A

Probability Generating Functions

This appendix is based on Feller (1968, Chap. XI and Chap. XII). Let X be a random variable taking values $j \in I\!N_0$ with $P(X = j) = p_j$. Upper case letters X, Y, and Z denote a random variable, while lower case letters j and k denote a realization. $p_{j \in I\!N_0}$ is called the *probability function*, while $F_{i \in I\!N_0} = P(X \leq i)$ is called the *distribution function.*

Definition 1. .
Let X be a random variable defined over the non-negative integers. The probability generating function (PGF) is given by the polynomial

$$\mathcal{P}^{(X)}(s) = p_0 + p_1 s + p_2 s^2 + \ldots = \sum_{j=0}^{\infty} p_j s^j = \mathrm{E}(s^X) \tag{A.1}$$

The function $\mathcal{P}(s)$ is defined by the $p_j's$ and, in turn, defines the $p_j's$ since a polynomial expansion is unique.

Example: Let X have a binomial distribution function with parameters n and p, $p_j = 0$ for $j > n$ (writing $X \sim B(n, p)$). The probability generating function is given by

$$\mathcal{P}(s) = \sum_{j=0}^{n} \binom{n}{j} (ps)^j q^{n-j} = (q + ps)^n \tag{A.2}$$

If it is not clear out of the context which random variable is meant, we write $\mathcal{P}^{(X)}$ where X is the random variable. An important property of a PGF is that it converges for $|s| \leq 1$ since $\mathcal{P}(1) = \sum_{j=0}^{\infty} p_j = 1$. The PGF can be used to directly derive the probability function of the random variable, as well as its moments. Single probabilities can be calculated as

$$P(X = j) = p_j = (j!)^{-1} \left. \frac{\mathrm{d}^j \mathcal{P}}{\mathrm{d}s^j} \right|_{s=0} \tag{A.3}$$

Example: A binomial distributed random variable has PGF $\mathcal{P}(s) = (q+ps)^n$. Thus,

$$\begin{aligned} P(X=0) &= \mathcal{P}(0) = q^n \\ P(X=1) &= \mathcal{P}'(0) = nq^{n-1}p^1 \\ P(X=2) &= (2!)^{-1}\mathcal{P}''(0) = (2!)^{-1}n(n-1)q^{n-2}p^2 \\ &\vdots \qquad \vdots \end{aligned}$$

The expectation $\mathrm{E}(X)$ satisfies the relation

$$\mathrm{E}(X) = \sum_{j=0}^{\infty} jp_j = \mathcal{P}'(1) \tag{A.4}$$

Example: A binomial distributed random variable has mean

$$\begin{aligned} \mathcal{P}'(1) &= np(q+p)^{n-1} \\ &= np \end{aligned}$$

Calculating first

$$\mathrm{E}[X(X-1)] = \sum_{j=1}^{\infty} j(j-1)p_j = \mathcal{P}''(1) \tag{A.5}$$

the variance is obtained as

$$\begin{aligned} \mathrm{Var}(X) &= \mathrm{E}[X(X-1)] + \mathrm{E}(X) - [\mathrm{E}(X)]^2 \\ &= \mathcal{P}''(1) + \mathcal{P}'(1) - [\mathcal{P}'(1)]^2 \end{aligned} \tag{A.6}$$

Example: A binomial distributed random variable has variance

$$\begin{aligned} \mathrm{Var}(X) &= n(n-1)p^2 + np - (np)^2 \\ &= np(1-p) \end{aligned}$$

Proposition 1. *Let X be a random variable defined over the non-negative integers with probability distribution $P(X=j) = p_j$, $j = 0, 1, \ldots$. Let X_T be a positive random variable with truncated-at-zero probability distribution $P(X_T = j) = p_j/(1-p_0)$, $j = 1, 2, \ldots$. The probability generating function of the truncated-at-zero distribution of X_T is given by*

$$\mathcal{P}_T(s) = \frac{\mathcal{P}(s) - \mathcal{P}(0)}{1 - \mathcal{P}(0)} \tag{A.7}$$

Proof: (A.7) follows directly from the definition of the probability generating function:

$$\mathcal{P}_T(s) = \mathrm{E}(s^{X_T}) = \sum_{j=1}^{\infty} \frac{p_j}{1-p_0} s^j$$

where $p_0 = \mathcal{P}(0)$.

