Structural Macroeconometrics

Errata

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Notice Regarding Code

We have found a programming error in the file `stogrow.src` posted under the heading "Solve Stochastic Optimal Growth Model Using Log-Linearization" on the textbook web site. Code downloaded prior to 9/1/07 should be adjusted as follows: the appearance of `xbar` as a local variable in the procedure `modelsol.p` should be eliminated. `xbar` must remain global, so that modifications performed within the procedure have global impact.

Several results reported in the text have been tainted by this error. Full details are provided below. In brief, the affected results are as follows:

- The moment comparisons reported in Table 6.4.
- The moment-matching exercise in Section 7.4 (Tables 7.1-7.3).
- The comparison of asset-pricing models in Section 9.7.
- The model simulations reported in Table 11.1.
- The maximum likelihood estimates in Table 11.2 (third column).

Chapter 2, Section 2.1.3, Examples

The approximation in equation (2.7) should be

$$\left[\frac{\partial \log\left[\Psi_1\right]}{\partial \log(x_{zt})}(\overline{z}) - \frac{\partial \log\left[\Psi_2\right]}{\partial \log(z_t)}(\overline{z})\right] = \left[1 \quad \frac{-\overline{c}}{\overline{c}+\overline{i}} \quad \frac{-\overline{i}}{\overline{c}+\overline{i}}\right].$$

Chapter 2, Section 2.2.2, Sims's Method

On the fourth line of p. 25, the matrix

$$[I - \Phi]$$

should instead be

$$[I \quad -\Phi].$$

With z_1 being $n_s \times 1$ and z_2 being $n_c \times 1$, such that $n_s + n_c = 1$, then in this case I is $n_s \times n_s$ and Φ is $n_s \times n_c$.

Again on p. 25, there is a problem with equation (2.50). In the text, the equation reads

$$\Theta_0 = Z\Lambda_{11}^{-1}[\Omega_{11}(\Omega_{12} - \Phi\Omega_{22})]Z'.$$

Instead, defining $Z_{\cdot 1}$ as the $n \times n_s$ matrix containing the first through $n_s th$ columns of Z, the equation should read

$$\Theta_0 = Z_{\cdot 1}\Lambda_{11}^{-1}[\Omega_{11} \quad (\Omega_{12} - \Phi\Omega_{22})]Z.$$

1 Chapter 4, Section 4.1.2, The VAR Model

In equation (4.30), the matrix $\Sigma = E\left(\varepsilon_t \varepsilon_t'\right)$ should be replaced by $\Sigma_e = E\left(e_t e_t'\right)$, where

$$e_t = \left[\varepsilon_{1t} \quad 0...0 \quad \varepsilon_{2t} \quad 0...0 \quad ...\varepsilon_{mt} \quad 0...0\right]',$$

as defined on the last line of p. 63. Thanks to Surach Tanboon for pointing out this error.

2 Chapter 4, Section 4.3, The Kalman Filter

Equation (4.57) should read

$$vec(P_{1|0}) = \left(I - F \otimes F\right)^{-1} vec(Q).$$

Existence requires that the eigenvalues of F be less than 1. Thanks to Michael Hauser for pointing out this error.

On the right-hand side of equation (4.63), x_{t-1} should instead be $x_{t-1|t-1}$. In the following line, the term $P_{t|t-1}$ on the right-hand side should instead be $P_{t-1|t-1}$. In light of this second issue, equation (4.64) (the updating equation for $P_{t|t-1}$) is seen to be incorrect. Instead, it should read

$$P_{t|t-1} = FP_{t-1|t-1}F' + Q.$$

Thanks to Roberto Chang for pointing out this error.

On p. 84, the expression for J_t just above equation (4.71) should read

$$J_t = P_{t|t}F'P_{t+1|t}^{-1}.$$

Thanks to Andres Fernandez for pointing out this error.

Equation (4.72) should read

$$\widehat{x}_{T-2|T} = \widehat{x}_{T-2|T-2} + J_{T-2}(\widehat{x}_{T-1|T} - \widehat{x}_{T-1|T-2}).$$

Thanks to Michael Hauser for pointing out this error.

