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ESTIMATION OF PANEL CORRELATIONS FOR THE CANADIAN LABOUR FORCE SURVEY

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ABSTRACT

The Canadian Labour Force Survey uses the rotation panel design. Every month, one sixth of the sample rotates and five sixths remain. Hence, under this rotation scheme, once a rotation panel enters in the sample, it stays 6 months in the sample before it rotates out. Because of this design feature, the estimates based on the same panel in different months are highly correlated. Moreover, when a rotation panel rotates out, a neighbouring rotation panel usually rotates in. Since they are geographically close, estimates based on the neighbouring rotation panels are also correlated. These correlations are called panel correlations: their magnitudes are variable-specific and time-dependent. This paper describes a methodology for estimating the panel correlations and presents estimated correlations for selected variables using 1980-81 and 1985-87 data. The work was originated for the study of composite estimation technique. However, the results are useful in any situation in which the panel correlation plays a role.

RÉSUMÉ

L'enquête sur la population active du Canada utilise une stratégie de renouvellement par panel. Chaque mois, un sixième de l'échantillon est renouvelé tandis que les cinq sixièmes demeurent les mêmes. Donc, sous cette stratégie de renouvellement, un panel demeure dans l'échantillon 6 mois avant d'en sortir. À cause de cette stratégie, les estimations basées sur les mêmes panels dans deux mois différents sont hautement corrélées. De plus, lorsqu'un panel sort de l'échantillon, le panel le remplaçant lui est en général géographiquement voisin. Il en découle que les estimations basées sur des panels voisins sont aussi corrélées. Ces corrélations sont appelées corrélations de panel: leur ampleur dépend de la variable à l'étude et de la période de référence. Cet article décrit la méthodologie pour estimer les corrélations de panel et présente les résultats pour quelques variables en utilisant des données des années 1980 à 1981 et 1985 à 1987. Ce travail a débuté pour l'étude d'une technique d'estimation composite; cependant, les résultats s'avèrent utiles pour toute situation où il y a corrélation de panel.

1. Introduction

The Labour Force Survey (LFS) is a continuing monthly household survey which employs rotating panel design. The sample consists of six equal size rotation panels one of which is replaced by a new panel each month. The rotated-in panel stays in the sample for six months before it rotates out from the sample. Therefore, the estimates based on the same panel consisting of the same sampling units in different months are highly correlated. Moreover, an outgoing rotation panel is usually replaced by a neighbouring panel. Because they are geographically close, estimates based on these neighbouring rotation panels are also correlated. These correlations are called panel correlations. In this paper, we will describe and discuss how the panel correlations can be estimated and present their estimates for selected variables. The work was originated for the study of compsite estimation technique. However, the results are applicable in any situation where the panel correlation plays a role.

The paper is structured as follows: In Section 2, necessary definitions, notations and assumptions are given. Methodology is described in Section 3 and results and discussion are given in Section 4.

2. Definitions of Panel Correlation Coefficients

To define various panel correlations we need to define common panels and the predecessor panel. A panel is identified by the panel number which indicates the duration of the panel in the sample. Thus, Panel 1 in month m, becomes Panel 2 in month $m+1$, Panel 3 in month $m+2$, and so on. Another term, "rotation group", is often used to identify a panel regardless of its duration in the sample. For instance, Rotation Group 1 which rotates in in January is identified as Rotation Group 1 throughout its stay in the sample until it rotates out in July. Then, Panel 1 in January indicates Rotation Group 1 and Panel 2 in February indicates the same rotation group which is now two months old and so on. Two panels in two different months which represent the same rotation group are called "common panels". On the other hand, when a rotation group rotates out, it is usually replaced by a panel consisting of neighboring households and given the same rotation

group number. A panel representing the out-going rotation group is called the "Predecessor panel" of the panel associated with the in-coming rotation group to replace the outgoing one. Therefore, in the example, Panel 6 in June which represents Rotation Group 1 is the predecessor panel of Panel 1 in July which rotates in to replace outgoing Rotation Group 1. Table 1 shows schematically the common and predecessor panels pertaining to given months m and $m-j$

Since each panel can be identified uniquely by two components, month and panel number, let P(month, panel number) denote the panel identified by the month and panel number. Then $P(m,4)$ and $P(m-1,3)$, for instance, are common panels 1 month apart. Similarly, $P(m,4)$ and $P(m-2,2)$ are common panels 2 months apart. The correlation coefficients of estimates of a characteristic based on these common panels are denoted by ρ_j of which j indicates the number of months apart. Obviously, there are no common panels which are more than 5 months apart and thus, the subscript j can be at most 5. We assume that ρ_j is independent of m and the particular panel numbers which define this correlation. For instance, $P(m,5)$ and $P(m-1,4)$ defines the same correlation ρ_1 as $P(m-2,4)$ and $P(m-3,3)$ do. However, it is function of j and characteristic-dependent.

The correlation coefficient defined by a panel and its predecessor is denoted by γ_j with j having the same meaning as before. But in this case, j can go up to 11, i.e. γ_{11} is the last correlation coefficient in this series and it is the correlation between $P(m,6)$ and $P(m-11,1)$. We assume again that γ's are independent of m and the particular panel number. They are also characteristic-dependent.

The third type of panel correlation is defined as the correlation between estimates for two different characteristics from common panels and denoted by τ_j for common panels j months part. Now j can take values from 0 to 5. The same assumption for ρ's and γ's is applied here as well. Now we give the formal definitions of ρ's, γ's and τ's.

