Appendix I. Regression Output for Section 10

Exhibit I-1. Non-HLM model for whole publication counts in an expanding journal set, referenced in footnote 39 in section 10.2

```
. regress pubwhle rdexpav rdexpch pstdocav pstdocch phdav phdch

      Source |       SS       df       MS              Number of obs =    2387
-------------+------------------------------           F(  6,  2380) = 6285.59
       Model |  2.0245e+09     6   337422622           Prob > F      =  0.0000
    Residual |   127762909  2380  53681.8946           R-squared     =  0.9406
-------------+------------------------------           Adj R-squared =  0.9405
       Total |  2.1523e+09  2386  902053.078           Root MSE      =  231.69

------------------------------------------------------------------------------
     pubwhle |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        cons |   98.17291   6.991847    14.04   0.000     84.46217    111.8837
     rdexpav |   .0050050   .0001529    32.74   0.000     .0047049    .0053045
     rdexpch |   .0035833   .0003475    10.31   0.000     .0029019    .0042647
    pstdocav |   1.752392    .026665    65.72   0.000     1.700103     1.80468
    pstdocch |   .6829881   .0882013     7.74   0.000     .5100288    .8559475
       phdav |   1.280022   .0817425    15.66   0.000     1.119728    1.440316
       phdch |   .9268645   .2884981     3.21   0.001     .3611308    1.492598
------------------------------------------------------------------------------

Note:
     cons = constant term in regression
     rdexpav = average R&D academic expenditure for institution over study years
     rdexpch = deviation from average R&D academic expenditure for institution
     pstdocav = average number of S&E postdoctorates for institution
     pstdocch = deviation from average number of S&E postdoctorates for institution
     phdav = average number of S&E Ph.D. recipients for institution
     phdch = deviation from average number of S&E Ph.D. recipients for institution
```

Exhibit I-2. HLM model for whole publication counts in an expanding journal set, referenced in footnote 40 in section 10.2

```
. xtmixed pubwhle rdexpav rdexpch pstdocav pstdocch phdav phdch || seq_inst_id:

Performing EM optimization:
Performing gradient-based optimization:
Computing standard errors:

Mixed-effects REML regression                   Number of obs      =      2387
Group variable: seq_inst_id                     Number of groups   =       200

                                                Obs per group: min =         6
                                                               avg =      11.9
                                                               max =        12


                                                Wald chi2(6)       =   7091.87
Log restricted-likelihood =  -14198.48          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
     pubwhle |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        cons |   97.73905   23.00457     4.24   0.000     52.59603    142.8821
     rdexpav |   .0050051   .0005058     9.90   0.000     .0040137    .0059965
     rdexpch |   .0036758    .000114    32.26   0.000     .0034525    .0038992
    pstdocav |   1.753123   .0878948    19.95   0.000     1.580852    1.925393
    pstdocch |   .6577186   .0289377    22.73   0.000     .6010017    .7144354
       phdav |   1.282554   .2702462     4.75   0.000     .7528817    1.812227
       phdch |   .8174343   .0949722     8.61   0.000     .6312922    1.003576
------------------------------------------------------------------------------

------------------------------------------------------------------------------
  Random-effects Parameters  |   Estimate   Std. Err.     [95% Conf. Interval]
-----------------------------+------------------------------------------------
```

```
seq_inst_id: Identity        |
                   sd(_cons) |   220.2537   11.23476      199.2989    243.4118
-----------------------------+------------------------------------------------
                sd(Residual) |    75.9213   1.148732      73.70288    78.20649
------------------------------------------------------------------------------
LR test vs. linear regression: chibar2(01) =  4405.79 Prob >= chibar2 = 0.0000
```

Note:

- cons = constant term in regression
- rdexpav = average R&D academic expenditure for institution over study years
- rdexpch = deviation from average R&D academic expenditure for institution
- pstdocav = average number of S&E postdoctorates for institution
- pstdocch = deviation from average number of S&E postdoctorates for institution
- phdav = average number of S&E Ph.D. recipients for institution
- phdch = deviation from average number of S&E Ph.D. recipients for institution

