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Performance Indicators for Public Employment Services

Context variables: Some econometric exercises with respect to the Performance Indicator 1

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Introduction

The Working Group has discussed the possibility of making use of »context variables« in order to arrive at »adjusted values« for the performance indicators. At the current stage of the data collecting process, it is premature to apply sophisticated economic techniques to the data set available. Nevertheless, it might be useful to provide some crude results on a (partly fictitious) data base. Such exercise could help to clarify the position of the Working Group whether such »context adjustments« are actually useful for the benchmarking purpose as envisaged by the Working Group.

The issue at hand is not whether a »context-model« can be estimated in principle; the question rather is whether the Working Group will find a consensus on an appropriate conceptual underpinning of such a model.

If such a consensus is unlikely to emerge, the »context adjustment« might detract from the issues central to the purpose of the Working Group. This is, of course, a matter on which the Working Group and not the Team of Consultants takes the decision.

For the Team of Consultants

Prof. Michael Wagner-Pinter

Vienna, May 2004

Aim:

To model the exit from unemployment to employment using countries' unemployment and expenditure on labour market programmes as exogenous variables

Data:

- The required variables are available for Austria, Germany, the Netherlands and Sweden for the years 2000, 2001 and 2002 (note for Belgium we do not have the exit from unemployment variable). Therefore only 12 observations (4 countries and 3 time periods) are available.
- Available variables: unemployment, employment, expenditure on labour market programmes as percentage of GDP, exit from unemployment to employment.
- We also construct the expenditure on labor market programmes variable using OECD data on GDP and exchange rates (for Sweden) – see Appendix A.
- The variable exit from unemployment seems to be measured differently amongst countries and the model will have to be adjusted accordingly – in particular Austria is a complete outlier with the exit from unemployment perhaps tenfold that what we would expect extrapolating from the other countries in the sample.

Model:

We are attempting to parameterize the function Y = f(X, U). Where Y is exit from unemployment to employment, X is unemployment and U is expenditure on labour market programmes (not as a percentage of GDP). A number of models suggest themselves.

1. *The Linear Specification:* the relationship is entirely linear

$Y = \lambda U + \beta X$ or $Y/U = \lambda + \beta X/U$ (A)

2. *The Semi-Logarithmic Specification*: we might believe that exit from unemployment is concave in the level of unemployment and/or level of expenditure

$Y = \lambda \ln U + \beta \ln X$ (B)
$Y = \lambda U + \beta \ln X$ (B')
$Y = \lambda \ln U + \beta X$ (B'')

Note: other non-linearities can of course be modeled, assuming the logarithmic form, however, minimizes the number of parameters we need to estimate.
3. *Logarithmic Specification*: we might believe that labour market programmes and unemployment enter multiplicatively.

$Y = U^{\lambda} * X^{\beta}$ or $\ln Y = \lambda \ln U + \beta \ln X$ (C)

4. *Including Interaction Terms*: if we believe that, for example, labour market programmes are particularly effective at high levels of unemployment, we might want to add an interaction term (X*U) to specification (A).

$Y = \lambda U + \beta X + \gamma(X*U)$ (D)
$Y = \lambda \ln U + \beta \ln X + \gamma(X*U)$ (D')

5. *Variable Coefficients*: λ, β or γ could be either common to all countries or variable by country, thereby perhaps obtaining an idea of the efficacy of the various labour market programmes. However, data constraints mean that this approach is unfeasible.

Estimation and Results:

In discussion it was suggested using normalized variables as inputs into the regression, e.g. expenditure as percent of GDP, the unemployment rate, etc… Intuitively this does not seem quite right, for example, presumably expenditure on labour market programmes per unemployed, not as a percentage of GDP, is what matters. Similarly, theoretically I was unable to derive a model suggesting the use of normalized variables where dependent and independent variables are normalized by different variables, e.g. expenditure on labour market programmes normalized by GDP and exit from unemployment by the number of unemployed.

See Appendix B for the raw data used.

