Housing Market in Portugal revisited
A spatial analysis for 275 counties

Pedro G. Carvalho **February, 24th, 2003**

Abstract

In a former study (Carvalho 1995) we modeled the housing market in Portugal in a classic cross section framework and did find that housing construction was dependant from income, population and sensitive to location. Nevertheless we couldn't find the extent of this sensitivity in such a framework.

This paper is an upgrade of that study, using a spatial econometric model. Comparing the results, there are some slightly different estimates in the coefficients, but a lot more of precision once we incorporate the spatial interaction between the counties, changing the magnitude and significance of the coefficients.

Keywords: Housing Market; Portugal; spatial econometrics

JEL: C53 – R 310

1. Motivation

In 1995 I tested an econometric model to explain housing constructed area in 1990 as a dependent variable, using income, population and housing costs as exogenous variables. The introduction of some dummy variables for county location also enabled us to conclude that Algarve and the Coast counties had a different pattern compared with the rest of the country. However, spatial dependence was not accounted at the time. Heteroskedascity was present and taken into account, once, successively dividing the model by the exogenous variable used for population overcome the White test.

In this study we would like to use the same specification model introducing a set of new tests for spatial effects, in order to accurate the reliability of parameter estimates. We also would like to test for model stability over time (1995, 1996, 1997 and 1998).

All those experiments were base on (Anselin 1988) and (Anselin 1999).

a) The base model used in 1990
Variable description:

Variable	Main symbol	Log form	Per capita	Description
Housing area	A	La	Lapc	Number of square meters of residential housing per county, each year
Income	INC	LINC	LINCPC	Proxy (automobile tax) of income per county, each year
Population	P	LP	INVP (inverse)	Resident population. Census data for 1990, INE estimates for other periods
Cost	Cost	Lcost	Lm2 (per sq.meter)	Data from local authorities reports

The model was first estimated in global values for each variable, and successively transformed, in per capita and/or square meter costs, then logarithmzed.

$lapc_{it} = lincpc_{it} + linvp_{it} + lm2_{it} + \varepsilon_{it}$

i = 1,….275
t = 1990

Results for the used former model (1990)
R^2adj = 0,597 White χ^2 (13) = 0.0000

Variables	β-Coefficient	t - statistic	Probability
Constant	2,292	5,95	0,0000
linvp90	- 0.095	- 3,82	0,0000
lincpc90	0, 455	7,19	0,0000
lm290	- 0,492	- 7,33	0,0000
DummyALG	0, 697	4, 08	0,0000

2. Spatial analysis

The following conclusions are based on the interpretation of the output files named a2, a3, a4, a5 and p (annex), corresponding to the purposed tasks on each assignment of the year 2001 Course 492se - Spatial Econometrics –(Tutor: Luc Anselin) and using the ArcView 3.2 and SpaceStat 1.91 R10 softwares.

a) Selection of meaningful spatial regimes

Six spatial regimes were created in ArcView; I selected two of them, those presenting the best results (magnitude of explanation and higher t-values), respectively ALG and COAST.

The other 4 regimes referred to LIT (coast, including the set of the counties within a certain distance from the west coast of the country); CDIST (the 18 administrative counties); AMP and AML (metropolitan areas of Porto and Lisbon).

The ALG regime contains all the counties of the Algarve province and the COAST regime contains the counties with Atlantic coast, which means that they partially overlap and thus are not used together.

b) Spatial ANOVA for the 2 spatial regimes

There is a highly significant difference between the average of the dependent variable between the two regions (ALG, 3 times more than non-ALG and COAST, 1.5 times more than non-COAST).

c) Testing for Heteroskedasticity using regimes

The base model presents values of adjusted R^2 of 0,579 and 0,540 (COAST and ALG respectively); all the variables are significant at a $p<0,01$ although the variable for population - linvp90 - has not the expected negative signal (once housing area should be higher in high populated counties). We will deal with this issue later.

The null hypothesis for error normality in both regimes is rejected (Jaques-Bera test with very low probability values).

The null hypothesis for homoskedasticity is clearly accepted in both regimes, considering the Koenker-Bassett test (probabilities of 0,76 and 0,79).

However, the results are different in what individual coefficient stability concerns. In fact, stability for housing cost is rejected in COAST regime.

d) Spatial homogeneity

Using the spatial expansion model (1^{st} order), heterogeneity is the rule with exception for the population variable in both regimes. Heteroskedascity is still remaining.

Using the spatial expansion model (2^{nd} order), heterogeneity is not present anymore (exception to the constant) and heteroskedascity is still present although with a probability of <0,1.

e) Spatial Weights

In order to run the spatial effects tests, several weight matrices (W) were created.

In ArcView we created the *rook* and *queen* matrices. In SpaceStat we created the others weight matrices, based on contiguity of second and third order (2_2 and 2_3); on distance (*d1* and *invd1s* – standardized) and k-nearest neighbors (for 2, 3 and 5 neighbors, respectively *Kn_3_2s, Kn_3_3s and Kn_5s*).

After running the tests for all the matrices we dropped the Kn_5s matrix because the results did not revealed any kind of spatial dependence, even with Moran's I. We present the results (just the probabilities) for the seven *W's* obtained:

Diagnostic	*rook*	*queen*	*invd1s*	*kn_3_3s*	*kn_3_2s*	*2_2*	*2_3*
Moran's I (error)	0,003312	0,003335	0,000000	0,008665	0,010042	0.000002	0.000689
LM (error)	0,006769	0,006840	0,000916	0,014659	0,015393	0.000014	0.002379
Robust LM (error)	0,267000	0,278842	0,497805	0,374953	0,349358	0.946761	0.427486
K-R (error)	0,012743	0,014310	0,906666	0,077545	0,309251	0.000403	0.000028
LM (lag)	0,000006	0,000007	0,00000	0,000057	0,000088	0.000000	0.000001
Robust LM (lag)	0,000147	0,000171	0,000067	0,000892	0,001274	0.000100	0.000078
LM (SARMA)	0,000019	0,000022	0,000001	0,000204	0,000296	0.000000	0.000004

To decide which matrix we were going to use for the next tests, we looked to Moran's I probabilities, followed by LM (error and lag), Robust (error and lag) and LM (SARMA). Proceeding this way, we think that the ***spatial model*** should be the correct specification in this case, once though the LM (error) presents low probabilities, the robust LM is never indicating that possibility.

The tests remain significant for the spatial lag when introducing the spatial regimes; however the probabilities are slightly greater overall.

Because Heteroskedasticity was still present, we run the Heteroskedasticity model (FGLS) and the Wald test do not reject the null hypothesis of homoskedasticity in both cases, although for a strict margin (in ALG - 0,118 – in Coast a 0,129).

f) Spatial Lag and Spatial Error models

We estimated both regression models for lag and error dependence and the results indicate that:

a) Spatial lag is significant with $\rho = 0{,}869$, with no heteroskedasticity for COAST regime and still remaining heteroskedasticity for ALG regime; no spatial autocorrelation remaining in both cases, once the Likelihood Ratio rejects the null hypothesis of $\rho = 0$;
b) Spatial Error model presents significant $\lambda\lambda$ estimates, but heteroskedascity and spatial autocorrelation are still remaining in both regimes.

After these results, the best-fit indicator for all the models is the spatial lag model with the regime COAST.

Comparing this model to the standard OLS estimation, we loose some fitness (LIK is a little bit higher in absolute value – 179.460 vs. 160.322) but we gain the correction of the spatial dependence (and we are aware of the problem), which totally disappears in the spatial lag specification.

Comparing with the model estimated in previous work, there are some slightly different estimates in the coefficients, but a lot more of precision once we incorporate the spatial interaction between the counties, changing the magnitude and significance of the coefficients.

	Normal OLS			Spatial lag model		
Variables	Coefficient β	t - statistic	Probability	Coefficient β	z - value	Probability
Constant	2,292	5,95	0,0000	2.19662	5,01	0,0000
linvp90	- 0.095	- 3,82	0,0000	0.232683	5,99	0,0000
lincpc90	0, 455	7,19	0,0000	0.452063	7,96	0,0000
lm290	- 0,492	- 7,33	0,0000	-0.27341	- 11,8	0,0000
DummyALG	0, 697	4, 08	0,0000	--	--	--
Lambda				0,813	6,46	0,0000

Another important difference refers to the different sign of the population variable. In the normal OLS estimation the predicted signal is negative, once the higher the value of resident population in each county the lower will be its inverse, thus affecting negatively the housing constructed area; estimating a spatial lag model, we can be possibly capturing the decreasing rate of housing construction in high populated counties once the lag smoothes the differences among neighbor counties. For that reason we tried another specification of the model (annex p), including both the variable and the logarithm of the variable (invp90 and linvp90) and the fitness improves as the sign become as expected; it looks like population plays a non-linear role on the equation and there is a decreasing effect the more the county gets highly populated.

We estimated the model with both linvp90 and l2invp90 (power 2) and the results are then consistent with our hypothesis: population coefficients become negative.

g) IV estimation

In all the regressions we carried with IV for spatial lag, the coefficient of the lagged variable (ρ was always > 1).

We tested for endogeneity with all the previous exogenous variables and the results were consistent with non-endogeneity.

3. Further research

I tried the first estimations for the years 1995, 1996, 97 and 98, but the model does not keep the same significant variables. Anyway I would try the new re-specification and intend to present the results for each time period separately studying the hypothesis of a panel data work.

Bibliographic References:

Anselin, L. (1988). Spatial Econometrics: Methods and Models. Dordrecht, Kluwer Academic Publishers.

Anselin, L. (1999). "The future of spatial analysis in the social sciences." *Geographic Information Sciences* **5**(2): 67-76.

Carvalho, P. G. (1995). O Mercado de Habitação em Portugal: uma análise cross-section para os 305 concelhos. Master Thesis, Fac. Economia de Coimbra, Coimbra.