Chapter 6, Section 6.4

The moment comparisons reported in Table 6.4 are affected by the programming error involving `xbar` noted above under "Notice Regarding Code". Table 6.4 should read as follows:

Table 6.4. Moment Comparison

	H-P Filtered Data					RBC Model				
j	σ_j	$\frac{\sigma_j}{\sigma_y}$	$\varphi(1)$	$\varphi_{j,y}(0)$	$\varphi_{j,y}(1)$	σ_j	$\frac{\sigma_j}{\sigma_y}$	$\varphi(1)$	$\varphi_{j,y}(0)$	$\varphi_{j,y}(1)$
y	0.0177	1.00	0.86	1.00	0.86	0.0184	1.00	0.79	1.00	0.79
c	0.0081	0.46	0.83	0.82	0.75	0.0085	0.46	0.96	0.77	0.62
i	0.0748	4.23	0.79	0.95	0.80	0.0799	4.34	0.74	0.95	0.75
n	0.0185	1.05	0.90	0.83	0.62	0.0087	0.47	0.73	0.91	0.72

Notes: $\varphi(1)$ denotes first-order serial correlation; $\varphi_{j,y}(l)$ denotes $l-th$ order correlation between variables j and y. Model moments based on the parameterization $\mu = [\alpha\ \beta\ \phi\ \varphi\ \delta\ \rho\ \sigma]' = [0.24\ 0.99\ 1.5\ 0.35\ 0.025\ 0.78\ 0.0067]'$.

Substantively, this change casts the performance of the model along the investment dimension in a relatively more favorable light. The poor performance noted in the text along the hours dimension remains evident.

Chapter 7, Section 7.4

The moment-matching exercise conducted in this section are affected by the programming error involving `xbar` noted above under "Notice Regarding Code". Tables 7.1-7.3 should read as follows:

Table 7.1. Baseline Moment Comparison

Moment	Point Estimate	Std. Err.	Model Moment	$t-$stat
σ_y	0.0177	0.0019	0.0184	-0.41
σ_c	0.0081	0.0008	0.0085	-0.47
σ_i	0.0748	0.0070	0.0799	-0.74
σ_n	0.0185	0.0021	0.0087	4.62
$\varphi_y(1)$	0.8642	0.0199	0.7947	3.50
$\varphi_c(1)$	0.8318	0.0293	0.9601	-4.38
$\varphi_i(1)$	0.7891	0.0307	0.7367	1.71
$\varphi_n(1)$	0.8992	0.0144	0.7290	11.78
$\varphi_{y,c}(0)$	0.8237	0.0379	0.7782	1.20
$\varphi_{y,i}(0)$	0.9502	0.0101	0.9459	0.42
$\varphi_{y,n}(0)$	0.8342	0.0241	0.9107	-3.18
$\varphi_{y,c}(1)$	0.7467	0.0436	0.7591	-0.28
$\varphi_{y,i}(1)$	0.7991	0.0355	0.6790	3.38
$\varphi_{y,n}(1)$	0.6230	0.0396	0.6312	-0.21

Notes: $\varphi(1)$ denotes first-order serial correlation; $\varphi_{j,y}(l)$ denotes $l-th$ order correlation between variables j and y. Model moments based on the parameterization $\theta = [\alpha\ \beta\ \phi\ \varphi\ \delta\ \rho\ \sigma]' = [0.24\ 0.99\ 1.5\ 0.35\ 0.025\ 0.78\ 0.0067]'$.

Table 7.2. Parameter Estimates

Parameter	Calibrated Value	All Moments	C Subset	I Subset	N Subset
α	0.24	0.1860	0.1792	0.3224	0.1791
		$(8.81e-6)$	$(4.89e-4)$	(0.0013)	$(2.41e-5)$
β	0.99	0.9983	0.9990	0.9916	0.9990
	$[0.9877, 0.999]$	$(1.17e-6)$	$(1.12e-4)$	$(7.27e-5)$	$(5.52e-6)$
δ	0.025	0.0267	0.0400	0.0100	0.0400
	$[0.01, 0.04]$	$(3.76e-5)$	$(5.07e-9)$	$(3.20e-9)$	$(4.07e-8)$
ϕ	1.5	1.184	2.4999	2.0512	1.0206
	$[0.5, 2.5]$	(0.0089)	(0.0031)	(0.3812)	(13.484)
φ	0.35	0.3364	0.3345	0.3785	0.3345
		$(2.24e-6)$	$(1.33e-4)$	$(4.48e-4)$	$(6.56e-6)$
ρ	0.78	0.8952	0.6000	0.8166	0.9499
	$[0.6, 0.95]$	(0.0075)	(0.5728)	(0.0593)	(1.4438)
σ	0.0067	0.0051	0.0099	0.0062	0.0006
	$(0, 0.01]$	$(2.04e-4)$	(0.0437)	(0.0018)	(0.0045)

Notes: Brackets reported under calibrated parameter values indicate range restrictions. Also, parentheses reported under parameter estimates indicate standard errors. Finally, moments included under J Subset are σ_y, σ_j, $\varphi_j(1)$, $\varphi_{y,j}(0)$ and $\varphi_{y,j}(1)$, $j = c, i, n$.