Let $y_{m,\ell}$ be the LFS estimate of a characteristic of interest obtained from $P(m,\ell)$. We assume that $V(Y_{m,\ell}) = \sigma_y^2$ regardless of m and ℓ.

Then, ρ's are defined by

$$\text{Cov}(y_{m,\ell}, y_{m-j,\ell-j}) = \rho_j\sigma_y^2,\ 1\leq j\leq 5,\ j<\ell\leq 6,$$

and γ's by

$$\text{Cov}(y_{m,\ell}, y_{m-j,6+\ell-j}) = \gamma_j\sigma_y^2,$$

where $1\leq\ell\leq j$ if $1\leq j\leq 6$, $j-5\leq\ell\leq 6$ if $7\leq j\leq 11$.

It is easy to conjecture that ρ's and γ's decrease as the subscript j increases and that ρ's are larger than γ's because ρ's are correlation of common households while γ's are correlation of neighboring households. We can also define the correlation between a panel and the predecessor of the panel's predecessor (denoted by double parentheses and called "double predecessor" in Table 1) in the similar way. However, these correlations will be very small and thus assumed to be zero for simplicity.

We also assume that all other panel correlations are zero. For instance, $\text{Cov}(y_{m,\ell}, y_{m,\ell'}) = 0$ if $\ell\neq\ell'$ and $\text{Cov}(y_{m,\ell}, y_{m-j,\ell'}) = 0$ if $P(m-j,\ell')$ is not a common panel nor predecessor of $P(m,\ell)$.

In order to define τ correlations, let $x_{m,\ell}$ be the LFS estimate of another characteristic obtained from $P(m,\ell)$ and let $V(x_{m,\ell}) = \sigma_x^2$ independent of m and ℓ. Then τ correlations are defined by

$$\text{Cov}(x_{m,\ell}, y_{m-j,\ell-j}) = \tau_j\sigma_x\sigma_y,\ 0\leq j\leq 5,\ j<\ell\leq 6,$$

3. Estimation of the Panel Correlations

Since a variance estimation computer program was available, the method described here was geared to use this program with minimum modification. The methodology used in the program is the generalized Keyfitz method (Woodruff 1971) better known as the Taylor method. The program can compute variance estimates of linear combinations of monthly estimates.

We employ the following basic equality to estimate the desired correlations using the existing varince program:

$$\mathrm{Cov}(A,B) = \frac{V(A) + V(B) - V(A-B)}{2} \tag{1}$$

From the program, $V(A-B)$, $V(A)$ and $V(B)$ can be obtained and so can $\mathrm{Cov}(A,B)$ using (1).

3.1 Estimation of ρ Correlations

Let $A = \sum_{\ell=2}^{6} y_{m,\ell}$ and $B = \sum_{\ell=1}^{5} y_{m-1,\ell}$. A and B are obtained by eliminating Panel 1 from month m and Panel 6 from month $m-1$, respectively. Note that the eliminated panels are uncommon ones and the remaining ones are all common panels. Using the variance program, we compute estimates of $V(A-B)$, $V(A)$ and $V(B)$ and obtain estimates of $\mathrm{Cov}(A,B)$ by (1). (An estimate will be indicated by a "^" over the parameter.) From the assumptions given in Section 2, it is easy to see that

$$\mathrm{Cov}(A,B) = 5\rho_1 \sigma_y^2,$$
$$V(A) = V(B) = 5\sigma_y^2,$$

and thus,

$$\rho_1 = \frac{\mathrm{Cov}(A,B)}{\{V(A)\ V(B)\}^{\frac{1}{2}}} . \tag{2}$$

An estimate of ρ_1 is then obtained by substituting estimates of $\mathrm{Cov}(A,B)$, $V(A)$ and $V(B)$. Estimates of ρ_2, ρ_3 and ρ_4 can be obtained similarly. But there is some problem in estimating ρ_5 this way. When we drop all uncommon panels from months m and $m-5$, only one panel is left in each month and this causes problem in variance estimation for Self-Representing (SR) areas. In Non-Self-Representing (NSR) areas, each PSU which becomes replicate for variance estimation has all rotation panels and after elimination of 5 uncommon panels, there is still one panel remaining in each PSU and thus, variance can be computed. In SR areas, however, rotation panels form replicates and if there is only one panel left, then there

is only one replicate in each stratum and thus variance cannot be computed in the usual way. Therefore, $\hat{\rho}_5$ was obtained by extrapolating $\hat{\rho}_3$ and $\hat{\rho}_4$. It is based on the assumption that there is a linear relation between ρ's and the subscript j. There is another way to get $\hat{\rho}_5$ which will be discussed later. (For detailed description of the Labour Force Survey methodology, readers are referred to Platek and Singh (1976)).

3.2 Estimation of γ correlations

It is easy to see that $\mathrm{Cov}(A,B) = (5\rho_1+\gamma_1)\sigma_y^2$ if $A = \sum_{\ell=1}^{6} y_{m,\ell}$ and $B = \sum_{\ell=1}^{6} y_{m-1,\ell}$. In general, $\mathrm{Cov}(A,B) = \{(6-j)\ \rho_j+j\gamma_j\}\sigma_y^2$ where $A = \sum_{\ell=1}^{6} y_{m,\ell}$, $B = \sum_{\ell=1}^{6} y_{m-j,\ell}$ $j=1,\ 2,\ \ldots,\ 4$.