ANNEX

```
A2

ANOVA

ORDINARY LEAST SQUARES ESTIMATION
ANALYSIS OF VARIANCE - USING INDICATOR VARIABLES
     ALG
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   2      DF 273
R2          0.1545     R2-adj      0.1514
LIK        -259.982    AIC         523.963    SC         531.197
RSS         106.663    F-test      49.8991    Prob 1.35159e-011
SIG-SQ     0.390705  (    0.625064 ) SIG-SQ(ML)     0.387864  (
0.622787 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT     -1.2438   0.0388396  -32.024031    0.000000
   ALG_1     1.13744     0.16102    7.063929    0.000000


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER     1.278973
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2    43.846350     0.000000
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    ALG_1
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     0.759592     0.383456


ORDINARY LEAST SQUARES ESTIMATION
ANALYSIS OF VARIANCE - USING INDICATOR VARIABLES
   COAST
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   2      DF 273
R2          0.1363     R2-adj      0.1332
```

```
LIK        -262.910    AIC         529.819    SC         537.053
RSS         108.958    F-test      43.0961    Prob 2.61579e-010
SIG-SQ     0.399114  (    0.631755 ) SIG-SQ(ML)     0.396212  (
0.629453 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT    -1.31956   0.0438043  -30.124045    0.000000
 COAST_1    0.582592   0.0887454    6.564758    0.000000


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER     1.717385
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2    82.816245     0.000000
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT  COAST_1
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     9.994567     0.001570

ORDINARY LEAST SQUARES ESTIMATION
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 271
R2          0.5159     R2-adj      0.5105
LIK        -183.320    AIC         374.639    SC         389.106
RSS         61.0765    F-test      96.2573    Prob 1.94637e-042
SIG-SQ     0.225375  (    0.474736 ) SIG-SQ(ML)     0.222097  (
0.471271 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT     2.42786    0.399209    6.081680    0.000000
LINCPC90    0.454962   0.0560489    8.117248    0.000000
 LINVP90    0.257756   0.0371117    6.945415    0.000000
   LM290   -0.292382   0.0234125  -12.488308    0.000000


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER    34.931108
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2    20.545063     0.000035
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT      ALG
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     6.792087     0.009156



ORDINARY LEAST SQUARES ESTIMATION
DATA SET     BD90
```

```
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 271
R2          0.5159     R2-adj      0.5105
LIK        -183.320    AIC         374.639    SC         389.106
RSS         61.0765    F-test      96.2573    Prob 1.94637e-042
SIG-SQ     0.225375  (    0.474736 ) SIG-SQ(ML)     0.222097  (
0.471271 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT     2.42786    0.399209    6.081680    0.000000
LINCPC90    0.454962   0.0560489    8.117248    0.000000
 LINVP90    0.257756   0.0371117    6.945415    0.000000
   LM290   -0.292382   0.0234125  -12.488308    0.000000


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER    34.931108
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2    20.545063     0.000035
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    COAST
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     2.163765     0.141298


SPATIAL REGIMES
ORDINARY LEAST SQUARES ESTIMATION
STRUCTURAL CHANGE - DIFFERENT SLOPES FOLLOWING VARIABLE    COAST
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   8      DF 267
R2          0.5904     R2-adj      0.5797
LIK        -160.322    AIC         336.645    SC         365.579
RSS         51.6698
SIG-SQ     0.193520  (    0.439909 ) SIG-SQ(ML)     0.187890  (
0.433463 )


VARIABLE    COEFF       S.D.      t-value        Prob
 CONST_0     0.25763     0.55555    0.463739    0.643213
 LINCP_0    0.199855   0.0732095    2.729901    0.006757
 LINVP_0   0.0861443   0.0494058    1.743608    0.082379
 LM290_0   -0.244123   0.0263315   -9.271146    0.000000
 CONST_1     4.95072    0.620913    7.973280    0.000000
 LINCP_1    0.442469    0.095805    4.618436    0.000006
 LINVP_1    0.485791   0.0626408    7.755193    0.000000
 LM290_1    -0.24375   0.0462973   -5.264883    0.000000


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER    45.486843
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2    25.518803     0.000003
TEST ON STRUCTURAL INSTABILITY FOR  2  REGIMES DEFINED BY    COAST
```

```
TEST                  DF      VALUE        PROB
Chow test         4 267    12.152110     0.000000
STABILITY OF INDIVIDUAL COEFFICIENTS
TEST                  DF      VALUE        PROB
 CONST_0          1 267    31.728653     0.000000
 LINCP_0          1 267     4.048764     0.045208
 LINVP_0          1 267    25.093916     0.000001
 LM290_0          1 267     0.000049     0.994416
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT  COAST_1
TEST                  DF      VALUE        PROB
Koenker-Bassett test  1     0.089269     0.765109


ORDINARY LEAST SQUARES ESTIMATION
STRUCTURAL CHANGE - DIFFERENT SLOPES FOLLOWING VARIABLE      ALG
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   8      DF 267
R2          0.5523     R2-adj      0.5405
LIK        -172.570    AIC         361.141    SC         390.075
RSS         56.4837
SIG-SQ     0.211549  (    0.459945 ) SIG-SQ(ML)     0.205395  (
0.453205 )


VARIABLE    COEFF       S.D.      t-value        Prob
 CONST_0     1.85191    0.410169    4.514988    0.000010
 LINCP_0     0.39201   0.0575911    6.806789    0.000000
 LINVP_0    0.215295   0.0376287    5.721571    0.000000
 LM290_0   -0.268032   0.0239667  -11.183480    0.000000
 CONST_1     5.70333     2.22903    2.558657    0.011060
 LINCP_1    0.739713    0.268545    2.754525    0.006282
 LINVP_1    0.521003    0.213484    2.440477    0.015318
 LM290_1   -0.294801   0.0947052   -3.112823    0.002054


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER    49.241065
TEST ON NORMALITY OF ERRORS
TEST                  DF      VALUE        PROB
Jarque-Bera           2    28.753187     0.000001
TEST ON STRUCTURAL INSTABILITY FOR  2  REGIMES DEFINED BY      ALG
TEST                  DF      VALUE        PROB
Chow test         4 267     5.427691     0.000324
STABILITY OF INDIVIDUAL COEFFICIENTS
TEST                  DF      VALUE        PROB
 CONST_0          1 267     2.887671     0.090425
 LINCP_0          1 267     1.602709     0.206623
 LINVP_0          1 267     1.988812     0.159629
 LM290_0          1 267     0.075086     0.784283
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    ALG_1
TEST                  DF      VALUE        PROB
Koenker-Bassett test  1     0.069353     0.792281
```

```
 SPATIAL EXPANSION

ORDINARY LEAST SQUARES ESTIMATION
SPATIAL EXPANSION OF COEFFICIENTS - FOLLOWING EXPANSION VARIABLES
 Y_COORD
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   7      DF 268
R2          0.5625     R2-adj      0.5527
LIK        -169.406    AIC         352.811    SC         378.129
RSS         55.1984    F-test     0.000000    Prob     0.000000
SIG-SQ     0.205964  (    0.453833 ) SIG-SQ(ML)     0.200722  (
0.448020 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT      2.3748    0.388404    6.114253    0.000000
LINCPC90     3.41562     1.55644    2.194499    0.029058
 LINVP90   -0.337893    0.214765   -1.573317    0.116825
   LM290    -2.22076    0.594398   -3.736145    0.000228
A_LINCPC-6.6842E-007 3.5146E-007   -1.901839    0.058264
A_LINVP91.34075E-007 4.6845E-008    2.862100    0.004541
 A_LM2904.40605E-007 1.3474E-007    3.270030    0.001216


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER   393.984837
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2    13.965605     0.000928
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    COAST
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     5.482117     0.019212


ORDINARY LEAST SQUARES ESTIMATION
SPATIAL EXPANSION OF COEFFICIENTS - FOLLOWING EXPANSION VARIABLES
 Y_COORD
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   7      DF 268
R2          0.5625     R2-adj      0.5527
LIK        -169.406    AIC         352.811    SC         378.129
RSS         55.1984    F-test     0.000000    Prob     0.000000
SIG-SQ     0.205964  (    0.453833 ) SIG-SQ(ML)     0.200722  (
0.448020 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT      2.3748    0.388404    6.114253    0.000000
LINCPC90     3.41562     1.55644    2.194499    0.029058
 LINVP90   -0.337893    0.214765   -1.573317    0.116825
   LM290    -2.22076    0.594398   -3.736145    0.000228
```

```
A_LINCPC-6.6842E-007 3.5146E-007   -1.901839    0.058264
A_LINVP91.34075E-007 4.6845E-008    2.862100    0.004541
 A_LM2904.40605E-007 1.3474E-007    3.270030    0.001216


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER   393.984837
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2    13.965605     0.000928
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT      ALG
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     8.837980     0.002950


ORDINARY LEAST SQUARES ESTIMATION
SPATIAL EXPANSION OF COEFFICIENTS - FOLLOWING EXPANSION VARIABLES
 Y_COORD
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS  10      DF 265
R2          0.5782     R2-adj      0.5639
LIK        -164.355    AIC         348.710    SC         384.878
RSS         53.2077    F-test     0.000000    Prob     0.000000
SIG-SQ     0.200784  (    0.448089 ) SIG-SQ(ML)     0.193482  (
0.439866 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT     2.29789    0.386988    5.937878    0.000000
LINCPC90      39.194     49.8987    0.785471    0.432879
 LINVP90    -10.6102     6.25849   -1.695330    0.091187
   LM290     17.3572     18.6264    0.931859    0.352258
A_LINCPC-1.71894E-005 2.2818E-005   -0.753326    0.451923
AA_LINCP1.90403E-0122.60593E-012    0.730653    0.465637
A_LINVP94.84407E-006 2.8719E-006    1.686715    0.092835
AA_LINVP-5.39533E-0133.29156E-013   -1.639138    0.102371
 A_LM290-8.46023E-0068.48941E-006   -0.996564    0.319885
AA_LM2901.01107E-0129.66551E-013    1.046058    0.296487


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER 26039.835688
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2    13.991479     0.000916
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    COAST
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     3.549662     0.059558


ORDINARY LEAST SQUARES ESTIMATION
SPATIAL EXPANSION OF COEFFICIENTS - FOLLOWING EXPANSION VARIABLES
```

```
 Y_COORD
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS  10      DF 265
R2          0.5782     R2-adj      0.5639
LIK        -164.355    AIC         348.710    SC         384.878
RSS         53.2077    F-test     0.000000    Prob     0.000000
SIG-SQ     0.200784  (    0.448089 ) SIG-SQ(ML)     0.193482  (
0.439866 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT     2.29789    0.386988    5.937878    0.000000
LINCPC90      39.194     49.8987    0.785471    0.432879
 LINVP90    -10.6102     6.25849   -1.695330    0.091187
   LM290     17.3572     18.6264    0.931859    0.352258
A_LINCPC-1.71894E-005 2.2818E-005   -0.753326    0.451923
AA_LINCP1.90403E-0122.60593E-012    0.730653    0.465637
A_LINVP94.84407E-006 2.8719E-006    1.686715    0.092835
AA_LINVP-5.39533E-0133.29156E-013   -1.639138    0.102371
 A_LM290-8.46023E-0068.48941E-006   -0.996564    0.319885
AA_LM2901.01107E-0129.66551E-013    1.046058    0.296487


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER 26039.835688
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2    13.991479     0.000916