Exhibit I-3. Non-HLM model for fractional publication counts in an expanding journal set, referenced in footnote 41 in section 10.2

```
. regress pubfrct rdexpav rdexpch pstdocav pstdocch phdav phdch

      Source |       SS       df       MS              Number of obs =    2387
-------------+------------------------------           F(  6,  2380) = 5850.01
       Model |   840320169     6   140053362           Prob > F      =  0.0000
    Residual |    56978857  2380  23940.6962           R-squared     =  0.9365
-------------+------------------------------           Adj R-squared =  0.9363
       Total |   897299026  2386  376068.326           Root MSE      =  154.73

------------------------------------------------------------------------------
     pubfrct |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        cons |   54.67857   4.669242    11.71   0.000     45.52237    63.83477
     rdexpav |    .003829   .0001021    37.50   0.000     .0036288    .0040292
     rdexpch |   .0003875    .000232     1.67   0.095    -.0000675    .0008426
    pstdocav |   .9171116   .0178072    51.50   0.000     .8821924    .9520308
    pstdocch |   .2815274   .0589019     4.78   0.000      .166023    .3970318
       phdav |   .9177823   .0545886    16.81   0.000     .8107361    1.024828
       phdch |    .513306   .1926626     2.66   0.008      .135502    .8911099
------------------------------------------------------------------------------

Note:
     cons = constant term in regression
     rdexpav = average R&D academic expenditure for institution over study years
     rdexpch = deviation from average R&D academic expenditure for institution
     pstdocav = average number of S&E postdoctorates for institution
     pstdocch = deviation from average number of S&E postdoctorates for institution
     phdav = average number of S&E Ph.D. recipients for institution
     phdch = deviation from average number of S&E Ph.D. recipients for institution
```

Exhibit I-4. HLM model for fractional publication counts in an expanding journal set, referenced in footnote 42 in section 10.2

```
. xtmixed pubfrct rdexpav rdexpch pstdocav pstdocch phdav phdch || seq_inst_id:

Performing EM optimization:
Performing gradient-based optimization:
Computing standard errors:

Mixed-effects REML regression                   Number of obs      =      2387
Group variable: seq_inst_id                     Number of groups   =       200

                                                Obs per group: min =         6
                                                               avg =      11.9
                                                               max =        12


                                                Wald chi2(6)       =   3818.49
Log restricted-likelihood = -13124.311          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
     pubfrct |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        cons |   54.18839   15.46764     3.50   0.000     23.87237    84.50441
     rdexpav |   .0038287   .0003397    11.27   0.000     .0031629    .0044944
     rdexpch |   .0004426   .0000722     6.13   0.000     .0003011    .0005842
    pstdocav |   .9176322   .0590265    15.55   0.000     .8019424    1.033322
    pstdocch |   .2667259   .0183392    14.54   0.000     .2307816    .3026701
       phdav |   .9204914   .1814866     5.07   0.000     .5647843    1.276199
       phdch |    .446872   .0601887     7.42   0.000     .3289042    .5648397
------------------------------------------------------------------------------

------------------------------------------------------------------------------
  Random-effects Parameters  |   Estimate   Std. Err.     [95% Conf. Interval]
-----------------------------+------------------------------------------------
```

```
seq_inst_id: Identity        |
                   sd(_cons) |    147.994    7.54079      133.9284    163.5369
-----------------------------+------------------------------------------------
                sd(Residual) |   48.11498   .7280076      46.70906    49.56322
------------------------------------------------------------------------------
LR test vs. linear regression: chibar2(01) =  4632.29 Prob >= chibar2 = 0.0000
```

Note:

- cons = constant term in regression
- rdexpav = average R&D academic expenditure for institution over study years
- rdexpch = deviation from average R&D academic expenditure for institution
- pstdocav = average number of S&E postdoctorates for institution
- pstdocch = deviation from average number of S&E postdoctorates for institution
- phdav = average number of S&E Ph.D. recipients for institution
- phdch = deviation from average number of S&E Ph.D. recipients for institution

Exhibit I-5. Stepwise regression model for whole publication counts in an expanding journal set, referenced in footnote 43 in section 10.3

Stepwise Fit

Response:
Pubs - Whole Counts - Exp J Set (Chng)

Stepwise Regression Control

Prob to Enter	0.250
Prob to Leave	0.100

Direction:

636 rows not used due to missing values.