Then, an estimate of γ_j can be obtained from the following equation:

$$\gamma_j = \left| 6\ \frac{\mathrm{Cov}(A,B)}{\{V(A)\ V(B)\}^{\frac{1}{2}}} - (6-j)\ \rho_j \right| / j \tag{3}$$

by substituting estimated values on the right. There is a direct way to estimate these γ correlations including γ_5 by

$$\gamma_j = \frac{\mathrm{Cov}(A_j,B_j)}{\{V(A_j)\ V(B_j)\}^{\frac{1}{2}}} \tag{4}$$

where $A_j = \sum_{\ell=1}^{j} y_{m,\ell}$ and $B_j = \sum_{\ell=7-j}^{6} y_{m-j,\ell}$, $j=2,\ \ldots,\ 5$. The reason why we do not use this method will be discussed in Section 4.

Other γ correlations $(\gamma_j,\ j=6,\ \ldots,\ 10)$ are obtained by (4) with

$A_j = \sum_{\ell=j-5}^{6} y_{m,\ell}$ and $B_j = \sum_{\ell=1}^{12-j} y_{m-j,\ell}$.

There is no simple way of estimating γ_{11} directly or indirectly. Thus, we again extrapolate $\hat{\gamma}_9$ and $\hat{\gamma}_{10}$ to get $\hat{\gamma}_{11}$.

We obtained $\hat{\gamma}_5$ by interpolating $\hat{\gamma}_4$ and $\hat{\gamma}_6$ even though it can be estimated by (4) directly.

3.3 Estimation of τ Correlations

These correlations can be estimated in the same way as for ρ correlations just by changing the role of $y_{m,\ell}$ by that of $x_{m,\ell}$.

Let $A = \sum_{\ell=j+1}^{6} x_{m,\ell}$ and $B = \sum_{\ell=1}^{6-j} y_{m-j,\ell}$, $j = 0, 1, \ldots, 4$.

Then $\mathrm{Cov}(A,B) = (6-j)\, \tau_j\, \sigma_x\, \sigma_y$, $V(A) = (6-j)\, \sigma_x^2$, and $V(B) = (6-j)\, \sigma_y^2$, whence we have

$$\tau_j = \frac{\mathrm{Cov}(A,B)}{\{V(A)\ V(B)\}^{\frac{1}{2}}}, \qquad j = 0, 1, \ldots, 4. \tag{5}$$

All τ's can be estimated using (5) except τ_5 which is estimated by extrapolating $\hat{\tau}_3$ and $\hat{\tau}_4$,

4. Results and Discussion

Tables 2 and 3 give the estimates of ρ and γ correlations for 5 labour force characteristics (In Labour Force, Employed, Employed Agriculture, Employed Non-agriculture, Unemployed) obtained by the method described in Section 3 and from 1980-81 data for three provinces, Nova Scotia, Ontario and British Columbia. The ρ correlations for all characteristics are much larger than γ's and behave nicely, i.e. decrease over time as expected. As expected, $\hat{\rho}$'s and $\hat{\gamma}$'s for Employed Agriculture are larger than other characteristics. For unemployed, the correlations are smaller than others. The behaviour of $\hat{\gamma}$'s for all characteristics except Employed Agriculture is somewhat fuzzy in that even though they show an over-all decreasing trend, there are up-and-downs locally. This up-and-down behaviour in $\hat{\gamma}$'s is more prominent with large subscripts, say $j \geq 6$, for all characteristics except Employed Agriculture.

Table 4 gives comparison between $\hat{\gamma}$'s obtained by (3) and (4) for Ontario. Employed was picked to serve as an example but the same is true for other

characteristics. As can be seen from these figures, $\hat{\gamma}$'s obtained by (4) behave quite differently from $\hat{\gamma}$'s obtained by (3). The $\hat{\gamma}$ series obtained by (4) behave against our intuition by showing increasing trend rather than decreasing trend. That's why we use (3) instead of (4). If the assumption given in Section 3 concerning panel correlations that panel correlations other than ρ's and γ's for the same characteristic are zero is true, then the two formulae should give similar results. This is not the case which indicates that there is some discrepancy between the assumption and real data.

Estimates of ρ and γ correlations from recent data (March 1985 - February 1987) are presented in Tables 5A-13A and 5B-13B. This time, estimation was extended to 10 provinces and 9 characteristics including Employed 15-24, Employed 25+, Unemployed 15-20, and Unemployed 25+.

The last table numbered 14 presents τ correlations for all possible combinations of Employed 15-24, Employed 25+, Unemployed 15-24 and Unemployed 25+ for three provinces Nova Scotia, Ontario and Alberta.

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References

Woodruff, R.S. (1971). A simple method for approximating the variance of a complicated estimate. *Journal of the American Statistical Association*, 66, 411-414.

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TABLE 1
Common and Predecessor Panels Pertaining to Months m and m-j

Panels in Month m	m-1	m-2	m-3	m-4	m-5	m-6	m-7	m-8	m-9	m-10	m-11
1	(6)	(5)	(4)	(3)	(2)	(1)	((6))	((5))	((4))	((3))	((2))
2	1	(6)	(5)	(4)	(3)	(2)	(1)	((6))	((5))	((4))	((3))
3	2	1	(6)	(5)	(4)	(3)	(2)	(1)	((6))	((5))	((4))
4	3	2	1	(6)	(5)	(4)	(3)	(2)	(1)	((6))	((5))
5	4	3	2	1	(6)	(5)	(4)	(3)	(2)	(1)	((6))
6	5	4	3	2	1	(6)	(5)	(4)	(3)	(2)	(1)

Note: Single parentheses indicate "*single*" predecessor and double parentheses "*double*" predecessor.