There exists a close relationship between the probability generating function and the moment generating function $\mathcal{M}(t)$:

$$\mathcal{M}(t) = \mathrm{E}(e^{tX}) = \mathcal{P}(e^t) \tag{A.8}$$

While the moment generating function is a concept that can be used for any distribution with existing moments, the probability generating function is defined for non-negative integers. Since $s = e^t = 1$ if and only if $t = 0$, we obtain $\mathrm{E}(X) = \mathcal{P}'(1) = \mathcal{M}'(0)$.

In the same way as in (A.1) one can define a *bivariate probability generating function.*

Definition 2. .
Let X, Y be a pair of integer-valued random variables with joint distribution $P(X = j, Y = k) = p_{jk}$, $j, k \in I\!N_0$. The bivariate probability generating function is given by:

$$\mathcal{P}(s_1, s_2) = \sum_{j=0}^{\infty}\sum_{k=0}^{\infty} p_{jk} s_1^j s_2^k = \mathrm{E}(s_1^X s_2^Y) \tag{A.9}$$

Proposition 2. *The probability generating functions of the marginal distributions $P(X = j)$ and $P(Y = k)$ are $\mathcal{P}(s, 1) = E(s^X)$ and $\mathcal{P}(1, s) = E(s^Y)$, respectively.*

Proposition 3. *The probability generating function of $X + Y$ is given by $\mathcal{P}(s, s) = E(s^{X+Y})$.*

Proposition 4. *The variables X and Y are independent if and only if $\mathcal{P}(s_1, s_2) = \mathcal{P}(s_1, 1)\mathcal{P}(1, s_2)$ for all s_1, s_2.*

Probability generating functions can be used to establish the distribution of a sum of independent variables. This is also called a *convolution.* Using **Proposition 3** and **Proposition 4**, the probability generating function of $Z = X + Y$ is given by:

$$\mathcal{P}^{(Z)}(s) = \mathrm{E}(s^Z) = \mathrm{E}(s^{X+Y}) = \mathrm{E}(s^X s^Y) \overset{(\star)}{=} \mathrm{E}(s^X)\mathrm{E}(s^Y) \tag{A.10}$$

where ($\star$) follows from the independence assumption.

Example: Let X have a binomial distribution function with $B(1,p)$. Consider the convolution $Z = \underbrace{X + \ldots + X}_{n-\text{times}}$. Then:

$$\mathcal{P}^{(Z)}(s) = (q + ps)^n \tag{A.11}$$

Z has a binomial distribution function $B(n,p)$. Conversely, the binomial distribution is obtained by a convolution of identically and independently distributed Bernoulli variables.

B

Gauss-Hermite Quadrature

This appendix describes the basic steps required for a numerical evaluation of the likelihood function of count data models with unobserved heterogeneity of the log-normal type. The method is illustrated for the Poisson-log-normal model, although a similar algorithm can be used to estimate the models with endogenous selectivity presented in Chap. 5.2. Butler and Moffitt (1982) discuss Gauss-Hermite quadrature in the context of a panel probit models. Million (1998) points out that the Poisson-log-normal integral can be approximated using Gauss-Laguerre and Gauss-Legendre polynomials as well, and he evaluates the relative performance of the three methods. Crouch and Spiegelman (1990) discuss numerical integration in the related logistic-normal model.

Starting point for Gauss-Hermite quadrature is the integral

$$\int_{-\infty}^{\infty} f(y|x,\beta,\varepsilon)g(\varepsilon|\sigma^2)\mathrm{d}\varepsilon \tag{B.1}$$

that cannot be solved by analytical methods. However, assume that by appropriate change of variable, B.1 can be brought into the form

$$\int_{-\infty}^{\infty} h(\nu;y,x,\beta,\sigma^2)\exp(-\nu^2)\mathrm{d}\nu \tag{B.2}$$

In this case, Gauss-Hermite quadrature can be applied to numerically evaluate the integral (B.1), and thus the marginal likelihood $L(y|x)$. Once the evaluation has been done, the logarithm $\ln L(y|x)$ can be passed on to a maximizer that uses numerical derivatives in order to find the maximum likelihood estimators $\hat{\beta}$ and $\hat{\sigma}^2$.

