{ if } P^* > 0 \text{ and } 0 \text{ otherwise}$$

and

$$F^* = Z'\delta + \Psi_{1y1} + \Psi_{2y2}u$$

$$F = 1 \text{ if } F^* > 0 \text{ and } 0 \text{ otherwise}$$

with Z and X being the vector of all regressors except income y_s . The corresponding vectors of parameters are β , γ , δ and Ψ . The error terms are u , v , $\sim (0, \sigma^2)$ and we normalize $\sigma = 1$. We maximize the resulting likelihood function for this bivariate probit model. To correct for the selectivity bias we account for the possible correlation between unobserved factors influencing both decisions.

Identification of each of the equations relies on one or more variables being excluded from it. Different factors could drive the participation and the intensity of participation decision but we assume that both decisions are determined by the same factors. Therefore, for identification we rely solely on the exclusion of y_0 from the participation intensity equation.

Wage Equation

In order to arrive at theoretically correct wage predictions one would have to estimate separate equations for part-time and full-time wages, correcting both estimates for the possible selectivity bias taking care of the possible correlation of the two selection rules (see Maddala 1983, p. 282 for a derivation of the corresponding formulae). Since we did not detect a significant difference between part-time and full-time wages in our data, we estimate only one wage equation.

In Table 4, all significant coefficients have the expected sign. The coefficient for the correction term for the selecti-

Table 5

Bivariate Probit

Variable	Coefficient	t-ratio
Constant	-0.54077	-0.084
CKLT4	-0.051433	-0.027
CK4__6	0.11955	0.125
CK7__15	0.15209	0.519
CK16__20	0.50566	2.200
LEDIG	1.1544	3.250
GESCH	0.15040	0.540
VERW	-0.40547	-0.328
AGE__10	1.0074	0.358
ASQ__1000	-99.281	-0.283
AUSL	0.74606	1.331
Y20	-1.2592	-1.269
Y40	-0.020056	-0.027
Variable	Coefficient	t-ratio
Constant	-2.4677	-2.135
CKLT4	-1.0961	-4.597
CK4__6	-0.58679	-3.350
CK7__15	-0.11621	-0.913
CK16__20	0.12876	0.842
LEDIG	0.07690	0.385
GESCH	-0.10814	-0.814
VERW	-0.81966	-5.313
AGE__10	1.7476	2.935
ASQ1000	-215.21	-3.055
AUSL	0.44993	3.324
Y0	-0.15048	-0.178
Y20	-0.61627	-0.660
Y40	0.46423	1.631
RHO (1,2)	0.10458	0.040

vity bias LAMBDA is insignificant. The base group for the school degrees (REAL: Realschulabschluß, ABITUR: Abitur) consists of women with a minimum level of schooling.

Bivariate Probit

The first panel of Table 5 gives the results for the intensity equation, the second for the participation equation. The correlation coefficient is insignificant.

The intensity equation is rather badly determined, the only significant coefficients being those for the children in age category 16 to 20 (CK16__20) and for single mothers (LEDIG). Both are positive, indicating that they raise the probability of working full-time. The base group for the marital states (LEDIG for the singles, GESCH for the divorced and VERW for the widows) are the ones that are married but separated.

The coefficients for the participation equation displayed in the second panel of Table 5 are better determined. The children in the age groups of the less than 4-year-olds (CKLT4) and between 4 and 6 years (CK7__14) significantly lower the probability of participation. Widows (VERW) have a significantly lower probability of participating than the women in the other marital states. The influence of age on participation is positive and that of age squared negative. The dichotomous variable for foreigners is positive and one is tempted to attribute this to the fact that the guest-workers migrated in order to work in Germany. Whether this argu-

ment holds true for single mothers is questionable, however. None of the income coefficients is significant.

Conclusion

This paper estimates the labour supply of single mothers in the presence of non-convex budget sets. A bivariate probit estimator was applied and parameters from a reduced form model were recovered.

The policy conclusions that can be drawn from our result are limited. We argue that there is no one single-parent specific labour market disadvantage but only a single parent specific cumulation of labour market disadvantages that, each taken in itself, can affect anyone. A lack of formal education, a lack of labour market experience, a transfer system that constitutes an outright disincentive to work, and problems with child care facilities comprise the set of disadvantages single parents often face. The first two could affect anyone, the third is relevant for all low income earners, and all families with children are affected by scarce and expensive child care facilities. The underlying problem of single parents is that secondary education, the transfer system and child care in Germany are far from optimal and need to be improved. Targeted policies like better access to child care facilities for single parents might improve conditions for this group in the short run but will not help to overcome the more general problems faced by the broader group of poorly educated and poorly trained.

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