TABLE 2
Estimates of ρ Correlations
(1980-81 Data)

Characteristic	$\hat{\rho}_1$	$\hat{\rho}_2$	$\hat{\rho}_3$	$\hat{\rho}_4$	$\hat{\rho}_5$
			Nova Scotia		
In LF	.862	.797	.744	.679	.614
Emp.	.866	.783	.714	.651	.588
Emp. Ag.	.913	.837	.756	.678	.600
Emp. Non-Ag.	.865	.774	.710	.649	.588
Unemp.	.590	.455	.333	.243	.153
			Ontario		
In LF	.843	.782	.717	.674	.631
Emp.	.852	.779	.709	.664	.619
Emp. Ag.	.955	.926	.901	.861	.821
Emp. Non-Ag.	.861	.791	.724	.678	.632
Unemp.	.580	.445	.334	.286	.238
			British Columbia		
In LF	.849	.767	.705	.665	.625
Emp.	.835	.755	.695	.651	.607
Emp. Ag.	.896	.809	.733	.656	.579
Emp. Non-Ag.	.855	.769	.715	.661	.607
Unemp.	.516	.407	.334	.320	.306

TABLE 3: Estimates of γ Correlations (1980-81 Data)

Characteristic	$\hat{\gamma}_1$	$\hat{\gamma}_2$	$\hat{\gamma}_3$	$\hat{\gamma}_4$	$\hat{\gamma}_5$	$\hat{\gamma}_6$	$\hat{\gamma}_7$	$\hat{\gamma}_8$	$\hat{\gamma}_9$	$\hat{\gamma}_{10}$	$\hat{\gamma}_{11}$
Nova Scotia											
In LF	.288	.263	.265	.250	.242	.233	.211	.199	.193	.167	.141
Emp.	.262	.219	.228	.226	.233	.239	.210	.200	.188	.161	.134
Emp. Ag.	.351	.308	.283	.237	.214	.190	.141	.113	.063	.021	-.021
Emp. Non-Ag.	.238	.187	.189	.180	.166	.151	.123	.121	.136	.091	.046
Unemp.	.106	.176	.091	.097	.087	.076	.066	.063	.066	.032	-.002
Ontario											
In LF	.161	.141	.128	.133	.135	.136	.125	.127	.124	.122	.120
Emp.	.164	.136	.142	.142	.146	.149	.148	.150	.153	.141	.129
Emp. Ag.	.477	.483	.474	.486	.480	.474	.459	.429	.394	.323	.252
Emp. Non-Ag.	.184	.150	.147	.157	.162	.167	.166	.169	.174	.156	.138
Unemp.	.141	.074	.076	.063	.057	.051	.045	.060	.077	.136	.195
British Columbia											
In LF	.177	.137	.117	.119	.116	.112	.101	.112	.094	.066	.038
Emp.	.211	.146	.133	.107	.095	.083	.050	.068	.058	-.033	-.061
Emp. Ag.	.380	.311	.301	.272	.244	.216	.198	.170	.122	.078	.034
Emp. Non-Ag.	.207	.166	.161	.129	.111	.093	.069	.038	.023	-.004	-.027
Unemp.	.126	.125	.114	.103	.090	.076	.062	.092	.032	.040	.048

TABLE 4: Comparison of Estimates of γ_2, γ_3, γ_4 and γ_5 Obtained by Different Methods (1980-81, Ontario)

Characteristic	Method	$\hat{\gamma}_2$	$\hat{\gamma}_3$	$\hat{\gamma}_4$	$\hat{\gamma}_5$
In Labour Force	Method 1	.141	.128	.133	.135
	Method 2	.107	.105	.116	.120
Employed	Method 1	.136	.142	.142	.146
	Method 2	.100	.115	.126	.133
Employed in Agriculture	Method 1	.483	.474	.486	.480
	Method 2	.321	.370	.407	.448
Employed in Non-Agriculture	Method 1	.150	.147	.157	.162
	Method 2	.117	.134	.145	.149
Unemployed	Method 1	.074	.076	.063	.057
	Method 2	.043	.056	.046	.043

Note: Method 1: The method by the formula (3) in Section 3 and used to obtain Table 3.
Method 2: The method by the formula (4).

TABLE 5A

ESTIMATES OF PANEL CORRELATION RHO'S
FOR EMPLOYED (MAR 85-FEB 87)

PROVINCE	RHO1	RHO2	RHO3	RHO4	RHO5
NFLD	0.855	0.748	0.651	0.586	0.522
PEI	0.831	0.734	0.676	0.608	0.541
NS	0.863	0.768	0.713	0.686	0.659
NB	0.881	0.794	0.743	0.709	0.675
PQ	0.882	0.816	0.754	0.700	0.647
ONT	0.853	0.771	0.706	0.648	0.589
MAN	0.861	0.793	0.737	0.698	0.659
SAS	0.918	0.867	0.811	0.746	0.681
ALT	0.832	0.748	0.680	0.641	0.602
BC	0.851	0.770	0.711	0.651	0.590

TABLE 5B

ESTIMATES OF PANEL CORRELATION GAMMA'S
FOR EMPLOYED (MAR 85-FEB 87)