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT      ALG
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     3.691288     0.054697

A3
Connectivity characteristics of weights matrix queen
Weights matrix stored in GAL format
Weights are row-standardized
Dimension:                       275
# nonzero links:                1456
% nonzero weights:              1.93232
Average weight:                 0.188874
Average # links:                5.29455
 3 most connected observation(s) - with 10 link(s):
   194    209    274
 1 least connected observation(s) - with  1 link(s):
   141
^Frequency Count for Weights File queen

Connections    Frequency

         1          1
         2         17
         3         21
         4         41
         5         81
```

```
         6         50

         7         35
         8         20
         9          6
        10          3
Connectivity characteristics of weights matrix rook
Weights matrix stored in GAL format
Weights are row-standardized
Dimension:                      275
# nonzero links:               1442
% nonzero weights:             1.91374
Average weight:                0.190707
Average # links:               5.24364
 2 most connected observation(s) - with 10 link(s):
   209    274
 1 least connected observation(s) - with  1 link(s):
   141
^Frequency Count for Weights File rook
Connections    Frequency

         1          1
         2         17
         3         22
         4         41
         5         86
         6         46

         7         35
         8         19
         9          6
        10          2
Connectivity characteristics of weights matrix kn_3_3s
Weights matrix is asymmetric
Weights are row-standardized
Dimension:                      275
# nonzero links:               825
% nonzero weights:             1.09489
Average weight:                0.333333
Average # links:               3.00000
275 most connected observation(s) - with  3 link(s):
     1      2      3      4      5      6      7      8      9     10
11
    12     13     14     15     16     17     18     19     20     21
22
    23     24     25     26     27     28     29     30     31     32
33
    34     35     36     37     38     39     40     41     42     43
44
    45     46     47     48     49     50     51     52     53     54
55
    56     57     58     59     60     61     62     63     64     65
66
    67     68     69     70     71     72     73     74     75     76
77
    78     79     80     81     82     83     84     85     86     87
88
```

```
    89     90     91     92     93     94     95     96     97     98
99
   100    101    102    103    104    105    106    107    108    109
110
   111    112    113    114    115    116    117    118    119    120
121
   122    123    124    125    126    127    128    129    130    131
132
   133    134    135    136    137    138    139    140    141    142
143
   144    145    146    147    148    149    150    151    152    153
154
   155    156    157    158    159    160    161    162    163    164
165
   166    167    168    169    170    171    172    173    174    175
176
   177    178    179    180    181    182    183    184    185    186
187
   188    189    190    191    192    193    194    195    196    197
198
   199    200    201    202    203    204    205    206    207    208
209
   210    211    212    213    214    215    216    217    218    219
220
   221    222    223    224    225    226    227    228    229    230
231
   232    233    234    235    236    237    238    239    240    241
242
   243    244    245    246    247    248    249    250    251    252
253
   254    255    256    257    258    259    260    261    262    263
264
   265    266    267    268    269    270    271    272    273    274
275
275 least connected observation(s) - with  3 link(s):
     1      2      3      4      5      6      7      8      9     10
11
    12     13     14     15     16     17     18     19     20     21
22
    23     24     25     26     27     28     29     30     31     32
33
    34     35     36     37     38     39     40     41     42     43
44
    45     46     47     48     49     50     51     52     53     54
55
    56     57     58     59     60     61     62     63     64     65
66
    67     68     69     70     71     72     73     74     75     76
77
    78     79     80     81     82     83     84     85     86     87
88
    89     90     91     92     93     94     95     96     97     98
99
   100    101    102    103    104    105    106    107    108    109
110
   111    112    113    114    115    116    117    118    119    120
121
```

```
   122    123    124    125    126    127    128    129    130    131
132
   133    134    135    136    137    138    139    140    141    142
143
   144    145    146    147    148    149    150    151    152    153
154
   155    156    157    158    159    160    161    162    163    164
165
   166    167    168    169    170    171    172    173    174    175
176
   177    178    179    180    181    182    183    184    185    186
187
   188    189    190    191    192    193    194    195    196    197
198
   199    200    201    202    203    204    205    206    207    208
209
   210    211    212    213    214    215    216    217    218    219
220
   221    222    223    224    225    226    227    228    229    230
231
   232    233    234    235    236    237    238    239    240    241
242
   243    244    245    246    247    248    249    250    251    252
253
   254    255    256    257    258    259    260    261    262    263
264
   265    266    267    268    269    270    271    272    273    274
275
^Frequency Count for Weights File kn_3_3s
Connections    Frequency
          3        275
Connectivity characteristics of weights matrix kn_3_2s
Weights matrix is asymmetric
Weights are row-standardized
Dimension:                      275
# nonzero links:                550
% nonzero weights:             0.729927
Average weight:                0.500000
Average # links:               2.00000
275 most connected observation(s) - with  2 link(s):
     1      2      3      4      5      6      7      8      9     10
11
    12     13     14     15     16     17     18     19     20     21
22
    23     24     25     26     27     28     29     30     31     32
33
    34     35     36     37     38     39     40     41     42     43
44
    45     46     47     48     49     50     51     52     53     54
55
    56     57     58     59     60     61     62     63     64     65
66
    67     68     69     70     71     72     73     74     75     76
77
    78     79     80     81     82     83     84     85     86     87
88
```

```
    89     90     91     92     93     94     95     96     97     98
99
   100    101    102    103    104    105    106    107    108    109
110
   111    112    113    114    115    116    117    118    119    120
121
   122    123    124    125    126    127    128    129    130    131
132
   133    134    135    136    137    138    139    140    141    142
143
   144    145    146    147    148    149    150    151    152    153
154
   155    156    157    158    159    160    161    162    163    164
165
   166    167    168    169    170    171    172    173    174    175
176
   177    178    179    180    181    182    183    184    185    186
187
   188    189    190    191    192    193    194    195    196    197
198
   199    200    201    202    203    204    205    206    207    208
209
   210    211    212    213    214    215    216    217    218    219
220
   221    222    223    224    225    226    227    228    229    230
231
   232    233    234    235    236    237    238    239    240    241
242
   243    244    245    246    247    248    249    250    251    252
253
   254    255    256    257    258    259    260    261    262    263
264
   265    266    267    268    269    270    271    272    273    274
275
275 least connected observation(s) - with  2 link(s):
     1      2      3      4      5      6      7      8      9     10
11
    12     13     14     15     16     17     18     19     20     21
22
    23     24     25     26     27     28     29     30     31     32
33
    34     35     36     37     38     39     40     41     42     43
44
    45     46     47     48     49     50     51     52     53     54
55
    56     57     58     59     60     61     62     63     64     65
66
    67     68     69     70     71     72     73     74     75     76
77
    78     79     80     81     82     83     84     85     86     87
88
    89     90     91     92     93     94     95     96     97     98
99
   100    101    102    103    104    105    106    107    108    109
110
   111    112    113    114    115    116    117    118    119    120
121
```

```
   122    123    124    125    126    127    128    129    130    131
132
   133    134    135    136    137    138    139    140    141    142
143
   144    145    146    147    148    149    150    151    152    153
154
   155    156    157    158    159    160    161    162    163    164
165
   166    167    168    169    170    171    172    173    174    175
176
   177    178    179    180    181    182    183    184    185    186
187
   188    189    190    191    192    193    194    195    196    197
198
   199    200    201    202    203    204    205    206    207    208
209
   210    211    212    213    214    215    216    217    218    219
220
   221    222    223    224    225    226    227    228    229    230
231
   232    233    234    235    236    237    238    239    240    241
242
   243    244    245    246    247    248    249    250    251    252
253
   254    255    256    257    258    259    260    261    262    263
264
   265    266    267    268    269    270    271    272    273    274
275
^Frequency Count for Weights File kn_3_2s
Connections    Frequency
          2        275
Connectivity characteristics of weights matrix 2_2
Weights matrix stored in GAL format
Weights are row-standardized
Dimension:                         275
# nonzero links:                 2998
% nonzero weights:               3.97877
Average weight:                  0.0917278
Average # links:                 10.9018
 3 most connected observation(s) - with 22 link(s):
   174    200    202
 3 least connected observation(s) - with  2 link(s):
   156    217    225
^Frequency Count for Weights File 2_2
Connections    Frequency

          2          3
          3          4
          4          9
          5         11
          6         11
          7         17
          8         18
          9         21
         10         23
         11         42
         12         19
```

```
        13         37
        14         19
        15         13
        16          6
        17          5
        18          8
        19          4
        20          0
        21          2
        22          3
Connectivity characteristics of weights matrix 2_3
Weights matrix stored in GAL format
Weights are row-standardized
Dimension:                      275
# nonzero links:               4440
% nonzero weights:             5.89250
Average weight:                0.0619369
Average # links:               16.1455
 1 most connected observation(s) - with 31 link(s):
   198
 1 least connected observation(s) - with  2 link(s):
   217
^Frequency Count for Weights File 2_3
Connections    Frequency

         2          1
         3          0
         4          4
         5          8
         6          6
         7          9
         8          5
         9         12
        10         11
        11          9
        12         13
        13         15
        14         17
        15          9
        16         19
        17         19
        18         16
        19         19