A. *Correlation coefficients by country*:

In Austria, the Netherlands and Sweden both the level of unemployment and expenditure on labour market programmes are positively correlated with the exit from unemployment, as well as with each other.
In Germany the level of unemployment is negatively correlated and expenditure on programmes is highly positively correlated with exit rates. Unemployment levels and expenditure on programmes are negatively correlated.

B. *Estimation*:

We estimate all the specifications outlined above. Moreover, we run the regressions with and without dummy variables for countries. Due to our very small sample it is probably not feasible to correct for heteroscedasticity and serial correlation. The appropriate results tend to be large sample and simulations suggest that it is often better not to undertake such corrections. In a more extensive investigation this issue is of course worth investigating. The variables are defined as follows:
exit = no. of exits from unemployment to employment (Y)
unemp = no. of unemployed (U)
totexp = expenditure on labour market programmes in thousands of euros (X)
ln(*variable name*) = natural log of the variable
d1 = dummy variable for Austria

The most promising regression results are below, further regression results can be found in Appendix C.

1. *Linear specification*:

This specification performs well, with the specification with a dummy for Austria performing best (see below) All other country dummies are insignificant and therefore dropped from the final specification. Similarly, as the theory predicts, the constant in the regression is insignificant and we present results dropping the constant from the regression below. The R-squared for all specifications are very high, probably a function of very little data with very little variation. Both coefficients have the expected sign (positive). The unemployment variable is significant at a higher significance level, when dropping the constant both variables are significant at the 5% level, with a constant the expenditure variable is not.

```
. regress exit  unemp totexp d1

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  3,     8) = 1157.72
       Model |  4.0980e+11     3  1.3660e+11           Prob > F      =  0.0000
    Residual |   943927106     8   117990888           R-squared     =  0.9977
-------------+------------------------------           Adj R-squared =  0.9968
       Total |  4.1075e+11    11  3.7341e+10           Root MSE      =   10862

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       unemp |   .0441966   .0156664     2.82   0.022     .0080697    .0803235
      totexp |   5.875334   2.933293     2.00   0.080    -.8888513    12.63952
          d1 |     467570   11303.05    41.37   0.000     441505.1    493634.9
       _cons |  -1465.693   9663.695    -0.15   0.883    -23750.21    20818.83
------------------------------------------------------------------------------
```

and without a constant

```
. regress exit  unemp totexp d1 , noconstant

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  3,     9) = 2809.92
       Model |  8.8666e+11     3  2.9555e+11           Prob > F      =  0.0000
    Residual |   946641345     9   105182372           R-squared     =  0.9989
-------------+------------------------------           Adj R-squared =  0.9986
       Total |  8.8761e+11    12  7.3968e+10           Root MSE      =   10256

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       unemp |   .0461041   .0088198     5.23   0.001     .0261523    .0660559
      totexp |   5.489016   1.373594     4.00   0.003      2.38173    8.596301
          d1 |   466144.6   5929.002    78.62   0.000     452732.3    479556.9
------------------------------------------------------------------------------
```

2. *Semi-logarithmic specification*:

As in the linear case the specification with just a dummy for Austria gives the best fit, other dummies are insignificant. The best performing version of semi-logarithmic specification has both independent variables in logs – see results below and further results in Appendix C. The problem with this specification (and the other semi-logarithmic) is that the constant is significant and negative – a rather hard to interpret fact. Moreover the coefficients are not straightforward to measure.

```
. regress exit lnunemp lntotexp d1

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  3,     8) = 2274.87
       Model |  4.1027e+11     3  1.3676e+11           Prob > F      =  0.0000
    Residual |   480925580     8  60115697.5           R-squared     =  0.9988
-------------+------------------------------           Adj R-squared =  0.9984
       Total |  4.1075e+11    11  3.7341e+10           Root MSE      =  7753.4

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnunemp |   70243.98   5588.166    12.57   0.000     57357.64    83130.31
    lntotexp |   22898.42   8447.265     2.71   0.027     3418.986    42377.84
          d1 |   509715.8   12130.31    42.02   0.000     481743.3    537688.4
       _cons |   -1022568   27994.71   -36.53   0.000     -1087124   -958011.9
------------------------------------------------------------------------------
```