PROVINCE	GAM1	GAM2	GAM3	GAM4	GAM5	GAM6	GAM7	GAM8	GAM9	GAM10	GAM11
NFLD	0.424	0.266	0.209	0.201	0.241	0.281	0.249	0.268	0.298	0.288	0.277
PEI	0.235	0.221	0.214	0.202	0.198	0.193	0.195	0.163	0.147	0.063	-0.022
NS	0.170	0.183	0.205	0.196	0.176	0.157	0.158	0.194	0.198	0.219	0.240
NB	0.360	0.338	0.366	0.392	0.365	0.338	0.339	0.345	0.308	0.287	0.265
PQ	0.362	0.356	0.343	0.332	0.318	0.304	0.281	0.267	0.257	0.223	0.188
ONT	0.114	0.122	0.121	0.122	0.123	0.124	0.119	0.108	0.110	0.112	0.113
MAN	0.213	0.174	0.158	0.160	0.172	0.185	0.179	0.174	0.190	0.231	0.273
SAS	0.532	0.551	0.528	0.521	0.499	0.476	0.436	0.383	0.363	0.302	0.241
ALT	0.063	0.113	0.109	0.127	0.137	0.148	0.171	0.167	0.157	0.131	0.105
BC	0.125	0.100	0.112	0.111	0.123	0.135	0.123	0.121	0.118	0.095	0.072

TABLE 6A

ESTIMATES OF PANEL CORRELATION RHO'S
FOR UNEMPLOYED (MAR 85-FEB 87)

PROVINCE	RHO1	RHO2	RHO3	RHO4	RHO5
NFLD	0.741	0.628	0.518	0.485	0.452
PEI	0.650	0.532	0.458	0.432	0.407
NS	0.703	0.546	0.426	0.415	0.405
NB	0.720	0.602	0.523	0.471	0.419
PQ	0.636	0.512	0.432	0.382	0.331
ONT	0.579	0.436	0.328	0.291	0.253
MAN	0.572	0.440	0.355	0.301	0.247
SAS	0.663	0.534	0.462	0.393	0.324
ALT	0.658	0.543	0.474	0.405	0.336
BC	0.634	0.524	0.459	0.363	0.267

TABLE 6B

ESTIMATES OF PANEL CORRELATION GAMMA'S
FOR UNEMPLOYED (MAR 85-FEB 87)

PROVINCE	GAM1	GAM2	GAM3	GAM4	GAM5	GAM6	GAM7	GAM8	GAM9	GAM10	GAM11
NFLD	0.482	0.458	0.442	0.449	0.419	0.388	0.383	0.341	0.330	0.308	0.285
PEI	0.190	0.174	0.148	0.150	0.139	0.129	0.123	0.126	0.136	0.112	0.088
NS	0.233	0.267	0.241	0.211	0.189	0.168	0.171	0.176	0.157	0.187	0.216
NB	0.479	0.575	0.540	0.522	0.485	0.448	0.433	0.359	0.288	0.192	0.096
PQ	0.141	0.098	0.071	0.061	0.075	0.089	0.080	0.087	0.090	0.081	0.072
ONT	0.030	0.047	0.055	0.047	0.047	0.048	0.039	0.030	0.039	0.048	0.057
MAN	0.067	0.025	0.009	0.050	0.067	0.084	0.068	0.053	0.045	0.035	0.025
SAS	0.124	0.169	0.175	0.142	0.123	0.104	0.094	0.056	0.038	0.042	0.046
ALT	0.074	0.132	0.127	0.140	0.148	0.155	0.164	0.190	0.170	0.185	0.199
BC	0.096	0.086	0.084	0.080	0.088	0.097	0.068	0.074	0.068	0.083	0.098

TABLE 7A

ESTIMATES OF PANEL CORRELATION RHO'S
FOR IN LABOUR FORCE (MAR 85-FEB 87)

PROVINCE	RHO1	RHO2	RHO3	RHO4	RHO5
NFLD	0.853	0.750	0.666	0.596	0.525
PEI	0.796	0.705	0.635	0.600	0.564
NS	0.845	0.769	0.730	0.696	0.662
NB	0.878	0.809	0.771	0.714	0.658
PQ	0.844	0.778	0.724	0.670	0.617
ONT	0.846	0.781	0.732	0.681	0.629
MAN	0.839	0.787	0.724	0.697	0.669
SAS	0.901	0.849	0.793	0.742	0.691
ALT	0.803	0.738	0.689	0.639	0.589
BC	0.817	0.753	0.701	0.647	0.594

TABLE 7B

ESTIMATES OF PANEL CORRELATION GAMMA'S
FOR IN LABOUR FORCE (MAR 85-FEB 87)

PROVINCE	GAM1	GAM2	GAM3	GAM4	GAM5	GAM6	GAM7	GAM8	GAM9	GAM10	GAM11
NFLD	0.518	0.452	0.427	0.401	0.395	0.390	0.379	0.375	0.351	0.288	0.225
PEI	0.114	0.098	0.131	0.113	0.119	0.125	0.133	0.116	0.135	0.109	0.083
NS	0.250	0.238	0.247	0.230	0.217	0.204	0.181	0.196	0.189	0.162	0.135
NB	0.515	0.466	0.480	0.494	0.479	0.465	0.457	0.458	0.395	0.343	0.292
PQ	0.319	0.306	0.288	0.276	0.259	0.243	0.210	0.203	0.196	0.170	0.143
ONT	0.162	0.138	0.141	0.134	0.134	0.135	0.127	0.116	0.111	0.103	0.095
MAN	0.161	0.144	0.139	0.139	0.147	0.154	0.138	0.139	0.148	0.188	0.227
SAS	0.468	0.475	0.471	0.467	0.451	0.435	0.392	0.345	0.301	0.262	0.223
ALT	0.187	0.132	0.100	0.109	0.099	0.090	0.072	0.064	0.074	0.068	0.062
BC	0.103	0.095	0.113	0.103	0.096	0.090	0.091	0.083	0.078	0.030	-0.018