        20         12
        21         12
        22         16
        23         10
        24         10
        25          8
        26          3
        27          7
        28          2
        29          2
        30          0
        31          1
Connectivity characteristics of weights matrix rook
Weights matrix stored in GAL format
```

```
Weights are row-standardized
Dimension:                         275
# nonzero links:                 1442
% nonzero weights:               1.91374
Average weight:                  0.190707
Average # links:                 5.24364
 2 most connected observation(s) - with 10 link(s):
   209    274
 1 least connected observation(s) - with  1 link(s):
   141
^Frequency Count for Weights File rook
Connections    Frequency

          1           1
          2          17
          3          22
          4          41
          5          86
          6          46
          7          35
          8          19
          9           6
         10           2
Connectivity characteristics of weights matrix queen
Weights matrix stored in GAL format
Weights are row-standardized
Dimension:                         275
# nonzero links:                 1456
% nonzero weights:               1.93232
Average weight:                  0.188874
Average # links:                 5.29455
 3 most connected observation(s) - with 10 link(s):
   194    209    274
 1 least connected observation(s) - with  1 link(s):
   141
^Frequency Count for Weights File queen
Connections    Frequency

          1           1
          2          17
          3          21
          4          41
          5          81
          6          50
          7          35
          8          20
          9           6
         10           3


TESTS FOR SPATIAL DEPENDENCE
ORDINARY LEAST SQUARES ESTIMATION
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 271
R2          0.5159     R2-adj      0.5105
LIK        -183.320    AIC         374.639    SC         389.106
```

```
RSS         61.0765    F-test      96.2573    Prob 1.94637e-042
SIG-SQ     0.225375  (    0.474736 ) SIG-SQ(ML)     0.222097  (
0.471271 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT     2.42786    0.399209    6.081680    0.000000
LINCPC90    0.454962   0.0560489    8.117248    0.000000
 LINVP90    0.257756   0.0371117    6.945415    0.000000
   LM290   -0.292382   0.0234125  -12.488308    0.000000




REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER    34.931108
TEST ON NORMALITY OF ERRORS
TEST                  DF      VALUE        PROB
Jarque-Bera            2    20.545063     0.000035
DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS
TEST                  DF      VALUE        PROB
Koenker-Bassett test   3    12.819347     0.005044
SPECIFICATION ROBUST TEST
TEST                  DF      VALUE        PROB
White                  9    64.342527     0.000000

DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX     ROOK (row-standardized weights)
TEST                            MI/DF        VALUE        PROB
Moran's I (error)              0.104687     2.937152     0.003312
Lagrange Multiplier (error)           1     7.333338     0.006769
Robust LM (error)                     1     1.232096     0.267000
Kelejian-Robinson (error)             4    12.717317     0.012743
Lagrange Multiplier (lag)             1    20.510873     0.000006
Robust LM (lag)                       1    14.409631     0.000147
Lagrange Multiplier (SARMA)           2    21.742969     0.000019
FOR WEIGHTS MATRIX    QUEEN (row-standardized weights)
TEST                            MI/DF        VALUE        PROB
Moran's I (error)              0.104170     2.935004     0.003335
Lagrange Multiplier (error)           1     7.314530     0.006840
Robust LM (error)                     1     1.172727     0.278842
Kelejian-Robinson (error)             4    12.448542     0.014310
Lagrange Multiplier (lag)             1    20.266899     0.000007
Robust LM (lag)                       1    14.125096     0.000171
Lagrange Multiplier (SARMA)           2    21.439625     0.000022
```

```
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)              0.025552     5.504620     0.000000
Lagrange Multiplier (error)           1    10.989890     0.000916
Robust LM (error)                     1     0.459614     0.497805
Kelejian-Robinson (error)             4     1.020540     0.906666
Lagrange Multiplier (lag)             1    26.411912     0.000000
Robust LM (lag)                       1    15.881636     0.000067
Lagrange Multiplier (SARMA)           2    26.871526     0.000001
FOR WEIGHTS MATRIX  KN_3_3S (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)              0.112770     2.624984     0.008665
Lagrange Multiplier (error)           1     5.957036     0.014659
Robust LM (error)                     1     0.787185     0.374953
Kelejian-Robinson (error)             4     8.413769     0.077545
Lagrange Multiplier (lag)             1    16.209240     0.000057
Robust LM (lag)                       1    11.039388     0.000892
Lagrange Multiplier (SARMA)           2    16.996425     0.000204
FOR WEIGHTS MATRIX  KN_3_2S (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)              0.135213     2.574379     0.010042
Lagrange Multiplier (error)           1     5.870978     0.015393
Robust LM (error)                     1     0.875789     0.349358
Kelejian-Robinson (error)             4     4.792564     0.309251
Lagrange Multiplier (lag)             1    15.375529     0.000088
Robust LM (lag)                       1    10.380340     0.001274
Lagrange Multiplier (SARMA)           2    16.251318     0.000296

FOR WEIGHTS MATRIX      2_2 (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)              0.119247     4.711966     0.000002
Lagrange Multiplier (error)           1    18.891482     0.000014
Robust LM (error)                     1     0.004459     0.946761
Kelejian-Robinson (error)             4    20.473736     0.000403
Lagrange Multiplier (lag)             1    34.025026     0.000000
Robust LM (lag)                       1    15.138002     0.000100
Lagrange Multiplier (SARMA)           2    34.029485     0.000000
FOR WEIGHTS MATRIX      2_3 (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)              0.068944     3.393887     0.000689
Lagrange Multiplier (error)           1     9.231717     0.002379
Robust LM (error)                     1     0.629644     0.427486
Kelejian-Robinson (error)             4    26.233311     0.000028
Lagrange Multiplier (lag)             1    24.213040     0.000001
Robust LM (lag)                       1    15.610967     0.000078
Lagrange Multiplier (SARMA)           2    24.842684     0.000004


INTRODUCING THE SPATIAL REGIMES
ORDINARY LEAST SQUARES ESTIMATION
STRUCTURAL CHANGE - DIFFERENT SLOPES FOLLOWING VARIABLE    COAST
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   8      DF 267
R2          0.5904     R2-adj      0.5797
LIK        -160.322    AIC         336.645    SC         365.579
RSS         51.6698
```

```
SIG-SQ     0.193520  (    0.439909 ) SIG-SQ(ML)     0.187890  (
0.433463 )


VARIABLE    COEFF       S.D.      t-value        Prob
 CONST_0     0.25763     0.55555    0.463739    0.643213
 LINCP_0    0.199855   0.0732095    2.729901    0.006757
 LINVP_0   0.0861443   0.0494058    1.743608    0.082379
 LM290_0   -0.244123   0.0263315   -9.271146    0.000000
 CONST_1     4.95072    0.620913    7.973280    0.000000
 LINCP_1    0.442469    0.095805    4.618436    0.000006
 LINVP_1    0.485791   0.0626408    7.755193    0.000000
 LM290_1    -0.24375   0.0462973   -5.264883    0.000000


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER    45.486843
TEST ON NORMALITY OF ERRORS
TEST                  DF      VALUE        PROB
Jarque-Bera            2    25.518803     0.000003
TEST ON STRUCTURAL INSTABILITY FOR  2  REGIMES DEFINED BY    COAST
TEST                  DF      VALUE        PROB
Chow test         4 267    12.152110     0.000000
STABILITY OF INDIVIDUAL COEFFICIENTS
TEST                  DF      VALUE        PROB
 CONST_0          1 267    31.728653     0.000000
 LINCP_0          1 267     4.048764     0.045208
 LINVP_0          1 267    25.093916     0.000001
 LM290_0          1 267     0.000049     0.994416
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT  COAST_1
TEST                  DF      VALUE        PROB
Koenker-Bassett test  1     0.089269     0.765109
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX    QUEEN (row-standardized weights)
TEST                            MI/DF        VALUE        PROB
Moran's I (error)             0.061742     1.902713     0.057078
Lagrange Multiplier (error)          1     2.569608     0.108935
Robust LM (error)                    1     0.368730     0.543698
Kelejian-Robinson (error)            8    18.217692     0.019652
Lagrange Multiplier (lag)            1     7.553622     0.005989
Robust LM (lag)                      1     5.352743     0.020690
Lagrange Multiplier (SARMA)          2     7.922351     0.019041
FOR WEIGHTS MATRIX     ROOK (row-standardized weights)
TEST                            MI/DF        VALUE        PROB
Moran's I (error)             0.062666     1.919354     0.054940
Lagrange Multiplier (error)          1     2.627745     0.105011
Robust LM (error)                    1     0.386613     0.534085
Kelejian-Robinson (error)            8    19.046457     0.014613
Lagrange Multiplier (lag)            1     7.750634     0.005369
Robust LM (lag)                      1     5.509503     0.018913
Lagrange Multiplier (SARMA)          2     8.137247     0.017101
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                            MI/DF        VALUE        PROB
Moran's I (error)             0.014733     3.807655     0.000140
Lagrange Multiplier (error)          1     3.653547     0.055950
```

```
Robust LM (error)                     1     0.222562     0.637095
Kelejian-Robinson (error)             8     3.223583     0.919553
Lagrange Multiplier (lag)             1    10.801251     0.001014
Robust LM (lag)                       1     7.370266     0.006631
Lagrange Multiplier (SARMA)           2    11.023813     0.004038
FOR WEIGHTS MATRIX  KN_3_2S (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)               0.089110     1.795904     0.072510
Lagrange Multiplier (error)           1     2.549910     0.110301
Robust LM (error)                     1     0.082056     0.774530
Kelejian-Robinson (error)             8     2.376831     0.967227
Lagrange Multiplier (lag)             1     5.719628     0.016776
Robust LM (lag)                       1     3.251775     0.071346
Lagrange Multiplier (SARMA)           2     5.801685     0.054977
FOR WEIGHTS MATRIX      2_2 (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)               0.106695     4.320196     0.000016
Lagrange Multiplier (error)           1    15.123669     0.000101
Robust LM (error)                     1     1.221602     0.269047
Kelejian-Robinson (error)             8    26.820756     0.000759
Lagrange Multiplier (lag)             1    19.844039     0.000008
Robust LM (lag)                       1     5.941972     0.014784
Lagrange Multiplier (SARMA)           2    21.065641     0.000027
FOR WEIGHTS MATRIX      2_3 (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)               0.038155     2.041093     0.041242
Lagrange Multiplier (error)           1     2.827354     0.092671
Robust LM (error)                     1     0.314225     0.575099
Kelejian-Robinson (error)             8    34.872818     0.000028
Lagrange Multiplier (lag)             1    10.025318     0.001544
Robust LM (lag)                       1     7.512189     0.006128
Lagrange Multiplier (SARMA)           2    10.339543     0.005686


ORDINARY LEAST SQUARES ESTIMATION
STRUCTURAL CHANGE - DIFFERENT SLOPES FOLLOWING VARIABLE      ALG