3. *Logarithmic specification*:

The specifications with or without a constant (and a dummy for Austria) perform well. The coefficients are easy to interpret since they are elasticities, i.e. the coefficient is the percentage increase in the dependent variable on account of a 1% increase in the independent variable, and have the expected sign. It is notable that the specification is approximately constant returns to scale since the coefficients sum to one, i.e. a doubling in unemployment and labour market programme expenditure leads to a doubling of exit rates into employment.

```
. regress lnexit lnunemp lntotexp d1

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  3,     8) = 2283.68
       Model |  18.0633986     3  6.02113287           Prob > F      =  0.0000
    Residual |  .021092775     8  .002636597           R-squared     =  0.9988
-------------+------------------------------           Adj R-squared =  0.9984
       Total |  18.0844914    11  1.64404467           Root MSE      =  .05135

------------------------------------------------------------------------------
      lnexit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnunemp |   .4899268   .0370081    13.24   0.000     .4045859    .5752677
    lntotexp |   .4814385   .0559428     8.61   0.000     .3524343    .6104428
          d1 |   3.649281   .0803341    45.43   0.000     3.464031    3.834532
       _cons |   .3534673   .1853975     1.91   0.093    -.0740601    .7809946
------------------------------------------------------------------------------
```

and without a constant

```
. regress lnexit lnunemp lntotexp d1, noconstant

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  3,     9) =       .
       Model |  1622.19698     3  540.732326           Prob > F      =  0.0000
    Residual |  .030676503     9    .0034085           R-squared     =  1.0000
-------------+------------------------------           Adj R-squared =  1.0000
       Total |  1622.22766    12  135.185638           Root MSE      =  .05838

------------------------------------------------------------------------------
      lnexit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnunemp |   .5020748   .0414498    12.11   0.000     .4083087    .5958408
    lntotexp |   .5030511   .0622873     8.08   0.000     .3621475    .6439547
          d1 |   3.712652   .0831545    44.65   0.000     3.524544    3.900761
-----------------------------------------------------------------------------
```

4. *Including Interaction Terms*:

The coefficient on the interaction term (X*U) is not significant in either the linear or logarithmic specifications. Moreover, it significantly reduces the performance of the model. See Appendix C.

Conclusions

All the specifications outlined above do surprisingly well – probably on account of the small variation in the data. The semi-logarithmic is unattractive since the coefficients are harder to interpret. The logarithmic has the disadvantage that the theory is not entirely clear – even though it performs well on the existing support. The linear specification is based on very clear and simple theory and performs well empirically. Hence, it is the model I would use. Furthermore I would, as the theory suggests, not include a constant term in the specification (despite this being somewhat unusual in empirical practice). The dummy variable for Austria has to be included, but can hopefully be dropped once the exit from unemployment variable is measured on a comparable basis. See Appendix D for model predictions versus actual exit from unemployment numbers.

Appendix A: Constructing the total expenditure on labour market programmes variable

I used OECD data to find GDP for each country. GD P is measured on expenditure basis at current prices, i.e. unadjusted for inflation, in the local currency. I then used OECd information on exchange rates to convert Swedish krona into euros.
The data can be found at:
Annual accounts for OECD member countries, GDP by expenditure at current prices (http://www.oecd.org/document/28/0,2340,en_2825_495684_2750044_1_1_1_1,00.html)
Interest and exchange rates – EO74 Annex Tables (http://www.oecd.org/topicstatsportal/0,2647,en_2825_495635_1_1_1_1_1,00.html#499362)

The exchange rates I used are listed below. The OECD uses the US dollar as a reference currency.