TABLE 8A

ESTIMATES OF PANEL CORRELATION RHO'S
FOR EMPLOYED AGRICULTURE (MAR 85-FEB 87)

PROVINCE	RHO1	RHO2	RHO3	RHO4	RHO5
NFLD	0.910	0.848	0.794	0.745	0.697
PEI	0.955	0.937	0.923	0.881	0.840
NS	0.912	0.867	0.825	0.802	0.779
NB	0.930	0.899	0.852	0.811	0.770
PQ	0.978	0.964	0.949	0.939	0.930
ONT	0.962	0.948	0.944	0.937	0.930
MAN	0.964	0.938	0.923	0.911	0.899
SAS	0.987	0.981	0.971	0.959	0.948
ALT	0.979	0.974	0.967	0.961	0.955
BC	0.938	0.886	0.847	0.828	0.808

TABLE 8B

ESTIMATES OF PANEL CORRELATION GAMMA'S
FOR EMPLOYED AGRICULTURE (MAR 85-FEB 87)

PROVINCE	GAM1	GAM2	GAM3	GAM4	GAM5	GAM6	GAM7	GAM8	GAM9	GAM10	GAM11
NFLD	0.159	0.254	0.304	0.390	0.397	0.403	0.343	0.264	0.208	0.147	0.085
PEI	0.531	0.526	0.527	0.533	0.530	0.526	0.529	0.531	0.512	0.529	0.545
NS	0.326	0.296	0.246	0.245	0.256	0.267	0.234	0.217	0.259	0.269	0.278
NB	0.482	0.574	0.584	0.586	0.572	0.558	0.547	0.525	0.492	0.369	0.245
PQ	0.646	0.632	0.608	0.584	0.598	0.611	0.596	0.554	0.525	0.562	0.600
ONT	0.508	0.518	0.553	0.561	0.565	0.569	0.582	0.617	0.668	0.650	0.632
MAN	0.407	0.372	0.363	0.379	0.396	0.412	0.446	0.408	0.418	0.446	0.474
SAS	0.770	0.756	0.756	0.742	0.722	0.702	0.672	0.658	0.666	0.637	0.607
ALT	0.725	0.734	0.724	0.730	0.724	0.717	0.722	0.738	0.753	0.705	0.658
BC	0.394	0.443	0.426	0.401	0.400	0.400	0.401	0.381	0.347	0.334	0.321

TABLE 9A

ESTIMATES OF PANEL CORRELATION RHO'S
FOR EMPLOYED NONAGRICULTURE (MAR 85-FEB 87)

PROVINCE	RHO1	RHO2	RHO3	RHO4	RHO5
NFLD	0.859	0.754	0.661	0.598	0.534
PEI	0.885	0.814	0.766	0.719	0.671
NS	0.873	0.779	0.724	0.697	0.669
NB	0.887	0.802	0.751	0.716	0.681
PQ	0.883	0.823	0.767	0.732	0.697
ONT	0.866	0.795	0.746	0.701	0.656
MAN	0.888	0.828	0.785	0.748	0.710
SAS	0.942	0.911	0.881	0.852	0.823
ALT	0.892	0.839	0.800	0.778	0.755
BC	0.857	0.784	0.730	0.679	0.628

TABLE 9B

ESTIMATES OF PANEL CORRELATION GAMMA'S
FOR EMPLOYED NONAGRICULTURE (MAR 85-FEB 87)

PROVINCE	GAM1	GAM2	GAM3	GAM4	GAM5	GAM6	GAM7	GAM8	GAM9	GAM10	GAM11
NFLD	0.423	0.267	0.206	0.197	0.239	0.280	0.252	0.274	0.304	0.290	0.277
PEI	0.349	0.330	0.313	0.299	0.295	0.291	0.288	0.250	0.246	0.179	0.113
NS	0.146	0.168	0.199	0.201	0.177	0.153	0.152	0.189	0.199	0.216	0.233
NB	0.376	0.363	0.373	0.387	0.361	0.335	0.336	0.347	0.319	0.285	0.252
PQ	0.262	0.260	0.264	0.263	0.255	0.246	0.254	0.261	0.253	0.255	0.257
ONT	0.133	0.140	0.132	0.140	0.148	0.156	0.168	0.182	0.204	0.205	0.206
MAN	0.262	0.255	0.252	0.277	0.287	0.298	0.310	0.296	0.316	0.327	0.338
SAS	0.463	0.479	0.465	0.458	0.444	0.430	0.412	0.408	0.438	0.407	0.375
ALT	0.290	0.350	0.332	0.327	0.322	0.317	0.332	0.346	0.344	0.326	0.308
BC	0.080	0.067	0.076	0.072	0.091	0.109	0.111	0.118	0.112	0.106	0.099

TABLE 10A

ESTIMATES OF PANEL CORRELATION RHO'S
FOR EMPLOYED 15-24 (MAR 85-FEB 87)

PROVINCE	RHO1	RHO2	RHO3	RHO4	RHO5
NFLD	0.767	0.613	0.503	0.411	0.319
PEI	0.708	0.548	0.474	0.384	0.294
NS	0.773	0.632	0.556	0.495	0.434
NB	0.758	0.615	0.518	0.469	0.420
PQ	0.756	0.633	0.552	0.472	0.392
ONT	0.747	0.605	0.500	0.429	0.357
MAN	0.760	0.632	0.547	0.479	0.410
SAS	0.798	0.670	0.590	0.496	0.403
ALT	0.718	0.589	0.492	0.447	0.401
BC	0.740	0.614	0.520	0.454	0.388