DATA SET     BD90


DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   8      DF 267
R2          0.5523     R2-adj      0.5405
LIK        -172.570    AIC         361.141    SC         390.075
RSS         56.4837
SIG-SQ     0.211549  (    0.459945 ) SIG-SQ(ML)     0.205395  (
0.453205 )


VARIABLE    COEFF       S.D.      t-value        Prob
 CONST_0     1.85191    0.410169    4.514988    0.000010
 LINCP_0     0.39201   0.0575911    6.806789    0.000000
 LINVP_0    0.215295   0.0376287    5.721571    0.000000
 LM290_0   -0.268032   0.0239667  -11.183480    0.000000
 CONST_1     5.70333     2.22903    2.558657    0.011060
 LINCP_1    0.739713    0.268545    2.754525    0.006282
 LINVP_1    0.521003    0.213484    2.440477    0.015318
 LM290_1   -0.294801   0.0947052   -3.112823    0.002054
```

```
REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER    49.241065
TEST ON NORMALITY OF ERRORS
TEST                  DF      VALUE        PROB
Jarque-Bera            2    28.753187     0.000001
TEST ON STRUCTURAL INSTABILITY FOR  2  REGIMES DEFINED BY      ALG
TEST                  DF      VALUE        PROB
Chow test          4 267     5.427691     0.000324
STABILITY OF INDIVIDUAL COEFFICIENTS
TEST                  DF      VALUE        PROB
 CONST_0           1 267     2.887671     0.090425
 LINCP_0           1 267     1.602709     0.206623
 LINVP_0           1 267     1.988812     0.159629
 LM290_0           1 267     0.075086     0.784283
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    ALG_1
TEST                  DF      VALUE        PROB
Koenker-Bassett test   1     0.069353     0.792281
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX    QUEEN (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)               0.056887     1.775819     0.075763
Lagrange Multiplier (error)            1     2.181334     0.139693
Robust LM (error)                      1     0.775336     0.378571
Kelejian-Robinson (error)              8    15.946687     0.043150
Lagrange Multiplier (lag)              1     6.234327     0.012530
Robust LM (lag)                        1     4.828329     0.027996
Lagrange Multiplier (SARMA)            2     7.009663     0.030052
FOR WEIGHTS MATRIX     ROOK (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)               0.057635     1.788284     0.073730
Lagrange Multiplier (error)            1     2.222734     0.135992
Robust LM (error)                      1     0.826906     0.363169
Kelejian-Robinson (error)              8    16.444267     0.036445
Lagrange Multiplier (lag)              1     6.429224     0.011226
Robust LM (lag)                        1     5.033395     0.024863
Lagrange Multiplier (SARMA)            2     7.256130     0.026568
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)               0.015932     4.058763     0.000049
Lagrange Multiplier (error)            1     4.272533     0.038733
Robust LM (error)                      1     0.085923     0.769426
Kelejian-Robinson (error)              8     3.203190     0.920967
Lagrange Multiplier (lag)              1     5.617340     0.017784
Robust LM (lag)                        1     1.430730     0.231645
Lagrange Multiplier (SARMA)            2     5.703262     0.057750
FOR WEIGHTS MATRIX  KN_3_2S (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)               0.093352     1.861446     0.062681
Lagrange Multiplier (error)            1     2.798492     0.094353
Robust LM (error)                      1     0.342508     0.558385
Kelejian-Robinson (error)              8     6.416456     0.600689
Lagrange Multiplier (lag)              1     6.196787     0.012798
Robust LM (lag)                        1     3.740803     0.053099
Lagrange Multiplier (SARMA)            2     6.539294     0.038020
```

```
FOR WEIGHTS MATRIX      2_2 (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)              0.091787     3.788757     0.000151
Lagrange Multiplier (error)           1    11.192800     0.000821
Robust LM (error)                     1     0.185839     0.666402
Kelejian-Robinson (error)             8    30.139704     0.000200
Lagrange Multiplier (lag)             1    16.566144     0.000047
Robust LM (lag)                       1     5.559183     0.018384
Lagrange Multiplier (SARMA)           2    16.751983     0.000230
FOR WEIGHTS MATRIX      2_3 (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)              0.049911     2.594123     0.009483
Lagrange Multiplier (error)           1     4.838212     0.027836
Robust LM (error)                     1     0.000133     0.990808
Kelejian-Robinson (error)             8    53.646186     0.000000
Lagrange Multiplier (lag)             1     9.377696     0.002196
Robust LM (lag)                       1     4.539616     0.033119
Lagrange Multiplier (SARMA)           2     9.377828     0.009197


HETEROSKEDASTIC ERROR MODEL (GENERIC)
FGLS ESTIMATION
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 271
R2          0.4648     Sq. Corr.   0.5152     R2(Buse)    0.4826


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT     2.06385    0.400408    5.154361    0.000000
LINCPC90    0.414286   0.0559409    7.405782    0.000000
 LINVP90    0.230363   0.0368692    6.248120    0.000000
   LM290     -0.2799   0.0231067  -12.113361    0.000000


HETEROSKEDASTIC COEFFICIENTS
VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT    0.201534   0.0198819   10.136548    0.000000
   COAST   0.0272361   0.0479708    0.567765    0.570194
     ALG    0.235899     0.16607    1.420481    0.155468


REGRESSION DIAGNOSTICS
TESTS ON HETEROSKEDASTICITY
TEST                 DF      VALUE        PROB
Wald test             2     2.718953     0.256795


DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX    QUEEN (row-standardized weights)
TEST                               DF          VALUE        PROB
Lagrange Multiplier (error)             1     5.466371     0.019386
Lagrange Multiplier (lag)               1    13.459112     0.000244
FOR WEIGHTS MATRIX     ROOK (row-standardized weights)
TEST                               DF          VALUE        PROB
Lagrange Multiplier (error)             1     5.506809     0.018943
Lagrange Multiplier (lag)               1    13.713715     0.000213
```

```
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)            1     8.537159     0.003480
Lagrange Multiplier (lag)              1    17.705229     0.000026
FOR WEIGHTS MATRIX  KN_3_2S (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)            1     5.330833     0.020951
Lagrange Multiplier (lag)              1    11.777281     0.000600
FOR WEIGHTS MATRIX      2_2 (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)            1    19.113775     0.000012
Lagrange Multiplier (lag)              1    30.223971     0.000000
FOR WEIGHTS MATRIX      2_3 (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)            1     6.851736     0.008856
Lagrange Multiplier (lag)              1    16.627856     0.000045


HETEROSKEDASTIC ERROR MODEL (GROUPWISE)
FGLS ESTIMATION
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 271
GROUPS               COAST_0  COAST_1
R2          0.4864     Sq. Corr.   0.5151


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT     2.13359    0.409809    5.206292    0.000000
LINCPC90    0.422463   0.0568411    7.432347    0.000000
 LINVP90     0.23446   0.0377668    6.208091    0.000000
   LM290   -0.286464   0.0231655  -12.365981    0.000000


HETEROSKEDASTIC COEFFICIENTS
VARIABLE    COEFF       S.D.      z-value        Prob
 COAST_0    0.202658   0.0198723   10.198039    0.000000
 COAST_1    0.282442   0.0487985    5.787918    0.000000


REGRESSION DIAGNOSTICS
TESTS ON HETEROSKEDASTICITY
TEST                 DF      VALUE        PROB
Wald test             1     2.292844     0.129972


DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX    QUEEN (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)            1     6.728216     0.009490
Lagrange Multiplier (lag)              1    17.409845     0.000030
FOR WEIGHTS MATRIX     ROOK (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)            1     6.759005     0.009328
Lagrange Multiplier (lag)              1    17.676753     0.000026
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                              DF          VALUE        PROB
```

```
Lagrange Multiplier (error)           1    10.548302     0.001163
Lagrange Multiplier (lag)             1    23.517860     0.000001
FOR WEIGHTS MATRIX  KN_3_2S (row-standardized weights)
TEST                                 DF          VALUE        PROB
Lagrange Multiplier (error)           1     5.361447     0.020587
Lagrange Multiplier (lag)             1    13.738473     0.000210
FOR WEIGHTS MATRIX  KN_3_2S (row-standardized weights)
TEST                                 DF          VALUE        PROB
Lagrange Multiplier (error)           1     5.361447     0.020587
Lagrange Multiplier (lag)             1    13.738473     0.000210
FOR WEIGHTS MATRIX      2_2 (row-standardized weights)
TEST                                 DF          VALUE        PROB
Lagrange Multiplier (error)           1    20.220538     0.000007
Lagrange Multiplier (lag)             1    33.985278     0.000000
FOR WEIGHTS MATRIX      2_3 (row-standardized weights)
TEST                                 DF          VALUE        PROB
Lagrange Multiplier (error)           1     8.427434     0.003696
Lagrange Multiplier (lag)             1    21.909706     0.000003


HETEROSKEDASTIC ERROR MODEL (GROUPWISE)
FGLS ESTIMATION
DATA SET     BD90


DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 271
GROUPS                 ALG_0    ALG_1
R2          0.4699     Sq. Corr.   0.5156


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT     2.13716    0.394541    5.416831    0.000000
LINCPC90    0.423602   0.0554056    7.645459    0.000000
 LINVP90    0.236236   0.0364323    6.484246    0.000000
   LM290   -0.280333   0.0230996  -12.135817    0.000000


HETEROSKEDASTIC COEFFICIENTS
VARIABLE    COEFF       S.D.      z-value        Prob
   ALG_0    0.207015   0.0181914   11.379807    0.000000
   ALG_1    0.466235    0.164839    2.828427    0.004678


REGRESSION DIAGNOSTICS
TESTS ON HETEROSKEDASTICITY
TEST                 DF      VALUE        PROB
Wald test             1     2.443210     0.118034


DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX    QUEEN (row-standardized weights)
TEST                                 DF          VALUE        PROB
Lagrange Multiplier (error)           1     5.406486     0.020062
Lagrange Multiplier (lag)             1    13.440963     0.000246
FOR WEIGHTS MATRIX     ROOK (row-standardized weights)
TEST                                 DF          VALUE        PROB
Lagrange Multiplier (error)           1     5.444922     0.019625
```

```
Lagrange Multiplier (lag)            1    13.687313     0.000216
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)          1     8.354873     0.003847
Lagrange Multiplier (lag)            1    17.344045     0.000031
FOR WEIGHTS MATRIX  KN_3_2S (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)          1     5.438615     0.019696
Lagrange Multiplier (lag)            1    11.772597     0.000601
FOR WEIGHTS MATRIX  KN_3_3S (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)          1     5.364213     0.020554
Lagrange Multiplier (lag)            1    11.846051     0.000578
FOR WEIGHTS MATRIX      2_2 (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)          1    18.623461     0.000016
Lagrange Multiplier (lag)            1    29.506414     0.000000
FOR WEIGHTS MATRIX      2_3 (row-standardized weights)
TEST                              DF          VALUE        PROB
Lagrange Multiplier (error)          1     6.885156     0.008691
Lagrange Multiplier (lag)            1    16.403887     0.000051
```