	2000	2001	2002
euro/dollar	1.086	1.118	1.062
krona/dollar	9.161	10.338	9.721
krona/euro	8.43544701	9.24910201	9.15224643

Appendix B: Data

Country	Date	Employment	Unemployment	Exp % of GDP	Exit unemployment	Expenditure (euros 000s)	Unemp*Exp	GDP (euros)
Austria	2000	4050000	140000	0.0050	462698	785.639	109989460	157127.8
Austria	2001	4077000	140000	0.0053	475956	857.01159	119981622.6	161700.3
Austria	2002	4061000	166000	0.0053	494147	872.33601	144807777.7	164591.7
Germany	2000	38752000	3066000	0.0125	265925	19772.375	60622101750	1581790
Germany	2001	38917000	3110000	0.0121	250890	19683.796	61216605560	1626760
Germany	2002	38687000	3396000	0.0120	250725	19691.04	66870771840	1640920
Netherlands	2000	8123000	224000	0.0172	36851	5021.196	1124747904	291930
Netherlands	2001	8277000	198000	0.0170	35510	5327.647	1054874106	313391
Netherlands	2002	8346000	230000	0.0174	37558	5755.137	1323681510	330755
Sweden	2000	4265000	253000	0.0137	30543	2698.92426	682827838.4	197001.771
Sweden	2001	4346000	224000	0.0139	25854	2587.53108	579606961.6	186153.315
Sweden	2002	4355000	228000	0.0141	25490	2779.00251	633612572	197092.377

Appendix C: Regression Results

Variable definitions:

exit = no. of exits from unemployment to employment (Y)
unemp = no. of unemployed (U)
totexp = expenditure on labour market programmes (X)
totexpunemp = X * U
ln(*variable name*) = natural log of the variable
d1 = dummy variable for Austria

1. Linear Specification:

```
. regress exit  unemp totexp

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  2,     9) =    4.61
       Model |  2.0790e+11     2  1.0395e+11           Prob > F      =  0.0418
    Residual |  2.0285e+11     9  2.2539e+10           R-squared     =  0.5061
-------------+------------------------------           Adj R-squared =  0.3964
       Total |  4.1075e+11    11  3.7341e+10           Root MSE      =  1.5e+05

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       unemp |   .4834818   .1591938     3.04   0.014     .1233604    .8436032
      totexp |  -82.46941   27.79111    -2.97   0.016    -145.3373   -19.60154
       _cons |   330918.8   74203.54     4.46   0.002     163058.7    498778.9
------------------------------------------------------------------------------

. regress exit  unemp totexp d1 d2 d3

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  5,     6) =  791.98
       Model |  4.1012e+11     5  8.2025e+10           Prob > F      =  0.0000
    Residual |   621417275     6   103569546           R-squared     =  0.9985
-------------+------------------------------           Adj R-squared =  0.9972
       Total |  4.1075e+11    11  3.7341e+10           Root MSE      =   10177

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       unemp |  -.0200608   .0397153    -0.51   0.631    -.1172407    .0771191
      totexp |   8.095271   18.60947     0.44   0.679    -37.44047    53.63101
          d1 |   463550.3   35693.97    12.99   0.000     376210.3    550890.3
          d2 |   150003.9   341630.8     0.44   0.676    -685936.5    985944.3
          d3 |  -12701.75   50533.83    -0.25   0.810    -136353.6    110950.1
       _cons |   10245.94   51532.67     0.20   0.849      -115850    136341.8
------------------------------------------------------------------------------

. regress exit  unemp totexp d1

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  3,     8) = 1157.72
       Model |  4.0980e+11     3  1.3660e+11           Prob > F      =  0.0000
    Residual |   943927106     8   117990888           R-squared     =  0.9977
-------------+------------------------------           Adj R-squared =  0.9968
       Total |  4.1075e+11    11  3.7341e+10           Root MSE      =   10862

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       unemp |   .0441966   .0156664     2.82   0.022     .0080697    .0803235
      totexp |   5.875334   2.933293     2.00   0.080    -.8888513    12.63952
          d1 |     467570   11303.05    41.37   0.000     441505.1    493634.9
       _cons |  -1465.693   9663.695    -0.15   0.883    -23750.21    20818.83
```

```
. regress exit  unemp totexp d1 , noconstant

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  3,     9) = 2809.92
       Model |  8.8666e+11     3  2.9555e+11           Prob > F      =  0.0000
    Residual |   946641345     9   105182372           R-squared     =  0.9989
-------------+------------------------------           Adj R-squared =  0.9986
       Total |  8.8761e+11    12  7.3968e+10           Root MSE      =   10256

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       unemp |   .0461041   .0088198     5.23   0.001     .0261523    .0660559
      totexp |   5.489016   1.373594     4.00   0.003      2.38173    8.596301
          d1 |   466144.6   5929.002    78.62   0.000     452732.3    479556.9
------------------------------------------------------------------------------

. regress exit  unemp totexp totexpunemp d1

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  4,     7) =  871.04
       Model |  4.0992e+11     4  1.0248e+11           Prob > F      =  0.0000
    Residual |   823568830     7   117652690           R-squared     =  0.9980
-------------+------------------------------           Adj R-squared =  0.9968
       Total |  4.1075e+11    11  3.7341e+10           Root MSE      =   10847

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       unemp |   .3604386   .3130584     1.15   0.287     -.379827    1.100704
      totexp |   11.26144   6.077625     1.85   0.106    -3.109862    25.63274
 totexpunemp |  -.0000165   .0000163    -1.01   0.345     -.000055    .0000221
          d1 |   496468.4   30720.28    16.16   0.000     423826.5    569110.3
       _cons |  -79834.79   78081.83    -1.02   0.341      -264469    104799.4
```

