Replicating Abowd and Card

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1. Summary statistics

In this note, I extend Abowd and Card (1989) using PSID data from 1967 to 1996

Tables 1, 2 and 3 replicate Table I from Abowd and Card (1989). They present summary statistics for the core variables, changes in earnings and hours, for each of the years in the sample, as well as demographics at the beginning of the sample period.

Here we see that average annual earnings have remained remarkably stable over the 30 year horizon. Average hours have fluctuated between 2173 and 2390 over the sample with no discernible trend. We see an upward trend in hourly earnings, however this is harder to comment on without controlling for inflation.

Looking at the change in earnings we see consistent growth in almost every year. The drop in 1990-91 corresponds with a US recession. The only drop in earnings outside a US recession is 1996, albeit this is a very small change, $< 1\%$.

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The annual changes in hours shows no discernible pattern, which is consistent with the stable hours profile over the whole period.

Tables 7-12 replicate the covariance matrix in Table IV from Abowd and Card (1989). Since these are large I leave them to the end. They present the covariance matrix for experience adjusted log changes in earnings $\Delta log(g)$ and hours $\Delta log(h)$. To adjust for potential experience I use the residuals from a regression of earnings and hours on potential experience and indicators for each year and whether the individual is non-white or married:

$$\begin{aligned}
\Delta log(g_{i,t}) &= \alpha + \sum_{t}^{T} \beta_t year_t + \beta_{T+1} exper_{i,t} + \beta_{T+2} nonwhite_i + \beta_{T+3} marr_i + \epsilon_i^g \\
\Delta log(h_{i,t}) &= \alpha + \sum_{t}^{T} \beta_t year_t + \beta_{T+1} exper_{i,t} + \beta_{T+2} nonwhite_i + \beta_{T+3} marr_i + \epsilon_i^h.
\end{aligned}$$

These regressions strip out the predictable effect of life cycle experience, inflation and individual characteristics on wage and hours changes leaving us with only the unexplained shocks.

Table 1: Summary statistics: earnings and hours 1967-1981

Year	Average hourly earnings	Average annual hours	Log change in hours (x100)	Log change in earnings (x100)
1967	3.0	2173		
1968	3.4	2240	3.64	15.26
1969	3.8	2268	1.57	13.86
1970	4.3	2292	0.43	10.05
1971	4.6	2340	4.19	12.65
1972	5.0	2356	2.58	12.44
1973	5.5	2361	-0.44	9.81
1974	6.3	2322	-0.91	10.18
1975	6.6	2393	2.61	8.09
1976	7.6	2369	-0.25	10.16
1977	8.1	2390	1.63	11.14
1978	10.5	2345	-4.08	11.02
1979	11.0	2311	-1.38	9.57
1980	11.0	2382	5.09	9.48
1981	12.0	2347	-1.55	6.13

Table 2: Summary statistics: earnings and hours 1982-1996

Year	Average annual hours	Average annual earnings	Log change in hours (x100)	Log change in earnings (x100)
1982	13.2	2334	-0.79	2.07
1983	13.9	2346	-0.62	7.21
1984	15.0	2361	0.12	7.24
1985	15.7	2333	-0.53	6.05
1986	16.9	2261	-2.21	4.08
1987	17.3	2392	6.07	5.03
1988	18.7	2348	-2.63	3.49
1989	29.1	2374	-0.95	2.79
1990	19.8	2308	-2.22	-1.23
1991	20.5	2254	-2.51	-3.20
1992	23.6	2214	-3.32	11.35
1993	24.0	2274	5.72	1.81
1994	23.2	2295	1.36	2.83
1995	25.3	2281	-0.98	9.07
1996	28.2	2212	-5.45	-0.30

Table 3: Summary statistics: demographics in 1969

Year	Age	Non White (%)	Average potential experience	Sample Size
1969	27.5824	0.131868	9.038462	182

2. Estimating models of variance-covariance

Methodology. Let's now estimate the models from Abowd and Card. I estimate seven models as seen in table 4.

First a brief explanation of the estimation process. Following the paper, for the nonstationary MA(2) I test the restriction that all covariances greater than two lags are zero. Then for the nonstationary MA(1) I test the further restriction that the second lags are also zero (versus the alternative that only lags greater than two are zero).

For the remaining models, I estimate the parameters according to the following relationships.