Table 7.3. Moment Comparisons Using Model Estimates

Moment	All Moments	C Subset	I Subset	N Subset
σ_y	0.0195 (−0.98)	0.0212 (−1.88)	0.0178 (−0.056)	0.0028 (7.96)
σ_c	0.0109 (−3.27)	0.0084 (−0.36)	XX	XX
σ_i	0.0739 (0.13)	XX	0.0784 (−0.52)	XX
σ_n	0.0079 (4.96)	XX	XX	0.0001 (8.39)
$\varphi_y(1)$	0.8952 (−1.56)	XX	XX	XX
$\varphi_c(1)$	0.9801 (−5.05)	0.8427 (−0.37)	XX	XX
$\varphi_i(1)$	0.8430 (−1.76)	XX	0.8031 (−0.46)	XX
$\varphi_n(1)$	0.8334 (4.55)	XX	XX	0.8520 (3.26)
$\varphi_{y,c}(0)$	0.8400 (−0.43)	0.8597 (−2.16)	XX	XX
$\varphi_{y,i}(0)$	0.9262 (2.38)	XX	0.9589 (−0.87)	XX
$\varphi_{y,n}(0)$	0.8691 (−1.45)	XX	XX	0.7313 (4.27)
$\varphi_{y,c}(1)$	0.8408 (−2.16)	0.6961 (−1.16)	XX	XX
$\varphi_{y,i}(1)$	0.7674 (0.89)	XX	0.7623 (1.04)	XX
$\varphi_{y,n}(1)$	0.6870 (−1.87)	XX	XX	0.59700 (0.66)

Notes: $\varphi(1)$ denotes first-order serial correlation; $\varphi_{j,y}(l)$ denotes $l-th$ order correlation between variables j and y. $t-$statistics indicating discrepancies with empirical counterparts provided in parentheses. XX denotes unestimated moment.

Based on the incorrect figures reported in the text, we noted that "... although the standard RBC model is well-known to have difficulties in characterizing the behavior of hours, we have also found its performance along the consumption dimension to be disappointing." In light of these corrected figures, this conclusion is no longer valid: e.g., only one of the five t statistics reported in the revised Table 7.3 under "C Subset"exceeds 2 in absolute value.

3 Chapter 9, Section 9.4.1

The expression for $s.e.(\overline{g}_N)_I$ in equation (9.26) should be modified by taking the square root of the right-hand side.

Chapter 9, Section 9.7

The model-estimation exercise conducted in this section are affected by the programming error involving `xbar` noted above under "Notice Regarding Code". In this case, changes from flawed to corrected results are minimal, and the substantive conclusions drawn from the exercise remain intact. In particular, differences in posterior means reported in Tables 9.3 and 9.4 are less than one half of one posterior standard deviation in all cases. The most significant change is in the posterior-odds comparison reported in the last full paragraph of p. 262: the previous odds of 2.4:1 in favor of the self-control specification drop to 1.6:1 given the correction.

Given the minimal changes in corrected results, Figures 9.3-9.7 are not reproduced here. Corrected versions of Tables 9.3 and 9.4 are as follows:

Table 9.3. Parameter Estimates

	β	γ	λ	ϕ	ρ_d	ρ_q	$\sigma_{\varepsilon d}$	$\sigma_{\varepsilon q}$	$\chi_{\varepsilon_d,\varepsilon_q}$	$\frac{\overline{q}}{d}$
Means:										
Prior	0.960	2.000	0.0000	0.4	0.900	0.900	UN	UN	UN	10.00
CRRA	0.958	2.914	NA	NA	0.877	0.914	0.114	0.096	0.311	10.75
Self-Con.	0.967	2.04	0.00294	0.32	0.879	0.910	0.114	0.149	0.320	7.54
Std. Dev.:										
Prior	0.020	1.000	0.01	0.2	0.050	0.050	UN	UN	UN	5.00
CRRA	0.004	0.826	NA	NA	0.033	0.027	0.007	0.034	0.130	4.44
Self-Con.	0.008	0.598	0.00330	0.16	0.029	0.023	0.007	0.043	0.124	3.65

Posterior Correlations

	$\gamma, \sigma_{\varepsilon q}$	$\gamma, \chi_{\varepsilon_d,\varepsilon_q}$	$\sigma_{\varepsilon q}, \chi_{\varepsilon_d,\varepsilon_q}$	$\chi_{\varepsilon_d,\varepsilon_q}, \frac{\overline{q}}{d}$
CRRA	-0.839	-0.337	0.201	0.557
Self-Con.	-0.850	-0.298	0.164	0.556

Notes: UN denotes "uninformative prior"; NA denotes "not applicable"; and $\chi_{x,y}$ denotes correlation between x and y.