A4

```
SPATIAL ERROR MODEL - MAXIMUM LIKELIHOOD ESTIMATION
DATA SET     BD90                 SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 271
R2          0.4747     Sq. Corr.   0.5154     R2(Buse)    0.4837
LIK        -179.460    AIC         366.920    SC         381.387
SIG-SQ     0.213841  (    0.462429 )


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT     2.19662    0.437765    5.017812    0.000001
LINCPC90    0.452063   0.0567756    7.962270    0.000000
 LINVP90    0.232683   0.0387948    5.997792    0.000000
   LM290    -0.27341   0.0231123  -11.829651    0.000000
  LAMBDA    0.813859     0.12591    6.463793    0.000000


REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    COAST
TEST                 DF      VALUE        PROB
Breusch-Pagan test    1     3.109619     0.077831
Spatial B-P test      1     3.109620     0.077831
DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL ERROR DEPENDENCE FOR WEIGHTS MATRIX   INVD1S (row-standardized
weights)
TEST                      DF      VALUE        PROB
Likelihood Ratio Test      1     7.719095     0.005464
TEST ON COMMON FACTOR HYPOTHESIS
TEST                      DF      VALUE        PROB
Likelihood Ratio Test      3    29.592322     0.000002
Wald Test                  3    27.562930     0.000004
```

```
LAGRANGE MULTIPLIER TEST ON SPATIAL LAG DEPENDENCE
WEIGHT     STAND  ZERO    DF      VALUE        PROB
  INVD1S    yes     no     1    22.400490     0.000002


SPATIAL ERROR MODEL - MAXIMUM LIKELIHOOD ESTIMATION
DATA SET     BD90                  SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 271
R2          0.4747     Sq. Corr.   0.5154     R2(Buse)    0.4837
LIK        -179.460    AIC         366.920    SC         381.387
SIG-SQ     0.213841  (    0.462429 )


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT     2.19662    0.437765    5.017812    0.000001
LINCPC90    0.452063   0.0567756    7.962270    0.000000
 LINVP90    0.232683   0.0387948    5.997792    0.000000
   LM290    -0.27341   0.0231123  -11.829651    0.000000
  LAMBDA    0.813859     0.12591    6.463793    0.000000


REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT      ALG
TEST                 DF      VALUE        PROB
Breusch-Pagan test    1     8.226428     0.004128
Spatial B-P test      1     8.226442     0.004128
DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL ERROR DEPENDENCE FOR WEIGHTS MATRIX   INVD1S (row-standardized
weights)
TEST                      DF      VALUE        PROB
Likelihood Ratio Test      1     7.719095     0.005464
TEST ON COMMON FACTOR HYPOTHESIS
TEST                      DF      VALUE        PROB
Likelihood Ratio Test      3    29.592322     0.000002
Wald Test                  3    27.562930     0.000004
LAGRANGE MULTIPLIER TEST ON SPATIAL LAG DEPENDENCE
WEIGHT     STAND  ZERO    DF      VALUE        PROB
  INVD1S    yes     no     1    22.400490     0.000002

a5

SPATIAL LAG MODEL - IV(2SLS) ESTIMATION
DATA SET     BD90                  SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 270
INSTRUMENTS          W_LINCPC W_LINVP9  W_LM290
R2          0.5754     Sq. Corr.   0.5612
SIG-SQ 0.2051  (0.4529 )


VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC90     2.00625     0.36357    5.518195    0.000000
CONSTANT     4.31467    0.511796    8.430449    0.000000
LINCPC90    0.377136   0.0552956    6.820364    0.000000
 LINVP90    0.223692   0.0359362    6.224703    0.000000
   LM290   -0.248448   0.0237106  -10.478332    0.000000
```

```
REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                                DF        VALUE        PROB
Lagrange Multiplier (error)           1     0.529650     0.466754


INSTRUMENTAL VARIABLES ESTIMATION (2SLS)
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      EXOG   4      DF 270
ENDOGENOUS VARIABLES W_AREA90
INSTRUMENTS          W_COST90  W_INC90  W_POP90
R2          0.5754     Sq. Corr.   0.5612
SIG-SQ 0.2051  (0.4529 )


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT     4.31467    0.511796    8.430449    0.000000
LINCPC90    0.377136   0.0552956    6.820364    0.000000
 LINVP90    0.223692   0.0359362    6.224703    0.000000
   LM290   -0.248448   0.0237106  -10.478332    0.000000
W_AREA90     2.00625     0.36357    5.518195    0.000000


REGRESSION DIAGNOSTICS

DURBIN-WU-HAUSMAN TEST ON EXOGENEITY
All Endogenous Variables
F-test (1 ,269 )    2.639374       Prob     0.105416
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                                DF        VALUE        PROB
Lagrange Multiplier (error)           1     0.616415     0.432382


SPATIAL LAG MODEL - GHET - IV(2SLS) ESTIMATION
DATA SET     BD90                   SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 270
INSTRUMENTS          W_LINCPC W_LINVP9  W_LM290
GROUPS               COAST_0  COAST_1
R2          0.5634     Sq. Corr.   0.5609


Convergence after    8 iterations
VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC90     1.98719    0.366607    5.420473    0.000000
CONSTANT     4.15422    0.521428    7.967001    0.000000
LINCPC90    0.363647   0.0554256    6.560985    0.000000
 LINVP90    0.212125   0.0361753    5.863799    0.000000
   LM290   -0.246798   0.0234686  -10.516092    0.000000
 COAST_0    0.191279           0    0.000000    0.000000
 COAST_1    0.232959           0    0.000000    0.000000
```

```
SPATIAL LAG MODEL - ROBUST - IV(2SLS) ESTIMATION
DATA SET     BD90                  SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 270
INSTRUMENTS          W_LINCPC W_LINVP9  W_LM290
R2          0.5816     Sq. Corr.   0.5608
SIG-SQ 0.2056  (0.4534 )


VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC90     1.96038    0.426427    4.597219    0.000004
CONSTANT     4.47056     0.58883    7.592279    0.000000
LINCPC90    0.361801   0.0682513    5.301020    0.000000
 LINVP90    0.243885   0.0457372    5.332312    0.000000
   LM290    -0.26055   0.0324164   -8.037614    0.000000


SPATIAL LAG MODEL - MAXIMUM LIKELIHOOD ESTIMATION
DATA SET     BD90                  SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   4      DF 271
R2          0.2584     Sq. Corr.   0.2584
LIK        -241.967    AIC         491.933    SC         506.400
SIG-SQ     0.340235  (    0.583296 )


VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC90-1.13105E-006    0.444061   -0.000003    0.999998
CONSTANT     2.51159    0.623844    4.025986    0.000057
W_AREA90     3.62701    0.543895    6.668574    0.000000
 LINVP90  -0.0654521   0.0355952   -1.838790    0.065946


REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT LINCPC90    LM290
TEST                 DF      VALUE        PROB
Breusch-Pagan test    2    43.107391     0.000000
Spatial B-P test      2    43.107391     0.000000
DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL LAG DEPENDENCE FOR WEIGHTS MATRIX   INVD1S (row-standardized
weights)
TEST                     DF      VALUE        PROB
Likelihood Ratio Test      1    -0.000000    -1.000000
LAGRANGE MULTIPLIER TEST ON SPATIAL ERROR DEPENDENCE
WEIGHT     STAND  ZERO    DF      VALUE        PROB
  INVD1S    yes     no     1    20.268292     0.000007
The dataset bd95
with  274 observations on   30  variables:
  NORDEM  X_COORD  Y_COORD    INC95      P95      A95   COST95      ALG
    ATLA    COAST      AMP      AML      LIT    CDIST     LA95   LINC95
 LCOST95     LP95   INVP95    APC95  INCPC95     M295   LAPC95 LINCPC95
   LM295  LINVP95 W_LAPC95 W_LINCPC W_LINVP9  W_LM295


ORDINARY LEAST SQUARES ESTIMATION
DATA SET     BD95
```

```
DEPENDENT VARIABLE    LAPC95       OBS 274      VARS   4      DF 270
R2          0.0906     R2-adj      0.0805
LIK        -307.061    AIC         622.121    SC         636.574
RSS         150.893    F-test      8.97054    Prob 1.10188e-005
SIG-SQ     0.558862  (    0.747571 ) SIG-SQ(ML)     0.550703  (
0.742094 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT    -0.81924    0.669325   -1.223981    0.222026
LINCPC95    0.575095    0.122515    4.694068    0.000004
 LINVP95   0.0670017   0.0541488    1.237361    0.217028
   LM295   0.0593808   0.0799613    0.742619    0.458358


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER    34.569609
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2   836.310589     0.000000
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    COAST
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     7.371063     0.006628
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX     ID95 (row-standardized weights)
TEST                            MI/DF        VALUE        PROB
Moran's I (error)              0.000202     0.939813     0.347314
Lagrange Multiplier (error)           1     0.000684     0.979131
Robust LM (error)                     1     6.587196     0.010271
Kelejian-Robinson (error)             4     3.266621     0.514238
Lagrange Multiplier (lag)             1     1.631194     0.201538
Robust LM (lag)                       1     8.217706     0.004148
Lagrange Multiplier (SARMA)           2     8.218390     0.016421


SPATIAL LAG MODEL - MAXIMUM LIKELIHOOD ESTIMATION
DATA SET     BD95                  SPATIAL WEIGHTS MATRIX     ID95
DEPENDENT VARIABLE    LAPC95       OBS 274      VARS   5      DF 269
R2          0.0930     Sq. Corr.   0.0969
LIK        -306.374    AIC         622.747    SC         640.813
SIG-SQ     0.546920  (    0.739540 )


VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC95     0.43158    0.305196    1.414107    0.157331