Stationary MA(2).

$$
\begin{aligned}
Cov(\Delta log(h_{i,t})\Delta log(h_{i,s})) = &\quad \sigma_{uu1} && |t = s| \\
= &\quad \sigma_{uu2} && |t-s| = 1 \\
= &\quad \sigma_{uu3} && |t-s| = 2 \\
Cov(\Delta log(g_{i,t})\Delta log(g_{i,s})) = &\quad \sigma_{vv1} && |t = s| \\
= &\quad \sigma_{vv2} && |t-s| = 1 \\
= &\quad \sigma_{vv3} && |t-s| = 2 \\
Cov(\Delta log(h_{i,t})\Delta log(g_{i,s})) = &\quad \sigma_{uv1} && |t = s| \\
= &\quad \sigma_{uv2} && |t-s| = 1 \\
= &\quad \sigma_{uv3} && |t-s| = 2
\end{aligned}
$$

Measurement error.

$$
\begin{aligned}
Cov(\Delta log(h_{i,t})\Delta log(h_{i,s})) = &\quad 2\sigma_{uu} && |t = s| \\
= &\quad -\sigma_{uu} && |t-s| = 1 \\
= &\quad 0 && |t-s| = 2 \\
Cov(\Delta log(g_{i,t})\Delta log(g_{i,s})) = &\quad 2\sigma_{vv} && |t = s| \\
= &\quad -\sigma_{vv} && |t-s| = 1 \\
= &\quad 0 && |t-s| = 2 \\
Cov(\Delta log(h_{i,t})\Delta log(g_{i,s})) = &\quad 2\sigma_{uv} && |t = s| \\
= &\quad -\sigma_{uv} && |t-s| = 1 \\
= &\quad 0 && |t-s| = 2
\end{aligned}
$$

Symmetric stationary MA(2). This is the same as the stationary MA(2) with the added restriction

$$Cov(\Delta log(h_{i,t})\Delta log(g_{i,s})) = \quad Cov(\Delta log(g_{i,t})\Delta log(h_{i,s})).$$

Two component model.

$$\begin{aligned}
Cov(\Delta log(h_{i,t})\Delta log(h_{i,s})) = & \quad \mu^2 Var[\Delta z_{it}] + 2\sigma_{uu} & |t = s| \\
= & \quad \mu^2 Cov[\Delta z_{it}, \Delta z_{is}] - \sigma_{uu} & |t - s| = 1 \\
= & \quad mu^2 Cov[\Delta z_{it}, \Delta z_{is}] & |t - s| = 2 \\
= & \quad 0 & |t - s| > 2 \\
Cov(\Delta log(g_{i,t})\Delta log(g_{i,s})) = & \quad Var[\Delta z_{it}] + 2\sigma_{vv} & |t = s| \\
= & \quad Cov[\Delta z_{it}, \Delta z_{is}] - \sigma_{vv} & |t - s| = 1 \\
= & \quad Cov[\Delta z_{it}, \Delta z_{is}] & |t - s| = 2 \\
= & \quad 0 & |t - s| > 2 \\
Cov(\Delta log(h_{i,t})\Delta log(g_{i,s})) = & \quad \mu Var[\Delta z_{it}] + 2\sigma_{uv} & |t = s| \\
= & \quad \mu Cov[\Delta z_{it}, \Delta z_{is}] - \sigma_{uv} & |t - s| = 1 \\
= & \quad \mu Cov[\Delta z_{it}, \Delta z_{is}] & |t - s| = 2 \\
= & \quad 0 & |t - s| > 2
\end{aligned}$$

Three component model. This is the same as the two component model with a change to the variance terms

$$\begin{aligned}
Cov(\Delta log(h_{i,t})\Delta log(h_{i,s})) = & \quad \mu^2 Var[\Delta z_{it}] + 2\sigma_{uu} + var[\epsilon_{1it}] & |t = s| \\
Cov(\Delta log(g_{i,t})\Delta log(g_{i,s})) = & \quad Var[\Delta z_{it}] + 2\sigma_{vv} + var[\epsilon_{2it}] & |t = s| \\
Cov(\Delta log(h_{i,t})\Delta log(g_{i,s})) = & \quad \mu Var[\Delta z_{it}] + 2\sigma_{uv} + cov[\epsilon_{1it}, \epsilon_{2it}] & |t = s|
\end{aligned}$$

After specifying the covariance structure of each model I minimise the equally weighted and optimal minimum distance estimators in equations 1 and 2 respectively[1].

[1]It's worth noting that the variance matrix is not invertible so we use the generalise (or pseudo) inverse. This arises because the rank of the variance matrix is larger the number of observations we have to computed the variance matrix.

$$(m - f(b))'I(m - f(b)) \tag{1}$$
$$(m - f(b))'V^{-1}(m - f(b)) \tag{2}$$

where m is a vector of covariances being tested and f(b) a vector of parameters to be estimated. I is the identity and V is the matrix of fourth moments income and earnings, i.e. it is the variance-covariance matrix of the vector m.