The Poisson-log-normal model has the following components (see also Chap. 4.2):

$$f(y|\varepsilon) = \frac{\exp(-\exp(x'\beta+\varepsilon))\exp(x'\beta+\varepsilon)^y}{y!}$$

where $\varepsilon \sim N(0,\sigma^2)$, i.e.,

$$f(\varepsilon) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2}\left(\frac{\varepsilon}{\sigma}\right)^2}$$

Change of variable from ε to ν where

$$\nu = \frac{\varepsilon}{\sqrt{2}\sigma}$$

has inverse $\varepsilon = \nu\sqrt{2}\sigma$ and Jacobian $\mathrm{d}f(\nu)/\mathrm{d}\nu = \sqrt{2}\sigma$. Therefore

$$g(\nu) = \frac{1}{\sqrt{\pi}} e^{-\nu^2}$$

and

$$f(y|\nu)g(\nu) = \frac{\exp(-\exp(x'\beta + \nu\sqrt{2}\sigma))\exp(x'\beta + \nu\sqrt{2}\sigma)^y}{\sqrt{\pi}y!} e^{-\nu^2}$$

Let

$$h_i(\nu) = \frac{\exp(-\exp(x_i'\beta + \nu\sqrt{2}\sigma))\exp(x_i'\beta + \nu\sqrt{2}\sigma)^{y_i}}{\sqrt{\pi}y_i!}$$

where the subscript i reminds us that this function depends on observations y_i and x_i. Then the Gauss-Hermite approximation to the integral $B.1$ is obtained as

$$\begin{aligned} L_i^{gh} &= \int_{-\infty}^{\infty} h_i(\nu)\exp(-\nu^2)\mathrm{d}\nu \\ &\approx \sum_{j=1}^{n} w_j h_i(\nu_j) \end{aligned}$$

where w_j are weights and ν_j are the evaluation points. The likelihood function for n independent observations is given by

$$L^{gh} = \prod_{i=1}^{n}\sum_{j=1}^{n} w_j h_i(\nu_j)$$

Weight factors and abscissas for 20-point quadrature are given in Tab. B.1 (Source: Abramowitz and Stegun, 1964, p. 924).

Table B.1. Abcissas and Weight Factors for 20-point Gauss-Hermite Integration

u_i	w_i
-5.3874809	2.2939000e-13
-4.6036824	4.3993400e-10
-3.9447640	1.0860000e-07
-3.3478546	7.8025500e-06
-2.7888061	0.00022833863
-2.2549740	0.0033243773
-1.7385377	0.024810521
-1.2340762	0.10901721
-0.73747373	0.28667551
-0.24534071	0.46224367
0.24534071	0.46224367
0.73747373	0.28667551
1.2340762	0.10901721
1.7385377	0.024810521
2.2549740	0.0033243773
2.7888061	0.00022833863
3.3478546	7.8025500e-06
3.9447640	1.0860000e-07
4.6036824	4.3993400e-10
5.3874809	2.2939000e-13

Source: Abramowitz and Stegun, 1964, p. 924

C

Software

Most statistical and econometric software distributions contain built-in procedures for standard count data models, such as the Poisson and the negative binomial regression models. Development in the software sector is fast, and specific recommendations risk to become outdated very quickly. Nevertheless, there are a few general points that should be of help to anyone interested in working with count data and estimating the models presented in this book.

Within the econometrics research community, GAUSS traditionally has been the major development tool. GAUSS is mostly a programming environment, but specialised procedures are available both as part of the general distribution, and through web sites and mailing lists. For example, the "count" module allows the estimation of seemingly unrelated regression models, of various types of negative binomial models as well as hurdle Poisson models. Yet, the development of this module has stalled for some time, and the latest models are not available.

Two alternative programs with a much more ambitious offering in this area are STATA and LIMDEP. This appendix is not intended as a comprehensive review of available software for count data, and there may be other software with similar or even broader scope. Yet, the possibilities that these two packages offers should be closely scrutinized by anyone seriously interested in count data applications who wants to apply up-to-date methods without doing the programming for herself. In fact, most of the models discussed in this book are easily estimated with STATA or LIMDEP, providing little support for those who resort to the most basic models in want of available software for the more appropriate ones.