TABLE 10B

ESTIMATES OF PANEL CORRELATION GAMMA'S
FOR EMPLOYED 15-24 (MAR 85-FEB 87)

PROVINCE	GAM1	GAM2	GAM3	GAM4	GAM5	GAM6	GAM7	GAM8	GAM9	GAM10	GAM11
NFLD	0.140	0.109	0.090	0.054	0.065	0.077	0.091	0.114	0.109	0.086	0.062
PEI	0.052	0.079	0.103	0.102	0.094	0.086	0.096	0.080	0.095	0.064	0.032
NS	0.107	0.127	0.140	0.133	0.119	0.105	0.099	0.107	0.090	0.074	0.059
NB	0.137	0.036	0.045	0.096	0.124	0.153	0.157	0.175	0.163	0.115	0.067
PQ	0.119	0.099	0.087	0.055	0.056	0.057	0.044	0.052	0.059	0.054	0.049
ONT	0.012	-0.006	0.018	0.031	0.027	0.023	0.011	0.011	0.016	0.044	0.071
MAN	0.126	0.118	0.103	0.092	0.094	0.096	0.107	0.099	0.093	0.067	0.041
SAS	0.247	0.268	0.223	0.220	0.211	0.203	0.178	0.158	0.169	0.123	0.077
ALT	0.084	0.016	0.016	0.035	0.044	0.054	0.055	0.033	0.038	0.037	0.036
BC	0.042	0.053	0.057	0.028	0.024	0.020	0.013	0.013	0.014	-0.006	-0.025

TABLE 11A

ESTIMATES OF PANEL CORRELATION RHO'S
FOR EMPLOYED 25+ (MAR 85-FEB 87)

PROVINCE	RHO1	RHO2	RHO3	RHO4	RHO5
NFLD	0.867	0.769	0.686	0.633	0.580
PEI	0.869	0.794	0.740	0.691	0.642
NS	0.878	0.800	0.754	0.729	0.703
NB	0.900	0.836	0.783	0.736	0.690
PQ	0.906	0.847	0.789	0.734	0.680
ONT	0.888	0.824	0.777	0.732	0.688
MAN	0.880	0.823	0.771	0.738	0.704
SAS	0.926	0.880	0.837	0.781	0.725
ALT	0.864	0.792	0.733	0.687	0.641
BC	0.877	0.804	0.752	0.695	0.637

TABLE 11B

ESTIMATES OF PANEL CORRELATION GAMMA'S
FOR EMPLOYED 25+ (MAR 85-FEB 87)

PROVINCE	GAM1	GAM2	GAM3	GAM4	GAM5	GAM6	GAM7	GAM8	GAM9	GAM10	GAM11
NFLD	0.414	0.283	0.220	0.211	0.249	0.286	0.275	0.296	0.329	0.313	0.298
PEI	0.235	0.195	0.207	0.198	0.199	0.199	0.194	0.182	0.139	0.105	0.072
NS	0.088	0.075	0.117	0.108	0.104	0.099	0.090	0.103	0.099	0.137	0.176
NB	0.322	0.289	0.295	0.319	0.302	0.284	0.298	0.317	0.301	0.295	0.288
PQ	0.354	0.358	0.349	0.343	0.328	0.312	0.298	0.285	0.276	0.240	0.204
ONT	0.124	0.124	0.115	0.107	0.114	0.122	0.117	0.103	0.109	0.114	0.119
MAN	0.138	0.106	0.091	0.091	0.101	0.112	0.105	0.107	0.125	0.184	0.242
SAS	0.462	0.494	0.461	0.458	0.440	0.421	0.390	0.348	0.335	0.278	0.221
ALT	0.099	0.138	0.126	0.128	0.132	0.135	0.150	0.160	0.151	0.143	0.136
BC	0.122	0.097	0.097	0.106	0.121	0.135	0.126	0.119	0.125	0.116	0.108

TABLE 12A

ESTIMATES OF PANEL CORRELATION RHO'S
FOR UNEMPLOYED 15-24 (MAR 85-FEB 87)

PROVINCE	RHO1	RHO2	RHO3	RHO4	RHO5
NFLD	0.622	0.480	0.382	0.325	0.267
PEI	0.532	0.400	0.329	0.219	0.110
NS	0.618	0.454	0.364	0.300	0.236
NB	0.582	0.470	0.370	0.311	0.251
PQ	0.563	0.419	0.334	0.310	0.285
ONT	0.468	0.339	0.257	0.219	0.182
MAN	0.455	0.311	0.205	0.171	0.137
SAS	0.536	0.397	0.289	0.256	0.223
ALT	0.486	0.346	0.276	0.259	0.242
BC	0.505	0.381	0.315	0.208	0.102

TABLE 12B

ESTIMATES OF PANEL CORRELATION GAMMA'S
FOR UNEMPLOYED 15-24 (MAR 85-FEB 87)