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
10891110	2150	5065.6326	0.6513	0.6501	8	18416.23

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	19.9893282	1	0	0.000	1.0000
	X	Acad R&D Exp-Fed Fin (Chng)	0.00459316	1	2197709	433.847	0.0000
	X	Acad R&D Exp-Non-Fed Fin (Chng)	0.00173521	1	383255.4	75.658	0.0000
	X	S&E PhD Recips (Chng)	0.76448866	1	334364.6	66.006	0.0000
	X	Fall Enroll-Grad Stu (Chng)	0.02611413	1	217576.3	42.951	0.0000
	X	Postdocs w/o MDs (Chng)	0.5519015	1	358333.7	70.738	0.0000
	X	Postdocs w/MDs supp by Fed Traineeships (Chng)	-3.5368905	1	519816.8	102.616	0.0000
	X	Postdocs supp by Fed Res Grants(Chng)	0.34508192	1	55787.84	11.013	0.0009

Step History

Step	Parameter	Action	"Sig Prob"	Seq SS	RSquare	Cp	p
1	Acad R&D Exp-Fed Fin (Chng)	Entered	0.0000	15963899	0.5112	859.66	2
2	Postdocs w/o MDs (Chng)	Entered	0.0000	2601914	0.5945	348.02	3
3	Acad R&D Exp-Non-Fed Fin (Chng)	Entered	0.0000	570759.2	0.6128	237.34	4
4	Postdocs w/MDs supp by Fed Traineeships (Chng)	Entered	0.0000	522515.5	0.6295	136.19	5
5	S&E PhD Recips (Chng)	Entered	0.0000	408089.7	0.6426	57.633	6
6	Fall Enroll-Grad Stu (Chng)	Entered	0.0000	215895.7	0.6495	17.013	7
7	Postdocs supp by Fed Res Grants(Chng)	Entered	0.0009	55787.84	0.6513	8	8

Exhibit I-6. Linear regression model for whole publication counts in an expanding journal set, referenced in footnote 43 in section 10.3

Response Pubs - Whole Counts - Exp J Set (Chng)
Summary of Fit

RSquare	0.650697
RSquare Adj	0.649964
Root Mean Square Error	72.17597
Mean of Response	24.52771
Observations (or Sum Wgts)	2387

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	23105853	4621171	887.0882
Error	2381	12403510	5209	Prob > F
C. Total	2386	35509363		0.0000

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack Of Fit	2376	12403453	5220.31	456.3207
Pure Error	5	57	11.44	Prob > F
Total Error	2381	12403510		<.0001
				Max RSq
				1.0000

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	20.797474	1.487897	13.98	<.0001
Acad R&D Exp-Fed Fin (Chng)	0.0049488	0.000203	24.42	<.0001
Acad R&D Exp-Non-Fed Fin (Chng)	0.0016989	0.000182	9.33	<.0001
S&E PhD Recips (Chng)	0.8116735	0.090033	9.02	<.0001
Postdocs w/o MDs (Chng)	0.7412513	0.03468	21.37	<.0001
Postdocs w/MDs supp by Fed Traineeships (Chng)	-3.26497	0.333762	-9.78	<.0001

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Acad R&D Exp-Fed Fin (Chng)	1	1	3105961.9	596.2260	<.0001
Acad R&D Exp-Non-Fed Fin (Chng)	1	1	453087.1	86.9754	<.0001
S&E PhD Recips (Chng)	1	1	423396.1	81.2759	<.0001
Postdocs w/o MDs (Chng)	1	1	2379873.1	456.8447	<.0001
Postdocs w/MDs supp by Fed Traineeships (Chng)	1	1	498504.9	95.6939	<.0001

Exhibit I-7. Stepwise regression model for fractional publication counts in an expanding journal set, referenced in footnote 44 in section 10.3

Stepwise Fit

Response:
Pubs - Fract Counts - Exp J Set (Chng)

Stepwise Regression Control

Prob to Enter	0.250
Prob to Leave	0.100

Direction:

636 rows not used due to missing values.