The following short summary refers to STATA release 7.0. This release includes built-in procedures, apart from the standard Poisson and Negbin models (in its various parameterizations, as Negbin I, Negbin II or with more flexible variance function), for zero-inflated Poisson and zero-inflated negative binomial models, and for fixed and random effects panel count data models. Random effects models include the negative binomial panel model (with fixed or random effects) but also the panel Poisson-log-normal model. This procedure can also be used in cross sections to estimate the standard Poisson-log-normal model that frequently has a better fit than the Negbin model. Hurdle Poisson or negative binomial models are not included in the standard distribution. However, they can be estimated using routines on truncated-at-zero models authored by Joseph Hilbe and described in the *Stata Technical Bulletin* Nr. 47. Most procedures include options for the computations of robust standard errors (to perform pseudo maximum likelihood estimation) as well as account for clustered sampling.

The latest version of LIMDEP is release 8.0. Apart from the standard count data models, its capabilities include the estimation of sample selection models by maximum likelihood, parametric models for underreporting where the observed counts represent only the reported fraction of the total events which have occurred, and maximum likelihood estimation of various types of hurdle models and zero-inflated models. LIMDEP and STATA are both quite versatile in the area of count data modelling.

D

Tables

Table D.1. Number of Job Changes: Poisson and Poisson-Log-Normal

	Poisson	Poisson-log-normal	Mean
Constant	0.501**	0.072	1
	(0.158)	(0.227)	
Education$*10^{-1}$	-0.138	-0.120	1.216
	(0.137)	(0.187)	
Experience$*10^{-1}$	-0.770**	-0.846**	1.460
	(0.111)	(0.155)	
Experience$^2 * 10^{-2}$	0.119**	0.127*	2.943
	(0.037)	(0.050)	
Union	-0.292**	-0.324**	0.429
	(0.065)	(0.088)	
Single	-0.050	-0.093	0.077
	(0.108)	(0.153)	
German	-0.368**	-0.390**	0.668
	(0.076)	(0.104)	
Qualified White Collar	0.067	-0.002	0.137
	(0.131)	(0.179)	
Ordinary White Collar	0.185	0.190	0.058
	(0.147)	(0.207)	
Qualified Blue Collar	0.147	0.112	0.501
	(0.082)	(0.114)	
σ^2		1.048**	
		(0.048)	
Log likelihood	-2044.47	-1866.80	
Log likelihood $(\beta_1, \ldots, \beta_9 = 0)$	-2155.40	-1934.53	
Number of Observations	1962		

Source: *German Socio-Economic Panel*, Wave A/1984; own calculations.
Note: Asymptotic standard errors in parentheses.

Table D.2. Number of Job Changes: Negative Binomial Models

	Negbin I	Negbin II	GEC$_k$
Constant	0.341	0.616**	0.380
	(0.191)	(0.224)	(0.212)
Education$*10^{-1}$	0.008	-0.179	-0.011
	(0.162)	(0.187)	(0.180)
Experience$*10^{-1}$	-0.762**	-0.786**	-0.775**
	(0.139)	(0.152)	(0.144)
Experience$^2 * 10^{-2}$	0.113*	0.118*	0.115*
	(0.046)	(0.048)	(0.047)
Union	-0.274**	-0.308**	-0.283**
	(0.080)	(0.087)	(0.084)
Single	-0.114	-0.054	-0.108
	(0.139)	(0.152)	(0.141)
German	-0.316**	-0.404**	-0.331**
	(0.097)	(0.102)	(0.103)
Qualified White Collar	-0.022	0.043	-0.013
	(0.163)	(0.174)	(0.173)
Ordinary White Collar	0.213	0.188	0.214
	(0.176)	(0.201)	(0.181)
Qualified Blue Collar	0.086	0.132	0.094
	(0.103)	(0.111)	(0.107)
σ^2	0.823**	1.378**	0.892**
	(0.088)	(0.137)	(0.080)
k			0.139
			(0.281)
Log likelihood	-1873.28	-1878.63	-1873.17
Number of Observations	1962		

Source: *German Socio-Economic Panel*, Wave A/1984; own calculations.

Notes: Asymptotic standard errors in parentheses. For $\sigma^2 > 0$ and $k = 0$, the GEC$_k$ model coincides with the Negbin I model. For $\sigma^2 > 0$ and $k = 1$, the GEC$_k$ model coincides with the Negbin II model.