2. Semi-logarithmic

```
regress exit lnunemp lntotexp

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  2,     9) =   12.83
       Model |  3.0412e+11     2  1.5206e+11           Prob > F      =  0.0023
    Residual |  1.0663e+11     9  1.1847e+10           R-squared     =  0.7404
-------------+------------------------------           Adj R-squared =  0.6827
       Total |  4.1075e+11    11  3.7341e+10           Root MSE      =  1.1e+05

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnunemp |   242319.5   53378.84     4.54   0.001     121568.1    363070.8
    lntotexp |  -288403.4   56975.07    -5.06   0.001      -417290   -159516.9
       _cons |    -535850   357782.2    -1.50   0.168     -1345210    273509.6
------------------------------------------------------------------------------

. regress exit lnunemp lntotexp d1 d2 d3

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  5,     6) = 1134.58
       Model |  4.1031e+11     5  8.2062e+10           Prob > F      =  0.0000
    Residual |   433970120     6  72328353.3           R-squared     =  0.9989
-------------+------------------------------           Adj R-squared =  0.9981
       Total |  4.1075e+11    11  3.7341e+10           Root MSE      =  8504.6

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnunemp |   43339.55   42090.72     1.03   0.343    -59652.74    146331.8
    lntotexp |   68153.62   67532.98     1.01   0.352    -97093.63    233400.9
          d1 |   549690.4   74326.73     7.40   0.000     367819.4    731561.3
          d2 |  -20335.32   139888.1    -0.15   0.889    -362629.1    321958.5
          d3 |  -34290.19   48416.34    -0.71   0.505    -152760.7    84180.32
       _cons |   -1046798   596051.5    -1.76   0.130     -2505283    411687.7
------------------------------------------------------------------------------

. regress exit lnunemp lntotexp d1

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  3,     8) = 2274.87
       Model |  4.1027e+11     3  1.3676e+11           Prob > F      =  0.0000
    Residual |   480925580     8  60115697.5           R-squared     =  0.9988
-------------+------------------------------           Adj R-squared =  0.9984
       Total |  4.1075e+11    11  3.7341e+10           Root MSE      =  7753.4

------------------------------------------------------------------------------
        exit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnunemp |   70243.98   5588.166    12.57   0.000     57357.64    83130.31
    lntotexp |   22898.42   8447.265     2.71   0.027     3418.986    42377.84
          d1 |   509715.8   12130.31    42.02   0.000     481743.3    537688.4
       _cons |   -1022568   27994.71   -36.53   0.000     -1087124   -958011.9
------------------------------------------------------------------------------
```