Following the appendix of Abowd and Card, when we have an estimate $\hat{b}$ that minimises a quadratic form (m-f(b))'A(m-f(b)), where A is a positive definite matrix, then we know

$$\begin{aligned} (m &- f(\hat{b}))'R^{-1}(m - f(\hat{b})) \\ R &= PVP' \\ P &= I - F(F'AF)^{-1}F'A \end{aligned} \tag{3}$$

converges in distribution to χ^2 with degrees of freedom equal to the dimension of m minus the rank of F. F is the Jacobian matrix of f() evaluated at $\hat{b}$.

For each model I minimise the relevant estimator in equations 1 or 2 and then use equation 3 to calculate the goodness of fit statistic and the p-values. Convergence is quick. Finally, I convert the estimated μ into an elasticity of intertemporal labor supply using the following relationship

$$\eta = \frac{1}{\mu - 1}.$$

Results. Tables 4-6 present the results of this estimation exercise. I reject the hypotheses that all but two of the models fit the data. For all but the unrestricted MA models I find the probability that the estimated parameters equal the data is zero. I fail to reject the unrestricted MA(1) and MA(2) models. This provides evidence that auto-covariances with lags greater than 1 are zero.

The remaining models are rejected, implying there is little evidence that the covariance structure imposed fit the data.

Moving forward with our estimate of μ from the two and three-component models we can estimate the elasticity of intertemporal labor supply, i.e. a Frisch elasticity. The results range from -1.83 to 13.02. The variation is consistent with Abowd and Card who also find both positive and negative numbers. However the magnitude of all these estimates seem unrealistic given the small yet positive elasticities estimated in plausibly causal studies such as Cesarini and coauthors'(2017) lottery study.

Why do our results differ from Abowd and Card who find more evidence in favour of the two and three-component models? Our data differ in two dimensions: we have a longer time period yet fewer people in the sample. Having fewer people (n=182) in our sample means the variance-covariance for each year (e.g. $Cov(g_{96}, g_{97})$) is less well estimated. The longer time sample means we have we have more estimates for each lag (e.g. $Cov(g_t, g_{t-2})$). For instance we have 27 auto-covariances of lag 2, whereas Abowd and Card have only 7. While it is hard to see how this directly feeds into our estimates my intuition is as follows. Having more observations for the auto-covariances makes it easier to find evidence for a simple structure, such as later lags being zero. This test imposes little structure, so having more observations (in terms of lags) helps the estimation error in the covariances wash out. If the later lags are truely zero then we can still see this on average.

The other models impose a stronger structure on the variances and first two auto-covariances. However, our smaller sample size (in terms of individuals) means each covariances are less well estimated. Thus we are trying to estimate more parameters from noisy estimates of the covariances. To give an example, the three-component model estimates μ^2, $Var[\Delta z_{it}]$ and σ_{uu} from noisy estimates of the variance of earnings.

It is hard to compare our estimates to Abowd and Card without knowing if the longer time series or smaller sample size is contributing to the results. That said, my exercise has presented more evidence in favour of unrestricted MA processes for earnings. This is in contrast to Abowd and Card who find more evidence in favour of their two and three-component models.

Table 4: Equally weighted minimum distance

	Goodness of fit	Degrees of freedom	P-value	Mu	s.e. (mu)
Nonstationary MA(2)	35	1404	1.0		
Stationary MA(2)	3422	296	0		
Nonstationary MA(1)	42	108	1.0		
Measurement error	4421	196	0		
Symmetric MA(2)	3590	298	0		
Two-component model	4276	246	0	1.77	5E-06
Three-component model	3190	188	0	1.08	1E-05

Table 5: Optimally weighted minimum distance

	Goodness of fit	Degrees of freedom	P-value	Mu	s.e. (mu)
Two-component model	792	246	1E-58	0.45	8E-09
Three-component model	238696	188	0	0.44	1E-07

Table 6: Estimates of the Elasticity of Intertemporal Labor Supply

	Equally weighted	**Optimal**
2 factor model	1.30	-1.83
3 factor model	13.02	-1.79