PROVINCE	GAM1	GAM2	GAM3	GAM4	GAM5	GAM6	GAM7	GAM8	GAM9	GAM10	GAM11
NFLD	0.206	0.166	0.181	0.186	0.138	0.090	0.102	0.119	0.127	0.127	0.127
PEI	0.096	0.007	0.018	0.023	0.019	0.016	0.041	0.051	0.059	0.023	-0.013
NS	0.051	0.080	0.042	0.024	0.042	0.061	0.079	0.081	0.058	0.011	-0.036
NB	0.203	0.261	0.267	0.242	0.221	0.199	0.181	0.130	0.090	0.072	0.053
PQ	0.099	0.027	0.015	0.003	0.018	0.032	0.014	0.031	0.050	0.013	-0.024
ONT	0.068	0.039	0.038	0.058	0.042	0.026	0.008	0.018	0.011	-0.002	-0.016
MAN	-0.012	0.009	-0.002	0.028	0.031	0.034	0.043	0.032	0.034	0.031	0.028
SAS	0.010	0.057	0.043	0.019	0.022	0.025	0.015	0.004	-0.018	-0.009	0.000
ALT	0.077	0.028	0.048	0.022	0.025	0.027	0.037	0.047	0.061	0.112	0.164
BC	0.076	0.077	0.045	0.033	0.031	0.028	0.027	0.026	0.027	0.037	0.047

TABLE 13A

ESTIMATES OF PANEL CORRELATION RHO'S
FOR UNEMPLOYED 25+ (MAR 85-FEB 87)

PROVINCE	RHO1	RHO2	RHO3	RHO4	RHO5
NFLD	0.752	0.622	0.530	0.484	0.438
PEI	0.663	0.553	0.466	0.441	0.416
NS	0.695	0.554	0.443	0.440	0.438
NB	0.703	0.582	0.492	0.449	0.406
PQ	0.658	0.535	0.445	0.385	0.325
ONT	0.622	0.468	0.365	0.313	0.261
MAN	0.609	0.484	0.399	0.331	0.264
SAS	0.675	0.553	0.497	0.425	0.354
ALT	0.700	0.577	0.500	0.433	0.365
BC	0.681	0.570	0.501	0.410	0.319

TABLE 13B

ESTIMATES OF PANEL CORRELATION GAMMA'S
FOR UNEMPLOYED 25+ (MAR 85-FEB 87)

PROVINCE	GAM1	GAM2	GAM3	GAM4	GAM5	GAM6	GAM7	GAM8	GAM9	GAM10	GAM11
NFLD	0.440	0.463	0.428	0.426	0.403	0.380	0.338	0.290	0.250	0.209	0.167
PEI	0.141	0.155	0.135	0.156	0.142	0.129	0.099	0.109	0.095	0.087	0.079
NS	0.155	0.129	0.177	0.171	0.165	0.159	0.158	0.127	0.102	0.134	0.165
NB	0.391	0.461	0.440	0.408	0.405	0.403	0.372	0.319	0.290	0.194	0.098
PQ	0.135	0.118	0.108	0.107	0.105	0.103	0.107	0.100	0.110	0.110	0.110
ONT	0.052	0.054	0.033	0.017	0.025	0.033	0.026	0.018	0.021	0.044	0.066
MAN	0.074	0.016	0.021	0.016	0.029	0.042	0.029	0.043	0.024	0.029	0.034
SAS	0.184	0.170	0.189	0.185	0.150	0.116	0.103	0.077	0.051	0.021	-0.010
ALT	0.058	0.118	0.125	0.143	0.155	0.167	0.170	0.194	0.182	0.189	0.196
BC	0.026	0.044	0.070	0.081	0.088	0.096	0.076	0.072	0.076	0.081	0.087

TABLE 14
ESTIMATES OF PANEL CORRELATION TAU'S
(MAR 85 - FEB 86)

PROV	CHAR	T0	T1	T2	T3	T4	T5
1	1	0.14955	0.14009	0.1484	0.18078	0.18687	0.19297
1	2	-0.44036	-0.27545	-0.1874	-0.13544	-0.03375	0.05794
1	3	-0.03582	-0.04000	-0.0429	-0.01522	0.02388	0.06297
1	4	-0.02945	-0.03691	-0.0779	-0.04944	-0.01637	0.01669
1	5	-0.43700	-0.37445	-0.2763	-0.18200	-0.23087	-0.27975
1	6	0.13591	0.12727	0.0943	0.05533	0.04837	0.04242
2	1	0.09182	0.06973	0.0551	0.04000	0.02812	0.01625
2	2	-0.41982	-0.26682	-0.2045	-0.16056	-0.14450	-0.12844
2	3	-0.06509	-0.05555	-0.0533	-0.03578	-0.02813	-0.02047
2	4	-0.06136	-0.05436	-0.0537	-0.04167	-0.08937	-0.13708
2	5	-0.39191	-0.30255	-0.2295	-0.18722	-0.18075	-0.17428
2	6	0.05836	0.04318	0.0217	0.01322	0.02150	0.02978
3	1	0.22227	0.15809	0.1290	0.11144	0.13800	0.16456
3	2	-0.47264	-0.29991	-0.2287	-0.19967	-0.17925	-0.15883
3	3	-0.16936	-0.13018	-0.1187	-0.08322	-0.09000	-0.09678
3	4	-0.08709	-0.06800	-0.0637	-0.10678	-0.10100	-0.09522
3	5	-0.55455	-0.42882	-0.3570	-0.30211	-0.23437	-0.16664
3	6	0.07373	0.08864	0.0910	0.08033	0.11937	0.15342

Legend: Province 1: Nova Scotia; 2: Ontario; 3: Alberta
Definition of CHAR:
1: Cor(X1, X2) 2: Cor(X1, X3)
3: Cor(X1, X4) 4: Cor(X2, X3)
5: Cor(X2, X4) 6: Cor(X3, X4)
where X1: Emp 15-24 X2: Emp 25+
X3: Unemp 15-24 X4: Unemp 25+.