3. Logarithmic:

```
. regress lnexit lnunemp lntotexp

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  2,     9) =   10.40
       Model |  12.6226491     2  6.31132454           Prob > F      =  0.0046
    Residual |   5.4618423     9  .606871366           R-squared     =  0.6980
-------------+------------------------------           Adj R-squared =  0.6309
       Total |  18.0844914    11  1.64404467           Root MSE      =  .77902

------------------------------------------------------------------------------
      lnexit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnunemp |   1.721891   .3820383     4.51   0.001     .8576606    2.586122
    lntotexp |  -1.747309   .4077769    -4.28   0.002    -2.669765   -.8248537
       _cons |   3.838095   2.560687     1.50   0.168    -1.954582    9.630772
------------------------------------------------------------------------------

. regress lnexit lnunemp lntotexp d1 d2 d3

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  5,     6) = 1283.85
       Model |  18.0676039     5  3.61352077           Prob > F      =  0.0000
    Residual |  .016887522     6  .002814587           R-squared     =  0.9991
-------------+------------------------------           Adj R-squared =  0.9983
       Total |  18.0844914    11  1.64404467           Root MSE      =  .05305

------------------------------------------------------------------------------
      lnexit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnunemp |   .4392106   .2625666     1.67   0.145    -.2032666    1.081688
    lntotexp |   .0379404   .4212782     0.09   0.931    -.9928902    1.068771
          d1 |   3.111258   .4636583     6.71   0.001     1.976727    4.245789
          d2 |   1.019465   .8726373     1.17   0.287    -1.115801    3.154732
          d3 |   .3059819   .3020265     1.01   0.350    -.4330502    1.045014
       _cons |   4.480236   3.718235     1.20   0.274    -4.617958    13.57843
------------------------------------------------------------------------------

. regress lnexit lnunemp lntotexp d1

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  3,     8) = 2283.68
       Model |  18.0633986     3  6.02113287           Prob > F      =  0.0000
    Residual |  .021092775     8  .002636597           R-squared     =  0.9988
-------------+------------------------------           Adj R-squared =  0.9984
       Total |  18.0844914    11  1.64404467           Root MSE      =  .05135

------------------------------------------------------------------------------
      lnexit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnunemp |   .4899268   .0370081    13.24   0.000     .4045859    .5752677
    lntotexp |   .4814385   .0559428     8.61   0.000     .3524343    .6104428
          d1 |   3.649281   .0803341    45.43   0.000     3.464031    3.834532
       _cons |   .3534673   .1853975     1.91   0.093    -.0740601    .7809946
------------------------------------------------------------------------------
```

```
. regress lnexit lnunemp lntotexp totexpunemp d1

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  4,     7) = 1551.42
       Model |  18.0641151     4  4.51602876           Prob > F      =  0.0000
    Residual |  .020376323     7  .002910903           R-squared     =  0.9989
-------------+------------------------------           Adj R-squared =  0.9982
       Total |  18.0844914    11  1.64404467           Root MSE      =  .05395

------------------------------------------------------------------------------
      lnexit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnunemp |   .5950732   .2154785     2.76   0.028     .0855474    1.104599
    lntotexp |   .4980034    .067602     7.37   0.000       .33815    .6578567
 totexpunemp |  -4.94e-12   9.96e-12    -0.50   0.635    -2.85e-11    1.86e-11
          d1 |   3.714487   .1562039    23.78   0.000     3.345123    4.083851
       _cons |    -1.0745   2.884901    -0.37   0.721    -7.896207    5.747207
```