CONSTANT   -0.327005    0.782167   -0.418076    0.675891
LINCPC95    0.506859    0.124027    4.086672    0.000044
 LINVP95   0.0504431   0.0536742    0.939801    0.347320
   LM295   0.0477218   0.0792102    0.602470    0.546861


REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS
TEST                 DF      VALUE        PROB
```

```
Breusch-Pagan test    3   112.931927     0.000000
Spatial B-P test      3   112.933113     0.000000
DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL LAG DEPENDENCE FOR WEIGHTS MATRIX     ID95 (row-standardized
weights)
TEST                        DF      VALUE        PROB
Likelihood Ratio Test        1     1.374012     0.241124
LAGRANGE MULTIPLIER TEST ON SPATIAL ERROR DEPENDENCE
WEIGHT     STAND  ZERO    DF      VALUE        PROB
    ID95    yes     no     1     3.273923     0.070389


SPATIAL LAG MODEL - MAXIMUM LIKELIHOOD ESTIMATION
DATA SET     BD95                  SPATIAL WEIGHTS MATRIX     ID95
DEPENDENT VARIABLE    LAPC95       OBS 274      VARS   3      DF 271
R2          0.0876     Sq. Corr.   0.0940
LIK        -306.968    AIC         619.935    SC         630.774
SIG-SQ     0.548720  (    0.740756 )


VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC95    0.521987      0.2745    1.901596    0.057224
CONSTANT   -0.511252    0.392192   -1.303575    0.192378
LINCPC95    0.434896   0.0999648    4.350491    0.000014


REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS
TEST                 DF      VALUE        PROB
Breusch-Pagan test    1     7.703244     0.005512
Spatial B-P test      1     7.703245     0.005512
DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL LAG DEPENDENCE FOR WEIGHTS MATRIX     ID95 (row-standardized
weights)
TEST                        DF      VALUE        PROB
Likelihood Ratio Test        1     2.327312     0.127121
LAGRANGE MULTIPLIER TEST ON SPATIAL ERROR DEPENDENCE
WEIGHT     STAND  ZERO    DF      VALUE        PROB
    ID95    yes     no     1     0.966435     0.325571


ORDINARY LEAST SQUARES ESTIMATION
ANALYSIS OF VARIANCE - USING INDICATOR VARIABLES
   COAST
DATA SET     BD95

DEPENDENT VARIABLE    LAPC95       OBS 274      VARS   2      DF 272

R2          0.0767     R2-adj      0.0733
LIK        -309.138    AIC         622.276    SC         629.502
RSS         153.198    F-test      22.6095    Prob 3.22258e-006
SIG-SQ     0.563229  (    0.750486 ) SIG-SQ(ML)     0.559118  (
0.747742 )
```

```
VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT    -1.57272   0.0521624  -30.150410    0.000000
 COAST_1    0.501581    0.105486    4.754949    0.000003


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER     1.719431
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2   431.243221     0.000000
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    COAST
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     4.386295     0.036229
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX     ID95 (row-standardized weights)
TEST                            MI/DF        VALUE        PROB
Moran's I (error)              0.011969     2.906393     0.003656
Lagrange Multiplier (error)           1     2.392214     0.121941
Robust LM (error)                     1     1.705643     0.191552
Kelejian-Robinson (error)             2     1.559976     0.458411
Lagrange Multiplier (lag)             1     4.488970     0.034114
Robust LM (lag)                       1     3.802400     0.051179
Lagrange Multiplier (SARMA)           2     6.194614     0.045171


ORDINARY LEAST SQUARES ESTIMATION
DATA SET     BD95

DEPENDENT VARIABLE    LAPC95       OBS 274      VARS   2      DF 272
R2          0.0391     R2-adj      0.0356
LIK        -314.608    AIC         633.216    SC         640.443
RSS         159.439    F-test      11.0780    Prob  0.000994148
SIG-SQ     0.586173  (    0.765619 ) SIG-SQ(ML)     0.581894  (
0.762820 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT     -1.4884   0.0476654  -31.226115    0.000000
     ALG     0.65652    0.197251    3.328356    0.000994


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER     1.279570
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2   204.522356     0.000000
DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     1.636965     0.200742
SPECIFICATION ROBUST TEST
TEST                 DF      VALUE        PROB
White                 1     1.636965     0.200742
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX     ID95 (row-standardized weights)
```

```
TEST                             MI/DF        VALUE        PROB
Moran's I (error)              0.018678     4.272792     0.000019
Lagrange Multiplier (error)           1     5.826136     0.015790
Robust LM (error)                     1     0.276077     0.599284
Kelejian-Robinson (error)             2     2.066966     0.355766
Lagrange Multiplier (lag)             1     6.533915     0.010584
Robust LM (lag)                       1     0.983856     0.321249
Lagrange Multiplier (SARMA)           2     6.809992     0.033207


ORDINARY LEAST SQUARES ESTIMATION
ANALYSIS OF VARIANCE - USING INDICATOR VARIABLES
     LIT
DATA SET     BD95

DEPENDENT VARIABLE    LAPC95       OBS 274      VARS   2      DF 272
R2          0.0191     R2-adj      0.0155
LIK        -317.429    AIC         638.859    SC         646.085
RSS         162.756    F-test      5.30810    Prob    0.0219805
SIG-SQ     0.598369  (    0.773543 ) SIG-SQ(ML)     0.594001  (
0.770715 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT    -1.54796   0.0631595  -24.508708    0.000000
   LIT_1    0.216308   0.0938866    2.303931    0.021980


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER     2.260754
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2   222.216481     0.000000
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    LIT_1
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1     0.731995     0.392237
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX     ID95 (row-standardized weights)
TEST                             MI/DF        VALUE        PROB
Moran's I (error)              0.029775     6.176410     0.000000
Lagrange Multiplier (error)           1    14.804954     0.000119
Robust LM (error)                     1     0.770679     0.380007
Kelejian-Robinson (error)             2     0.820491     0.663487
Lagrange Multiplier (lag)             1    14.179800     0.000166
Robust LM (lag)                       1     0.145525     0.702849
Lagrange Multiplier (SARMA)           2    14.950479     0.000567


ORDINARY LEAST SQUARES ESTIMATION
ANALYSIS OF VARIANCE - USING INDICATOR VARIABLES
   CDIST
DATA SET     BD95

DEPENDENT VARIABLE    LAPC95       OBS 274      VARS   2      DF 272
R2          0.0009     R2-adj      -0.0028
```

```
LIK        -319.959    AIC         643.919    SC         651.145
RSS         165.790    F-test     0.234298    Prob     0.628745
SIG-SQ     0.609521  (    0.780718 ) SIG-SQ(ML)     0.605072  (
0.777864 )


VARIABLE    COEFF       S.D.      t-value        Prob
CONSTANT    -1.45594   0.0486999  -29.896154    0.000000
 CDIST_1   0.0946375    0.195514    0.484043    0.628745


REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER     1.289737
TEST ON NORMALITY OF ERRORS
TEST                 DF      VALUE        PROB
Jarque-Bera           2   185.182091     0.000000

DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT  CDIST_1
TEST                 DF      VALUE        PROB
Koenker-Bassett test  1    13.028657     0.000307
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX     ID95 (row-standardized weights)
TEST                            MI/DF        VALUE        PROB
Moran's I (error)              0.032333     6.257032     0.000000
Lagrange Multiplier (error)           1    17.458458     0.000029
Robust LM (error)                     1     2.975756     0.084521
Kelejian-Robinson (error)             2     5.259536     0.072095
Lagrange Multiplier (lag)             1    17.584234     0.000027
Robust LM (lag)                       1     3.101533     0.078219
Lagrange Multiplier (SARMA)           2    20.559991     0.000034


INSTRUMENTAL VARIABLES ESTIMATION (2SLS)
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      EXOG   5      DF 269
ENDOGENOUS VARIABLES W_AREA90
INSTRUMENTS           W_POP90  W_INC90 W_COST90 W_L2INVP
R2          0.5923     Sq. Corr.   0.5803
SIG-SQ 0.1969  (0.4437 )


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT    -4.23717     2.51387   -1.685518    0.091889
LINCPC90    0.300876   0.0585756    5.136551    0.000000
 LINVP90    -1.40794    0.472612   -2.979049    0.002891
L2INVP90  -0.0789336   0.0227947   -3.462808    0.000535
   LM290   -0.233099   0.0236754   -9.845630    0.000000
W_AREA90     1.93367    0.356323    5.426739    0.000000


REGRESSION DIAGNOSTICS

DURBIN-WU-HAUSMAN TEST ON EXOGENEITY
All Endogenous Variables
```

```
F-test (1 ,268 )    2.088370       Prob     0.149593
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                                DF        VALUE        PROB
Lagrange Multiplier (error)           1     1.218806     0.269595


INSTRUMENTAL VARIABLES ESTIMATION (2SLS)
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      EXOG   4      DF 269
ENDOGENOUS VARIABLES W_AREA90    LM290
INSTRUMENTS           W_POP90  W_INC90 W_COST90 W_L2INVP
R2          0.4997     Sq. Corr.   0.1722
SIG-SQ 0.4282  (0.6544 )


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT    -15.4349      9.7621   -1.581107    0.113853
LINCPC90    0.347547    0.094234    3.688122    0.000226