Table D.3. Number of Job Changes: Robust Poisson Regression

			Robust *t*-Values		
	Coefficient	t_{Poisson}	t_{WHITE}	t_{LVF}	t_{QVF}
Constant	0.501	3.167	2.617	2.229	2.304
Education$*10^{-1}$	-0.138	-1.006	-0.823	-0.707	-0.749
Experience$*10^{-1}$	-0.770	-6.929	-4.830	-4.877	-5.055
Experience$^2 * 10^{-2}$	0.119	3.269	2.385	2.301	2.486
Union	-0.292	-4.499	-3.115	-3.167	-3.385
Single	-0.050	-0.460	-0.309	-0.323	-0.326
German	-0.368	-4.843	-2.892	-3.409	-3.503
Qualified White Collar	0.067	0.514	0.343	0.361	0.384
Ordinary White Collar	0.185	1.255	0.964	0.883	0.917
Qualified Blue Collar	0.147	1.794	1.261	1.263	1.308
Log likelihood	-2044.47				
Number of Observations	1962				

Notes:

Three alternative methods to calculate robust standard errors (and thus robust *t*-values) were given in Chap. 3.3.3. t_{LVF} and t_{QVF} are based on the assumption of a quadratic and linear variance function, respectively, while the White method makes no explicit assumption.

Table D.4. Number of Job Changes: Poisson-Logistic Regression

	a) Overlapping		**b) Non Overlapping**	
Variable	Offers	Acceptance	Offers	Acceptance
Constant	0.812		1.151	
	(3.746)		(9.740)	
Education$*10^{-1}$	-0.322	3.732		-0.260
	-2.073)	(1.582)		(-1.633)
Experience$*10^{-1}$	-0.668	-6.044		-1.068
	(-4.804)	(-1.221)		(-7.678)
Experience$^2 * 10^{-2}$	0.071	3.321		0.175
	(1.382)	(1.132)		(3.920)
Union	-0.291		-0.290	
	(-4.477)		(-4.470)	
Single		0.379		-0.068
		(0.153)		(-0.460)
German	-0.397		-0.355	
	(-5.112)		(-4.708)	
Qualified White Collar	0.069		0.088	
	(0.452)		(0.684)	
Ordinary White Collar	0.178		0.195	
	(1.125)		(1.328)	
Qualified Blue Collar	0.132		0.156	
	(1.389)		(1.919)	
Log likelihood	-2039.35		-2043.88	
Observations	1962			

Notes:

Asymptotic *t*-values in parentheses.

Table D.5. Number of Job Changes: Hurdle Count Data Models

	Hurdle Poisson		Probit-Poisson-log-normal	
Variable	1+/0	1+	1+/0	1+
Constant	-0.069	1.163	0.269	0.799
	(0.202)	(0.245)	(0.157)	(0.666)
Education$*10^{-1}$	0.133	-0.600**	0.094	-0.764**
	(0.170)	(0.218)	(0.128)	(0.324)
Experience$*10^{-1}$	-0.758**	-0.403**	-0.629**	-0.544
	(0.148)	(0.156)	(0.111)	(0.405)
Experience$^2 * 10^{-2}$	0.107**	0.085	0.098**	0.103
	(0.048)	(0.050)	(0.034)	(0.088)
Union	-0.268**	-0.167*	-0.205**	-0.230
	(0.084)	(0.097)	(0.061)	(0.189)
Single	-0.194	0.192	-0.149	0.195
	(0.149)	(0.147)	(0.114)	(0.249)
German	-0.330**	-0.206**	-0.254**	-0.223
	(0.101)	(0.108)	(0.076)	(0.208)
Qualified White Collar	-0.071	0.271	-0.076	0.283
	(0.170)	(0.196)	(0.125)	(0.285)
Ordinary White Collar	0.239	-0.039	0.200	-0.057
	(0.185)	(0.236)	(0.143)	(0.336)
Qualified Blue Collar	0.069	0.184	0.042	0.167
	(0.109)	(0.117)	(0.081)	(0.172)
σ^2			0.932**	
			(0.156)	
ρ			0.212	
			(0.893)	
Log-likelihood	-1928.00		-1856.70	
Observations	1962			

Notes:

Asymptotic standard errors in parentheses.
Hurdle negbin results are nor displayed because of convergence problems.