Appendix D: Model Predictions versus Actual

1. Linear model without constant

Regression: Exit on unemployment and expenditure , no constant			
	Unemployment	Expenditure (000s)	dummy Austria
Coefficient	0.046104	5.489016	466144.6

Predicted versus Actual Exit from Unemployment into Employment (by country and year) - linear model without constant				
		2000	2001	2002
Austria	Predicted	476912	477303	478586
	Actual	462698	475956	494147
	Difference	14214	1347	-15561
	(in %)	3.1%	0.3%	-3.1%
Germany	Predicted	249886	251428	264654
	Actual	265925	250890	250725
	Difference	-16039	538	13929
	(in %)	-6.0%	0.2%	5.6%
Netherlands	Predicted	37889	38372	42194
	Actual	36851	35510	37558
	Difference	1038	2862	4636
	(in %)	2.8%	8.1%	12.3%
Sweden	Predicted	26479	24530	25766
	Actual	30543	25854	25490
	Difference	-4064	-1324	276
	(in %)	-13.3%	-5.1%	1.1%

2. Log-linear model with constant

Regression: lnexit on lnunemployment and lnexpenditure, with constant				
	lnunemployment	lnexpenditure (000s)	constant	dummy Austria
Coefficient	0.489927	0.481439	1.423996	38.44701
			0.353467	3.649281

Predicted versus Actual Exit from Unemployment into Employment (by country and year) - loglinear model with constant				
		2000	2001	2002
Austria	Predicted	450266.2	469515.8	514755.2
	Actual	462698	475956	494147
	Difference	-12432	-6440	20608
	(in %)	-2.7%	-1.4%	4.2%
Germany	Predicted	251039.8	252252.5	263409.4
	Actual	265925	250890	250725
	Difference	-14885	1363	12684
	(in %)	-5.6%	0.5%	5.1%
Netherlands	Predicted	36012.22	34880.67	38958.18
	Actual	36851	35510	37558
	Difference	-839	-629	1400
	(in %)	-2.3%	-1.8%	3.7%
Sweden	Predicted	28349.78	26171.78	27322.82
	Actual	30543	25854	25490
	Difference	-2193	318	1833
	(in %)	-7.2%	1.2%	7.2%

Supplement Notes to the Linear Model

To deal with the fact that the variables in different countries have a very different scale we can divide both sides of the linear model by the number of unemployed to obtain:

$Y/U = \lambda + \beta(X/U)$

Regression with Austria, the explanatory variable and constant are insignificant – it seems that in this specification it requires more than a simple dummy to adjust for Austria.

```
. regress exitperunemp expperunemp d1

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  2,     9) = 1004.00
       Model |  21.7104674     2  10.8552337           Prob > F      =  0.0000
    Residual |  .097308352     9  .010812039           R-squared     =  0.9955
-------------+------------------------------           Adj R-squared =  0.9945
       Total |  21.8077757    11  1.98252507           Root MSE      =  .10398

------------------------------------------------------------------------------
exitperunemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 expperunemp |   4.884123   4.383786     1.11   0.294     -5.03269    14.80094
          d1 |   3.146781   .0786697    40.00   0.000     2.968818    3.324744
       _cons |   .0527149   .0710487     0.74   0.477    -.1080084    .2134381
------------------------------------------------------------------------------
```