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
4440826.3	2150	2065.5006	0.2788	0.2764	8	16480.28

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	7.63908822	1	0	0.000	1.0000
	X	Acad R&D Exp-Fed Fin (Chng)	0.00086954	1	78762.81	38.133	0.0000
	X	Acad R&D Exp-Non-Fed Fin (Chng)	-0.0001885	1	4523.448	2.190	0.1391
	X	S&E PhD Recips (Chng)	0.32892874	1	61898.73	29.968	0.0000
	X	Fall Enroll-Grad Stu (Chng)	0.01886188	1	113509.1	54.955	0.0000
	X	Postdocs w/o MDs (Chng)	0.1203116	1	17028.62	8.244	0.0041
	X	Postdocs w/MDs supp by Fed Traineeships (Chng)	-1.1652812	1	56424.61	27.318	0.0000
	X	Postdocs supp by Fed Res Grants(Chng)	0.30726722	1	44231.09	21.414	0.0000

Step History

Step	Parameter	Action	"Sig Prob"	Seq SS	RSquare	Cp	p
1	Postdocs supp by Fed Res Grants(Chng)	Entered	0.0000	1176832	0.1911	257.34	2
2	Acad R&D Exp-Fed Fin (Chng)	Entered	0.0000	251201	0.2319	137.72	3
3	Fall Enroll-Grad Stu (Chng)	Entered	0.0000	143277.4	0.2552	70.355	4
4	Postdocs w/MDs supp by Fed Traineeships (Chng)	Entered	0.0000	64237.11	0.2656	41.255	5
5	S&E PhD Recips (Chng)	Entered	0.0000	60972.77	0.2756	13.735	6
6	Postdocs w/o MDs (Chng)	Entered	0.0061	15584.98	0.2781	8.19	7
7	Acad R&D Exp-Non-Fed Fin (Chng)	Entered	0.1391	4523.448	0.2788	8	8

Exhibit I-8. Linear regression model for fractional publication counts in an expanding journal set, referenced in footnote 44 in section 10.3

Response Pubs - Fract Counts - Exp J Set (Chng)
Summary of Fit

RSquare	0.275523
RSquare Adj	0.27384
Root Mean Square Error	45.52939
Mean of Response	8.545422
Observations (or Sum Wgts)	2158

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	1696520.6	339304	163.6837
Error	2152	4460934.7	2073	Prob > F
C. Total	2157	6157455.4		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	7.7447809	0.996376	7.77	<.0001
Acad R&D Exp-Fed Fin (Chng)	0.0008474	0.000133	6.35	<.0001
S&E PhD Recips (Chng)	0.324181	0.059774	5.42	<.0001
Fall Enroll-Grad Stu (Chng)	0.0187387	0.002541	7.37	<.0001
Postdocs w/MDs supp by Fed Traineeships (Chng)	-1.221569	0.221921	-5.50	<.0001
Postdocs supp by Fed Res Grants(Chng)	0.4642365	0.037086	12.52	<.0001

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Acad R&D Exp-Fed Fin (Chng)	1	1	83626.17	40.3421	<.0001
S&E PhD Recips (Chng)	1	1	60972.77	29.4139	<.0001
Fall Enroll-Grad Stu (Chng)	1	1	112725.81	54.3801	<.0001
Postdocs w/MDs supp by Fed Traineeships (Chng)	1	1	62809.05	30.2997	<.0001
Postdocs supp by Fed Res Grants(Chng)	1	1	324825.49	156.6991	<.0001