Table D.6. Number of Job Changes: Finite Mixture Models

	2-components Poisson		2-components Negbin II	
Variable	group 1	group 2	group 1	group 2
Constant	-0.000	2.229**	1.047*	0.154
	(0.226)	(0.433)	(0.630)	(0.458)
Education$*10^{-1}$	0.078	-0.368	-0.648	0.243
	(0.184)	(0.374)	(0.425)	(0.307)
Experience$*10^{-1}$	-0.857**	-0.541**	-0.371	-1.140**
	(0.172)	(0.231)	(0.346)	(0.296)
Experience$^2 * 10^{-2}$	0.104*	0.081	0.050	0.138
	(0.060)	(0.074)	(0.099)	(0.105)
Union	-0.309**	-0.207	-0.259	-0.328**
	(0.095)	(0.141)	(0.181)	(0.152)
Single	-0.156	0.057	0.200	-0.274
	(0.158)	(0.229)	(0.325)	(0.267)
German	-0.351**	-0.478**	-0.609**	-0.101
	(0.114)	(0.158)	(0.236)	(0.229)
Qualified White Collar	-0.037	0.168	0.320	-0.263
	(0.192)	(0.288)	(0.386)	(0.327)
Ordinary White Collar	0.253	0.103	-1.037	0.609*
	(0.202)	(0.358)	(0.945)	(0.353)
Qualified Blue Collar	0.082	0.317*	0.393	-0.130
	(0.124)	(0.173)	(0.263)	(0.224)
σ^2			2.096**	0.146
			(0.949)	(0.281)
π_1	0.930**		0.395**	
	(0.013)		(0.158)	
Log-likelihood	-1868.16		-1856.05	
Observations	1962			

Notes:

Asymptotic standard errors in parentheses.
Hurdle Negbin I results are nor displayed because of convergence problems.

Table D.7. Number of Job Changes: Zero Inflated Count Data Models

	zero-inflated Poisson		zero-inflated Negbin II	
Variable	logit	Poisson	logit	Negbin II
Constant	1.132	-0.303	0.483*	-7.390**
	(0.245)	(0.529)	(0.255)	(2.777)
Education$*10^{-1}$	-0.583**	1.016**	-0.262	-0.746
	(0.203)	(0.455)	(0.216)	(1.152)
Experience$*10^{-1}$	-0.373**	1.035**	-0.613**	4.535**
	(0.153)	(0.312)	(0.192)	(1.715)
Experience$^2 * 10^{-2}$	0.072	-0.157	0.129**	-.759**
	(0.049)	(0.091)	(0.062)	(0.346)
Union	-0.158	0.293	-0.253**	0.351
	(0.097)	(0.179)	(0.102)	(0.465)
Single	0.151	0.461	0.066	1.368
	(0.154)	(0.297)	(0.169)	(0.962)
German	-0.173	0.435**	-0.236**	1.306
	(0.106)	(0.211)	(0.118)	(0.788)
Qualified White Collar	0.272	0.519	0.178	1.228
	(0.189)	(0.354)	(0.206)	(0.843)
Ordinary White Collar	-0.123	-0.870	0.025	11.967
	(0.243)	(0.711)	(0.203)	(349.869)
Qualified Blue Collar	0.166	0.094	0.151	0.193
	(0.115)	(0.219)	(0.129)	(0.614)
σ^2			1.103	
			(0.146)	
Log-likelihood	-1926.28		-1866.73	
Observations	1962			

Notes:

Asymptotic standard errors in parentheses.

Table D.8. Number of Job Changes: Quantile Regressions

	$Q_z(0.5, x)$	$Q_z(0.75, x)$	$Q_z(0.9, x)$
Constant	-0.181	1.138	1.768
	(0.468)	(0.475)	(0.272)
Education$*10^{-1}$	0.319	0.026	-0.343
	(0.373)	(0.343)	(0.207)
Experience$*10^{-1}$	-1.346	-1.413	-0.721
	(0.249)	(0.258)	(0.196)
Experience$^2 * 10^{-2}$	0.288	0.220	0.066
	(0.069)	(0.083)	(0.054)
Union	-0.388	-0.395	-0.336
	(0.193)	(0.187)	(0.117)
Single	-0.469	-0.191	-0.128
	(0.324)	(0.248)	(0.220)
German	-0.479	-0.522	-0.209
	(0.246)	(0.213)	(0.162)
Qualified White Collar	-0.144	-0.063	-0.020
	(0.304)	(0.302)	(0.237)
Ordinary White Collar	0.240	0.312	-0.061
	(0.319)	(0.340)	(0.188)
Qualified Blue Collar	-0.142	-0.078	-0.082
	(0.212)	(0.179)	(0.137)
Observations	1962		

Notes:

Bootstrap standard errors in parentheses (50 replications).

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