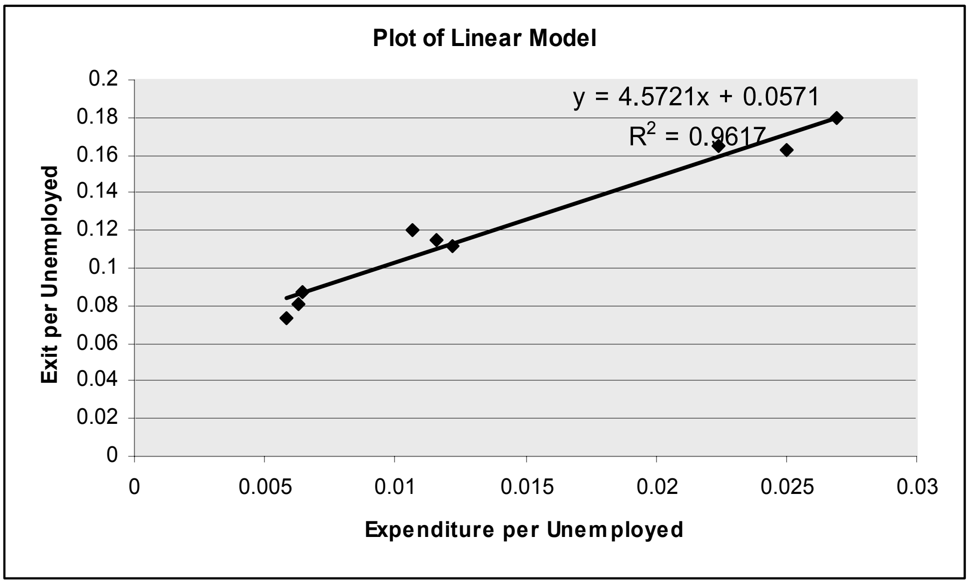
Therefore we run the regression without Austria and the relationship holds well:

```
. regress exitperunemp expperunemp if country !="Austria"

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  1,     7) =  175.57
       Model |   .01175321     1   .01175321           Prob > F      =  0.0000
    Residual |  .000468598     7  .000066943           R-squared     =  0.9617
-------------+------------------------------           Adj R-squared =  0.9562
       Total |  .012221808     8  .001527726           Root MSE      =  .00818

------------------------------------------------------------------------------
exitperunemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 expperunemp |   4.572148   .3450587    13.25   0.000     3.756213    5.388082
       _cons |   .0571286    .005592    10.22   0.000     .0439057    .0703515
------------------------------------------------------------------------------
```

A plot reveals that the relationship seems to hold in the aggregate, i.e. across countries, but not within an individual country. This suggests that it is a reasonable approximation in the aggregate, but unsuited to forecast at the country level, where idiosyncratic shocks dominate the aggregate relationship. It is worth noting that for Sweden the relationship is actually negative.



A simple look at the numbers is interesting, and tells the same story. Note that there are very large variations in expenditure per unemployed amongst countries.

Country	Date	Expenditure per Unemployed	Exit per Unemployed
Austria	2000	0.005611707	3.30498571
Austria	2001	0.006121511	3.39968571
Austria	2002	0.005255036	2.97678916
Germany	2000	0.006448916	0.08673353
Germany	2001	0.006329195	0.08067203
Germany	2002	0.005798304	0.07382951
Netherlands	2000	0.022416054	0.16451339
Netherlands	2001	0.026907308	0.17934343
Netherlands	2002	0.025022335	0.16329565
Sweden	2000	0.010667685	0.12072332
Sweden	2001	0.011551478	0.11541964
Sweden	2002	0.012188607	0.11179825

As noted running the model including Austria is difficult. The predicted versus actual values for the regression without Austria are below.

Predicted versus Actual Exit from Unemployment into Employment per Unemployed (by country and year) - linear model				
		2000	2001	2002
Germany	Predicted	0.0866	0.0861	0.0836
	Actual	0.0867	0.0807	0.0738
	Difference	-0.0001	0.0054	0.0098
	(in %)	-0.14%	6.69%	13.29%
Netherlands	Predicted	0.1596	0.1802	0.1715
	Actual	0.1645	0.1793	0.1633
	Difference	-0.0049	0.0008	0.0082
	(in %)	-2.98%	0.45%	5.05%
Sweden	Predicted	0.1059	0.1099	0.1129
	Actual	0.1207	0.1154	0.1118
	Difference	-0.0148	-0.0055	0.0011
	(in %)	-12.28%	-4.74%	0.95%

Again it needs to be emphasized that despite the high R-squared the actual predictions by country of the model are rather poor.

Conclusion: the model works well when considering cross-country comparisons, but not within an individual country.