Table 7: Covariance Matrix (1)

	g 67-68	g 68-69	g 69-70	g 70-71	g 71-72	g 72-73	g 73-74	g 74-75	g 75-76	g 76-77	g 77-78
g 67-68	0.14	0.00	-0.03	-0.02	-0.02	-0.02	0.00	0.00	-0.01	0.00	0.00
g 68-69	0.00	0.12	-0.06	0.01	-0.03	0.00	-0.02	-0.02	0.02	0.00	0.00
g 69-70	-0.03	-0.06	0.27	-0.11	0.02	0.00	0.01	-0.01	0.00	-0.01	0.01
g 70-71	-0.02	0.01	-0.11	0.19	0.00	0.00	0.00	0.00	-0.02	0.00	0.00
g 71-72	-0.02	-0.03	0.02	0.00	0.16	-0.06	0.00	-0.02	0.01	-0.01	0.00
g 72-73	-0.02	0.00	0.00	0.00	-0.06	0.13	-0.05	0.01	-0.01	0.00	0.00
g 73-74	0.00	-0.02	0.01	0.00	0.00	-0.05	0.09	-0.02	0.00	0.00	-0.01
g 74-75	0.00	-0.02	-0.01	0.00	-0.02	0.01	-0.02	0.10	-0.05	-0.02	0.00
g 75-76	-0.01	0.02	0.00	-0.02	0.01	-0.01	0.00	-0.05	0.13	-0.02	-0.02
g 76-77	0.00	0.00	-0.01	0.00	-0.01	0.00	0.00	-0.02	-0.02	0.07	0.00
g 77-78	0.00	0.00	0.01	0.00	0.00	0.00	-0.01	0.00	-0.02	0.00	0.06
g 78-79	0.01	0.00	-0.01	-0.01	0.01	0.00	0.01	0.00	0.01	-0.02	-0.03
g 79-80	0.00	-0.01	0.02	0.00	0.00	-0.01	0.01	0.00	0.00	0.01	0.00
g 80-81	0.00	0.00	-0.01	0.01	0.01	-0.01	0.00	-0.01	-0.01	-0.01	0.00
g 81-82	0.00	-0.01	0.00	0.01	0.00	0.01	0.00	0.01	-0.02	0.00	-0.01
g 82-83	0.02	-0.01	0.00	-0.04	-0.01	0.00	-0.01	0.02	0.01	0.00	-0.01
g 83-84	-0.02	0.01	0.01	0.01	0.00	0.01	0.00	-0.03	0.03	0.00	-0.01
g 84-85	0.00	0.01	0.00	0.02	0.00	0.00	-0.01	0.00	-0.01	0.00	0.01
g 85-86	0.00	0.00	0.00	-0.01	0.00	-0.01	0.01	0.01	-0.01	0.00	-0.02
g 86-87	0.00	-0.01	0.01	-0.01	0.00	-0.01	0.02	-0.01	0.01	-0.02	0.01
g 87-88	0.00	0.00	0.00	0.01	0.02	-0.01	0.00	0.00	-0.01	0.01	0.00
g 88-89	0.00	0.00	0.00	0.00	-0.03	0.02	0.00	0.01	0.00	0.00	0.00
g 89-90	-0.01	0.00	0.01	0.00	-0.01	0.00	0.00	0.03	-0.02	0.00	0.00
g 90-91	0.02	0.01	-0.03	-0.02	0.01	0.00	0.01	0.01	0.00	-0.01	0.01
g 91-92	0.00	-0.01	0.04	-0.03	0.03	-0.02	-0.02	-0.01	0.02	0.01	0.00
g 92-93	0.00	0.00	-0.03	0.04	-0.03	0.02	0.00	-0.01	-0.02	0.00	0.02
g 93-94	0.00	0.00	0.01	0.01	0.02	-0.02	0.00	0.00	-0.01	0.01	0.00
g 94-95	-0.01	0.00	0.00	-0.01	-0.01	0.02	-0.01	-0.01	0.02	-0.01	-0.02
g 95-96	0.00	0.00	-0.04	0.03	0.02	-0.01	0.02	-0.03	0.02	-0.01	-0.01

Table 8: Covariance Matrix (2)