Table 9.4. Summary Statistics

	σ_p	σ_d	$\frac{\sigma_d}{\sigma_p}$	$\chi_{p,d}$
Means:				
VAR	0.620	0.268	0.448	0.672
CRRA	0.434	0.244	0.571	0.536
Self-Control	0.418	0.248	0.608	0.564
Std. Dev.:				
VAR	0.183	0.065	0.095	0.178
CRRA	0.067	0.041	0.101	0.079
Self-Control	0.069	0.035	0.125	0.101

Notes: VAR statistics summarize flat-prior posterior distributions associated with a six-lag vector autoregression; σ_x denotes the standard deviation of the logged deviation of x from its steady state value; and $\chi_{x,y}$ denotes the correlation between logged deviations from steady state values of x and y.

Chapter 10, Section 10.2.4, Implementation

In equation (10.33), the roots of $T_r(s)$ should be expressed as

$$\widehat{s}_j = \cos\left(\frac{(2j-1)}{r}\frac{\pi}{2}\right), \quad j = 1, 2, ..., r.$$

Chapter 10, Section 10.2.6, Application to the Optimal Growth Model

In equation (10.53), the ratios $\frac{x^*}{c^*}$, $x = a, k$ should instead be $\frac{c^*}{x^*}$.

Chapter 11, Section 11.1

The model-estimation exercise conducted in this section are affected by the programming error involving `xbar` noted above under "Notice Regarding Code". Table 11.1 should read as follows:

Table 11.1. Model Simulations.

	Linear Approximation				Non-Linear Approximation			
j	σ_j	$\frac{\sigma_j}{\sigma_y}$	$\varphi(1)$	$\varphi_{j,y}(0)$	σ_j	$\frac{\sigma_j}{\sigma_y}$	$\varphi(1)$	$\varphi_{j,y}(0)$
y	0.0153	1.00	0.90	1.00	0.0151	1.00	0.89	1.00
c	0.0110	0.72	0.97	0.95	0.0109	0.72	0.96	0.95
i	0.0330	2.16	0.80	0.94	0.0330	2.19	0.79	0.94
k	0.0189	1.24	0.99	0.86	0.0184	1.22	0.99	0.76
a	0.0112	0.73	0.80	0.93	0.0112	0.74	0.80	0.94

Notes: $\varphi(1)$ denotes first-order serial correlation; $\varphi_{j,y}(0)$ denotes contemporaneous correlation between variables j and y. Model moments based on the parameterization $\mu = [\alpha\ \beta\ \delta\ \phi\ \rho\ \sigma]' = [0.33\ 0.96\ 0.1\ 2.0\ 0.8\ 0.0067]'$.

Substantively, these corrections cast the differences observed across the linear and non-linear approximation techniques as relatively small in comparison with the differences noted in the text.

Chapter 11, Section 11.3

The estimation exercise conducted in this section are affected by the programming error involving `xbar` noted above under "Notice Regarding Code". Table 11.2 should read as follows:

Table 11.2. Maximum Likelihood Estimates

Parameter	Actual Value	Log-Lin. Appx.	Non-Lin. Appx.	Exact Policy Fcn.
α	0.33	0.331 (1.69e−04)	0.327 (1.11e−05)	0.327 (3.77e−05)
β	0.96	0.957 (4.88e−04)	0.968 (1.04e−04)	0.968 (3.52e−05)
ρ	0.80	0.789 (2.18e−03)	0.794 (5.10e−05)	0.809 (2.80e−05)
σ_{ε}	0.0067	0.0062 (5.36e−04)	0.0061 (1.01e−06)	0.0061 (1.08e−06)
$\sigma_{u,y}$	0.00284	0.00485 (5.45e−04)	0.00309 (2.77e−07)	0.00316 (6.90e−07)
$\sigma_{u,i}$	0.0090	0.00484 (5.12e−04)	0.00086 (7.81e−09)	0.00087 (6.76e−09)
$\log L$:		782.81	917.74	917.78

Notes: Standard deviations are in parentheses.

The substantive impact of these changes is minimal.