 LINVP90    -3.46963     1.80289   -1.924487    0.054294
L2INVP90   -0.160551   0.0739101   -2.172241    0.029837
W_AREA90      3.2798     1.20612    2.719298    0.006542

   LM290    0.179808    0.334822    0.537027    0.591249


REGRESSION DIAGNOSTICS

DURBIN-WU-HAUSMAN TEST ON EXOGENEITY
All Endogenous Variables
F-test (2 ,267 )    2.750174       Prob     0.065728
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                                DF        VALUE        PROB
Lagrange Multiplier (error)           1     0.940345     0.332189


INSTRUMENTAL VARIABLES ESTIMATION (2SLS)
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      EXOG   4      DF 269
ENDOGENOUS VARIABLES W_AREA90  LINVP90
INSTRUMENTS           W_POP90  W_INC90 W_COST90 W_L2INVP
R2          0.5944     Sq. Corr.   0.5803
SIG-SQ 0.1969  (0.4437 )


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT    -4.81111     6.09101   -0.789870    0.429604
LINCPC90    0.295712   0.0769676    3.842028    0.000122
   LM290   -0.231838   0.0266293   -8.706127    0.000000
L2INVP90  -0.0841807    0.055608   -1.513823    0.130071
W_AREA90     1.92961    0.358505    5.382386    0.000000
 LINVP90      -1.517     1.15534   -1.313029    0.189173
```

```
REGRESSION DIAGNOSTICS

DURBIN-WU-HAUSMAN TEST ON EXOGENEITY
All Endogenous Variables
F-test (2 ,267 )    1.045692       Prob     0.352883
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                                DF        VALUE        PROB
Lagrange Multiplier (error)           1     1.202099     0.272903


INSTRUMENTAL VARIABLES ESTIMATION (2SLS)
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      EXOG   4      DF 269
ENDOGENOUS VARIABLES W_AREA90 LINCPC90
INSTRUMENTS           W_POP90  W_INC90 W_COST90 W_L2INVP
R2          0.5614     Sq. Corr.   0.5648
SIG-SQ 0.2041  (0.4518 )


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT    -7.03207      3.5405   -1.986179    0.047013
 LINVP90    -1.95183    0.676872   -2.883597    0.003932
L2INVP90   -0.104696   0.0323584   -3.235512    0.001214
   LM290   -0.234267   0.0241304   -9.708402    0.000000
W_AREA90      2.1759    0.420227    5.177923    0.000000
LINCPC90    0.126362    0.163955    0.770710    0.440879


REGRESSION DIAGNOSTICS

DURBIN-WU-HAUSMAN TEST ON EXOGENEITY
All Endogenous Variables
F-test (2 ,267 )    1.727338       Prob     0.179737
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                                DF        VALUE        PROB
Lagrange Multiplier (error)           1     1.869505     0.171532


INSTRUMENTAL VARIABLES ESTIMATION (2SLS)
DATA SET     BD90

DEPENDENT VARIABLE    LAPC90       OBS 275      EXOG   4      DF 269
ENDOGENOUS VARIABLES W_AREA90 L2INVP90
INSTRUMENTS           W_POP90  W_INC90 W_COST90 W_L2INVP
R2          0.5941     Sq. Corr.   0.5803
SIG-SQ 0.1969  (0.4437 )


VARIABLE    COEFF       S.D.      z-value        Prob
CONSTANT    -4.65997     5.67194   -0.821582    0.411315
LINCPC90    0.297101   0.0741125    4.008780    0.000061
 LINVP90    -1.48862     1.07931   -1.379238    0.167821
   LM290   -0.232338   0.0253851   -9.152539    0.000000
W_AREA90     1.93019     0.35878    5.379889    0.000000
```

```
L2INVP90   -0.082837   0.0521828   -1.587438    0.112413


REGRESSION DIAGNOSTICS

DURBIN-WU-HAUSMAN TEST ON EXOGENEITY
All Endogenous Variables
F-test (2 ,267 )    1.043780       Prob     0.353554
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
TEST                                DF        VALUE        PROB
Lagrange Multiplier (error)           1     1.208431     0.271643
p

SPATIAL LAG MODEL - MAXIMUM LIKELIHOOD ESTIMATION
DATA SET     BD90                   SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   6      DF 269
R2          0.5517     Sq. Corr.   0.5728
LIK        -167.875    AIC         347.750    SC         369.451
SIG-SQ     0.196092  (    0.442822 )


VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC90     0.86362   0.0914672    9.441862    0.000000
CONSTANT     4.89054    0.577098    8.474354    0.000000
LINCPC90    0.370387    0.054087    6.847973    0.000000
   LM290   -0.258384   0.0222295  -11.623436    0.000000
  INVP90    -2997.68     785.703   -3.815283    0.000136
 LINVP90    0.396132   0.0529911    7.475438    0.000000


REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    COAST
TEST                 DF      VALUE        PROB
Breusch-Pagan test    1     2.288295     0.130353
Spatial B-P test      1     2.288295     0.130353
DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL LAG DEPENDENCE FOR WEIGHTS MATRIX   INVD1S (row-standardized
weights)
TEST                     DF      VALUE        PROB
Likelihood Ratio Test      1    16.377624     0.000052
LAGRANGE MULTIPLIER TEST ON SPATIAL ERROR DEPENDENCE
WEIGHT     STAND  ZERO    DF      VALUE        PROB
  INVD1S    yes     no     1     0.381096     0.537017


SPATIAL LAG MODEL - MAXIMUM LIKELIHOOD ESTIMATION
DATA SET     BD90                   SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   6      DF 269
R2          0.5482     Sq. Corr.   0.5704
LIK        -168.694    AIC         349.389    SC         371.089
SIG-SQ     0.197202  (    0.444074 )
```

```
VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC90    0.869059   0.0881334    9.860726    0.000000
CONSTANT    -5.53241     2.48064   -2.230233    0.025732
LINCPC90    0.339434   0.0572808    5.925791    0.000000
   LM290   -0.255826   0.0224726  -11.383917    0.000000
 LINVP90    -1.44645    0.472865   -3.058900    0.002222
L2INVP90  -0.0816692   0.0227972   -3.582422    0.000340


REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    COAST
TEST                 DF      VALUE        PROB
Breusch-Pagan test    1     2.954605     0.085633
Spatial B-P test      1     2.954606     0.085633
DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL LAG DEPENDENCE FOR WEIGHTS MATRIX   INVD1S (row-standardized
weights)
TEST                      DF      VALUE        PROB
Likelihood Ratio Test      1    16.951870     0.000038
LAGRANGE MULTIPLIER TEST ON SPATIAL ERROR DEPENDENCE
WEIGHT     STAND  ZERO    DF      VALUE        PROB
  INVD1S    yes     no     1     0.744295     0.388289


SPATIAL LAG MODEL - MAXIMUM LIKELIHOOD ESTIMATION
DATA SET     BD90                 SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   6      DF 269
R2          0.5517     Sq. Corr.   0.5728
LIK        -167.875    AIC         347.750    SC         369.451
SIG-SQ     0.196092  (    0.442822 )


VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC90     0.86362   0.0914672    9.441862    0.000000
CONSTANT     4.89054    0.577098    8.474354    0.000000
LINCPC90    0.370387    0.054087    6.847973    0.000000
   LM290   -0.258384   0.0222295  -11.623436    0.000000
 LINVP90    0.396132   0.0529911    7.475438    0.000000
  INVP90    -2997.68     785.703   -3.815283    0.000136


REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
LINEAR SPECIFICATION USING VARIABLES
CONSTANT    COAST
TEST                 DF      VALUE        PROB
Breusch-Pagan test    1     2.288295     0.130353
Spatial B-P test      1     2.288295     0.130353
DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL LAG DEPENDENCE FOR WEIGHTS MATRIX   INVD1S (row-standardized
weights)
TEST                      DF      VALUE        PROB
Likelihood Ratio Test      1    16.377624     0.000052
LAGRANGE MULTIPLIER TEST ON SPATIAL ERROR DEPENDENCE
WEIGHT     STAND  ZERO    DF      VALUE        PROB
```

```
  INVD1S    yes     no     1     0.381096     0.537017


SPATIAL LAG MODEL - MAXIMUM LIKELIHOOD ESTIMATION
GROUPWISE HETEROSKEDASTICITY
DATA SET     BD90                 SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      VARS   6      DF 269
GROUPS               COAST_0  COAST_1
R2          0.5265     Sq. Corr.   0.5725
LIK        -166.620    AIC         345.239    SC         366.940


Convergence after    4 iterations
VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC90    0.845528    0.103222    8.191394    0.000000
CONSTANT     4.66414    0.595581    7.831247    0.000000
LINCPC90    0.346541    0.054904    6.311753    0.000000
   LM290   -0.253948    0.022165  -11.457164    0.000000
 LINVP90     0.38047   0.0542222    7.016870    0.000000
  INVP90    -2990.87     768.108   -3.893821    0.000099


GROUP VARIANCES
VARIABLE    COEFF       S.D.      z-value        Prob
 COAST_0    0.179129   0.0175893   10.183997    0.000000
 COAST_1    0.251117   0.0434055    5.785371    0.000000


REGRESSION DIAGNOSTICS
TEST ON GROUPWISE HETEROSKEDASTICITY
GROUPS  COAST_0  COAST_1
TEST                      DF      VALUE        PROB
Likelihood Ratio Test      1     2.510721     0.113074



SPATIAL LAG MODEL - IV(2SLS) ESTIMATION
DATA SET     BD90                 SPATIAL WEIGHTS MATRIX   INVD1S
DEPENDENT VARIABLE    LAPC90       OBS 275      EXOG   3      DF 270
ENDOGENOUS VARIABLES    LM290
INSTRUMENTS           W_INC90  W_POP90 W_COST90 W_LINCPC W_INVP90
R2          0.5580     Sq. Corr.   0.0893
SIG-SQ 0.5194  (0.7207 )


VARIABLE    COEFF       S.D.      z-value        Prob
W_LAPC90      3.4605    0.730867    4.734785    0.000002
CONSTANT     3.64487    0.846355    4.306547    0.000017
LINCPC90    0.450429    0.094131    4.785133    0.000002
  INVP90     -4701.8     2382.29   -1.973645    0.048422
   LM290    0.248635    0.167877    1.481058    0.138591


REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHTS MATRIX   INVD1S (row-standardized weights)
```

TEST	DF	VALUE	PROB
Lagrange Multiplier (error)	1	0.574165	0.448609