g 67-68	g 82-83	g 83-84	g 84-85	g 85-86	g 86-87	g 87-88	g 88-89	g 89-90	g 90-91	g 91-92	g 92-93	g 93-94
g 68-69	0.02	-0.02	0.00	0.00	0.00	0.00	0.00	-0.01	0.02	0.00	0.00	0.00
g 69-70	-0.01	0.01	0.01	0.00	-0.01	0.00	0.00	0.00	0.01	-0.01	0.00	0.00
g 70-71	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	-0.03	0.04	-0.03	0.01
g 71-72	-0.04	0.01	0.02	-0.01	-0.01	0.01	0.00	0.00	-0.02	-0.03	0.04	0.01
g 72-73	-0.01	0.00	0.00	0.00	0.00	0.02	-0.03	-0.01	0.01	0.03	-0.03	0.02
g 73-74	0.00	0.01	0.00	-0.01	-0.01	-0.01	0.02	0.00	0.00	-0.02	0.02	-0.02
g 74-75	-0.01	0.00	-0.01	0.01	0.02	0.00	0.00	0.00	0.01	-0.02	0.00	0.00
g 75-76	0.02	-0.03	0.00	0.01	-0.01	0.00	0.01	0.03	0.01	-0.01	-0.01	0.00
g 76-77	0.01	0.03	-0.01	-0.01	0.01	-0.01	0.00	-0.02	0.00	0.02	-0.02	-0.01
g 77-78	0.00	0.00	0.00	0.00	-0.02	0.01	0.00	0.00	-0.01	0.01	0.00	0.01
g 78-79	-0.01	-0.01	0.01	-0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.00
g 79-80	0.02	-0.04	0.00	0.00	0.00	-0.01	0.01	0.00	0.00	0.00	-0.01	0.00
g 80-81	-0.01	0.03	-0.01	-0.01	0.00	0.01	-0.01	0.01	-0.02	0.01	-0.02	0.01
g 81-82	-0.01	0.01	0.00	-0.01	0.00	0.00	-0.01	0.00	-0.01	0.00	0.02	0.00
g 82-83	-0.05	-0.03	-0.02	0.03	0.00	-0.01	0.00	0.01	0.00	-0.01	-0.03	0.01
g 83-84	0.16	-0.08	0.01	0.00	-0.02	-0.01	0.00	0.00	0.01	-0.02	0.01	0.00
g 84-85	-0.08	0.19	-0.03	-0.03	0.01	0.00	-0.01	-0.02	-0.01	0.03	0.00	0.02
g 85-86	0.01	-0.03	0.10	-0.04	-0.01	0.01	0.00	0.01	-0.01	-0.02	0.01	0.05
g 86-87	0.00	-0.03	-0.04	0.13	-0.03	-0.02	0.00	0.00	0.01	0.01	0.00	-0.04
g 87-88	-0.02	0.01	-0.01	-0.03	0.08	-0.01	0.00	-0.01	0.02	-0.02	0.01	-0.02
g 88-89	-0.01	0.00	0.01	-0.02	-0.01	0.11	-0.05	-0.01	-0.01	0.02	-0.01	-0.02
g 89-90	0.00	-0.01	0.00	0.00	0.00	-0.05	0.09	0.00	-0.01	-0.02	0.01	0.01
g 90-91	0.00	-0.02	0.01	0.00	-0.01	-0.01	0.00	0.13	-0.02	-0.05	-0.02	0.00
g 91-92	0.01	-0.01	-0.01	0.01	0.02	-0.01	-0.01	-0.02	0.27	-0.11	-0.06	-0.01
g 92-93	-0.02	0.03	-0.02	0.01	-0.02	0.02	-0.02	-0.05	-0.11	0.27	-0.10	0.00
g 93-94	0.01	0.00	0.01	0.00	0.01	-0.01	0.01	-0.02	-0.06	-0.10	0.26	-0.06
g 94-95	0.00	0.02	0.05	-0.04	-0.02	-0.02	0.01	0.00	-0.01	0.00	-0.06	0.31
g 95-96	0.03	-0.03	-0.04	0.04	0.01	0.01	0.00	0.00	0.01	-0.03	0.00	-0.19
h 67-68	-0.08	0.05	-0.01	-0.02	0.01	0.00	0.00	0.01	-0.02	0.02	-0.04	0.00

Table 9: Covariance Matrix (3)

g 67-68	h 67-68	h 68-69	h 69-70	h 70-71	h 71-72	h 72-73	h 73-74	h 74-75	h 75-76	h 76-77	h 77-78
g 68-69	0.06025	0.02	-0.04	0.00	-0.03	0.00	-0.01	0.01	0.00	0.00	-0.01
g 69-70	0.0131	0.05	-0.04	-0.01	0.00	-0.02	-0.01	-0.01	0.01	0.01	0.00
g 70-71	-0.0225	-0.03	0.15	-0.06	0.01	0.03	-0.02	0.02	-0.01	0.00	0.00
g 71-72	0.00178	-0.01	-0.03	0.08	0.00	0.00	0.01	0.00	-0.01	0.00	0.01
g 72-73	-0.0205	-0.03	0.02	0.02	0.09	-0.03	-0.01	-0.01	0.01	-0.01	0.00
g 73-74	-0.0073	0.00	0.00	-0.01	-0.03	0.07	-0.03	0.01	-0.01	0.01	-0.01
g 74-75	-0.0114	-0.01	0.01	0.01	0.00	-0.02	0.04	-0.02	0.00	0.01	0.01
g 75-76	0.01645	0.00	-0.02	0.01	0.00	0.01	0.00	0.03	-0.03	-0.01	-0.01
g 76-77	-0.0173	0.00	0.00	-0.01	0.02	-0.01	-0.01	-0.03	0.07	-0.01	-0.01
g 77-78	-0.0023	0.00	0.01	0.00	-0.01	0.00	0.00	-0.01	-0.02	0.03	0.02
g 78-79	0.00611	0.01	0.01	0.00	-0.01	0.00	0.00	0.01	-0.01	0.00	0.01
g 79-80	-0.0197	0.01	-0.02	0.02	0.00	0.00	0.00	0.01	0.00	0.00	-0.01
g 80-81	0.01081	-0.01	0.01	0.00	0.01	0.01	-0.01	0.00	0.00	-0.01	0.00
g 81-82	-0.006	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
g 82-83	0.00701	-0.01	0.00	0.02	-0.02	0.01	0.00	0.01	-0.01	-0.01	0.01
g 83-84	0.00725	0.00	-0.01	0.00	-0.01	-0.02	0.01	-0.01	0.01	0.01	0.00
g 84-85	-0.0212	0.00	0.00	-0.01	0.03	0.02	-0.02	-0.02	0.01	-0.01	0.00
g 85-86	0.00773	0.01	0.02	-0.01	0.00	-0.01	0.01	0.01	0.01	0.00	0.00
g 86-87	0.00422	-0.01	0.00	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	-0.02
g 87-88	0.00588	-0.01	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.00
g 88-89	0.02091	-0.01	0.01	0.00	0.02	-0.01	-0.01	0.00	-0.01	0.01	0.00
g 89-90	-0.0042	0.00	-0.01	0.00	-0.02	0.01	0.01	0.00	0.00	-0.01	0.00
g 90-91	0.00283	0.00	0.01	0.00	0.00	-0.01	0.00	0.03	-0.02	0.00	-0.01
g 91-92	-0.0016	0.01	-0.02	-0.01	0.00	0.00	0.01	-0.01	0.01	-0.01	0.01
g 92-93	-0.0073	-0.02	0.03	0.01	0.01	0.00	-0.02	-0.03	0.01	0.01	-0.01
g 93-94	0.01309	0.01	-0.02	-0.01	-0.01	0.00	0.01	0.02	0.00	0.00	-0.01
g 94-95	-0.0006	0.01	0.00	-0.01	0.01	-0.01	0.01	0.00	0.02	-0.01	0.02
g 95-96	0.0023	-0.01	0.00	0.01	-0.01	0.01	-0.01	0.00	-0.02	0.01	-0.02
h 67-68	-0.014	0.00	0.00	0.01	-0.01	-0.01	0.00	-0.01	0.01	-0.01	0.02

Table 10: Covariance Matrix (4)

g 67-68	h 81-82	h 82-83	h 83-84	h 84-85	h 85-86	h 86-87	h 87-88	h 88-89	h 89-90	h 90-91	h 91-92	h 92-93
g 68-69	0.00	0.01136	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.0
g 69-70	0.00	-0.005	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
g 70-71	0.00	0.00463	0.00	-0.01	-0.01	0.00	-0.01	0.01	0.01	0.00	0.00	-0.0
g 71-72	-0.01	-0.0089	0.00	0.02	-0.01	0.00	0.01	0.00	0.00	-0.02	-0.01	0.0
g 72-73	0.00	-0.0016	0.01	-0.01	0.00	0.01	0.01	-0.02	-0.01	0.01	0.03	-0.0
g 73-74	0.00	0.00506	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	-0.02	0.0
g 74-75	-0.01	-0.005	0.00	-0.01	0.02	0.00	0.00	0.01	0.00	0.00	-0.01	0.0
g 75-76	0.00	0.00065	-0.01	0.02	0.00	0.00	-0.01	0.00	0.01	0.00	-0.01	0.0
g 76-77	0.00	0.00572	0.02	-0.01	0.00	0.00	0.01	-0.01	0.00	0.00	0.02	-0.0
g 77-78	0.01	-0.0126	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
g 78-79	-0.01	-0.0004	0.00	0.01	-0.01	0.01	-0.01	0.00	0.00	0.00	0.00	0.0
g 79-80	0.00	0.03061	-0.03	-0.01	0.01	0.00	0.00	-0.01	0.01	-0.01	0.00	0.0
g 80-81	-0.01	-0.0215	0.03	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.01	-0.0
g 81-82	-0.01	0.00389	0.00	0.01	0.00	0.00	0.00	-0.01	0.00	0.00	0.01	0.0
g 82-83	0.01	0.00501	-0.02	-0.01	0.01	-0.01	0.00	0.02	-0.01	0.00	-0.02	0.0
g 83-84	0.00	0.03768	-0.02	0.00	0.00	-0.01	0.00	-0.01	0.02	0.00	0.00	-0.0
g 84-85	0.00	-0.0494	0.07	-0.01	0.00	0.00	0.00	0.00	-0.03	-0.01	0.03	-0.0
g 85-86	0.00	0.00974	-0.01	0.03	-0.01	-0.02	0.01	0.00	0.00	0.00	0.00	0.0
g 86-87	0.00	-0.0079	-0.02	-0.01	0.04	-0.01	-0.01	0.01	-0.01	0.01	-0.03	0.0
g 87-88	-0.01	0.00711	0.00	0.00	-0.01	0.03	-0.01	-0.01	0.00	0.00	0.00	0.0
g 88-89	-0.01	0.00153	0.01	0.00	-0.01	0.00	0.03	-0.03	0.01	-0.01	0.03	-0.0
g 89-90	0.00	-0.003	-0.02	0.02	-0.01	0.01	-0.02	0.04	0.00	0.00	-0.02	0.0
g 90-91	0.00	0.00736	-0.01	0.00	0.01	-0.02	0.00	0.02	0.06	0.00	-0.05	0.0
g 91-92	0.00	-0.0011	0.01	0.01	0.00	-0.01	0.00	-0.01	0.00	0.06	-0.03	-0.0
g 92-93	0.00	-0.0116	0.00	0.00	0.00	0.00	0.02	-0.01	-0.04	-0.02	0.09	-0.0
g 93-94	0.00	0.00713	0.01	-0.01	0.00	0.01	-0.03	0.01	-0.01	-0.02	-0.02	0.0
g 94-95	0.00	-0.0172	0.01	0.03	0.00	-0.02	0.00	0.00	-0.02	0.00	-0.01	0.0
g 95-96	0.00	0.01286	-0.03	-0.02	0.00	0.03	0.00	-0.01	0.00	0.00	0.00	-0.0
h 67-68	0.00	-0.0074	0.01	-0.01	0.00	-0.02	0.02	-0.01	0.00	0.00	0.01	0.0

Table 11: Covariance Matrix (5)

h 67-68	0.11178	0.00	-0.02	-0.01	-0.02	-0.01	0.01	0.00	0.00	-0.01	0.00
h 68-69	0.00462	0.09	-0.04	-0.02	-0.03	-0.01	0.00	0.00	0.01	0.00	0.00
h 69-70	-0.0209	-0.04	0.20	-0.08	-0.01	0.01	0.00	0.00	0.00	0.01	0.02
h 70-71	-0.0121	-0.02	-0.08	0.14	-0.01	0.00	0.00	0.00	-0.01	0.00	-0.01
h 71-72	-0.0208	-0.03	-0.01	-0.01	0.16	-0.03	-0.03	0.00	0.01	-0.01	-0.01
h 72-73	-0.0117	-0.01	0.01	0.00	-0.03	0.08	-0.03	0.01	-0.02	0.00	-0.01
h 73-74	0.00693	0.00	0.00	0.00	-0.03	-0.03	0.09	-0.04	0.00	0.00	0.01
h 74-75	0.0033	0.00	0.00	0.00	0.00	0.01	-0.04	0.09	-0.04	-0.01	0.00
h 75-76	-0.0031	0.01	0.00	-0.01	0.01	-0.02	0.00	-0.04	0.10	-0.04	-0.02
h 76-77	-0.0066	0.00	0.01	0.00	-0.01	0.00	0.00	-0.01	-0.04	0.06	0.00
h 77-78	-0.0008	0.00	0.02	-0.01	-0.01	-0.01	0.01	0.00	-0.02	0.00	0.11
h 78-79	0.00474	0.01	-0.03	0.01	0.00	0.02	-0.03	0.01	0.01	-0.01	-0.08
h 79-80	-0.0077	-0.01	0.01	0.01	0.01	-0.01	0.01	0.00	0.00	-0.01	-0.01
h 80-81	0.00241	0.00	0.00	0.00	0.00	0.00	0.01	-0.01	0.01	0.00	0.00
h 81-82	-0.0092	0.00	-0.01	0.01	0.00	0.01	0.00	0.00	-0.01	0.01	0.00
h 82-83	0.00245	0.00	-0.01	0.02	-0.02	0.00	-0.01	0.01	0.00	0.00	0.00
h 83-84	0.00864	0.00	0.01	-0.02	0.02	0.00	-0.01	0.00	0.01	0.00	0.00
h 84-85	0.00386	0.00	0.01	-0.01	0.00	0.00	0.01	0.00	0.00	-0.01	0.00
h 85-86	-0.0157	0.01	-0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	-0.01
h 86-87	0.00422	-0.01	0.00	0.00	0.01	0.01	-0.01	0.00	-0.01	0.00	0.00
h 87-88	0.00702	0.00	0.00	0.00	0.02	-0.01	-0.01	0.00	0.00	0.00	0.00
h 88-89	-0.0074	0.01	0.01	0.00	-0.02	0.01	0.01	0.00	0.01	-0.01	-0.01
h 89-90	0.01098	0.00	-0.01	0.01	-0.01	0.00	0.01	0.01	-0.01	0.00	0.01
h 90-91	-0.0035	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
h 91-92	-0.0036	-0.01	0.01	0.00	0.02	-0.02	-0.02	-0.02	0.02	0.00	0.00
h 92-93	0.012	0.01	-0.02	0.01	-0.01	0.01	0.02	0.03	-0.02	0.00	0.00
h 93-94	-0.0107	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	0.01	0.00	0.00
h 94-95	0.00102	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.01	0.00	0.00
h 95-96	0.00494	-0.01	-0.01	0.00	0.02	-0.01	-0.01	0.00	-0.01	0.01	-0.01

Table 12: Covariance Matrix (6)

h 67-68	-0.0092	0.00	0.01	0.00	-0.02	0.00	0.01	-0.01	0.01	0.00	0.00	0.0
h 68-69	-0.0003	0.00	0.00	0.00	0.01	-0.01	0.00	0.01	0.00	0.00	-0.01	0.0
h 69-70	-0.0068	-0.01	0.01	0.01	-0.01	0.00	0.00	0.01	-0.01	0.00	0.01	-0.0
h 70-71	0.00502	0.02	-0.02	-0.01	0.00	0.00	0.00	0.00	0.01	-0.01	0.00	0.0
h 71-72	0.00022	-0.02	0.02	0.00	0.00	0.01	0.02	-0.02	-0.01	0.00	0.02	-0.0
h 72-73	0.0062	0.00	0.00	0.00	0.00	0.01	-0.01	0.01	0.00	0.00	-0.02	0.0
h 73-74	-0.0045	-0.01	-0.01	0.01	0.01	-0.01	-0.01	0.01	0.01	0.00	-0.02	0.0
h 74-75	0.00171	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	-0.02	0.0
h 75-76	-0.0074	0.00	0.01	0.00	0.00	-0.01	0.00	0.01	-0.01	0.00	0.02	-0.0
h 76-77	0.00716	0.00	0.00	-0.01	0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.0
h 77-78	0.00136	0.00	0.00	0.00	-0.01	0.00	0.00	-0.01	0.01	0.00	0.00	0.0
h 78-79	0.00653	0.03	-0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0
h 79-80	-0.0059	-0.02	0.02	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.01	0.0
h 80-81	-0.0142	-0.01	0.00	0.01	0.01	-0.01	0.00	0.00	0.00	0.00	-0.01	0.0
h 81-82	0.03279	-0.01	0.00	-0.01	0.00	0.00	0.00	0.01	0.00	0.00	-0.01	0.0
h 82-83	-0.0104	0.07	-0.04	0.00	-0.01	0.00	0.00	-0.01	0.01	0.01	0.00	-0.0
h 83-84	-0.0015	-0.04	0.11	-0.05	0.00	0.00	0.01	-0.01	-0.01	0.00	0.02	-0.0
h 84-85	-0.0066	0.00	-0.05	0.10	-0.04	-0.01	0.01	0.00	0.00	0.00	0.03	-0.0
h 85-86	0.00108	-0.01	0.00	-0.04	0.07	-0.02	-0.01	0.01	0.00	0.00	-0.03	0.0
h 86-87	-0.0027	0.00	0.00	-0.01	-0.02	0.05	-0.02	0.00	-0.01	0.00	0.00	0.0
h 87-88	-0.0034	0.00	0.01	0.01	-0.01	-0.02	0.05	-0.03	0.00	0.00	0.03	-0.0
h 88-89	0.00639	-0.01	-0.01	0.00	0.01	0.00	-0.03	0.19	-0.14	0.00	-0.03	0.0
h 89-90	-0.0022	0.01	-0.01	0.00	0.00	-0.01	0.00	-0.14	0.22	-0.03	-0.03	-0.0
h 90-91	-0.0023	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.03	0.08	-0.03	0.0
h 91-92	-0.0081	0.00	0.02	0.03	-0.03	0.00	0.03	-0.03	-0.03	-0.03	0.19	-0.1
h 92-93	0.00385	-0.01	-0.01	-0.02	0.02	0.01	-0.02	0.02	-0.01	0.00	-0.12	0.1
h 93-94	0.00032	0.00	0.01	-0.01	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	-0.0
h 94-95	0.005	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0
h 95-96	-0.0006	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.01	0.0