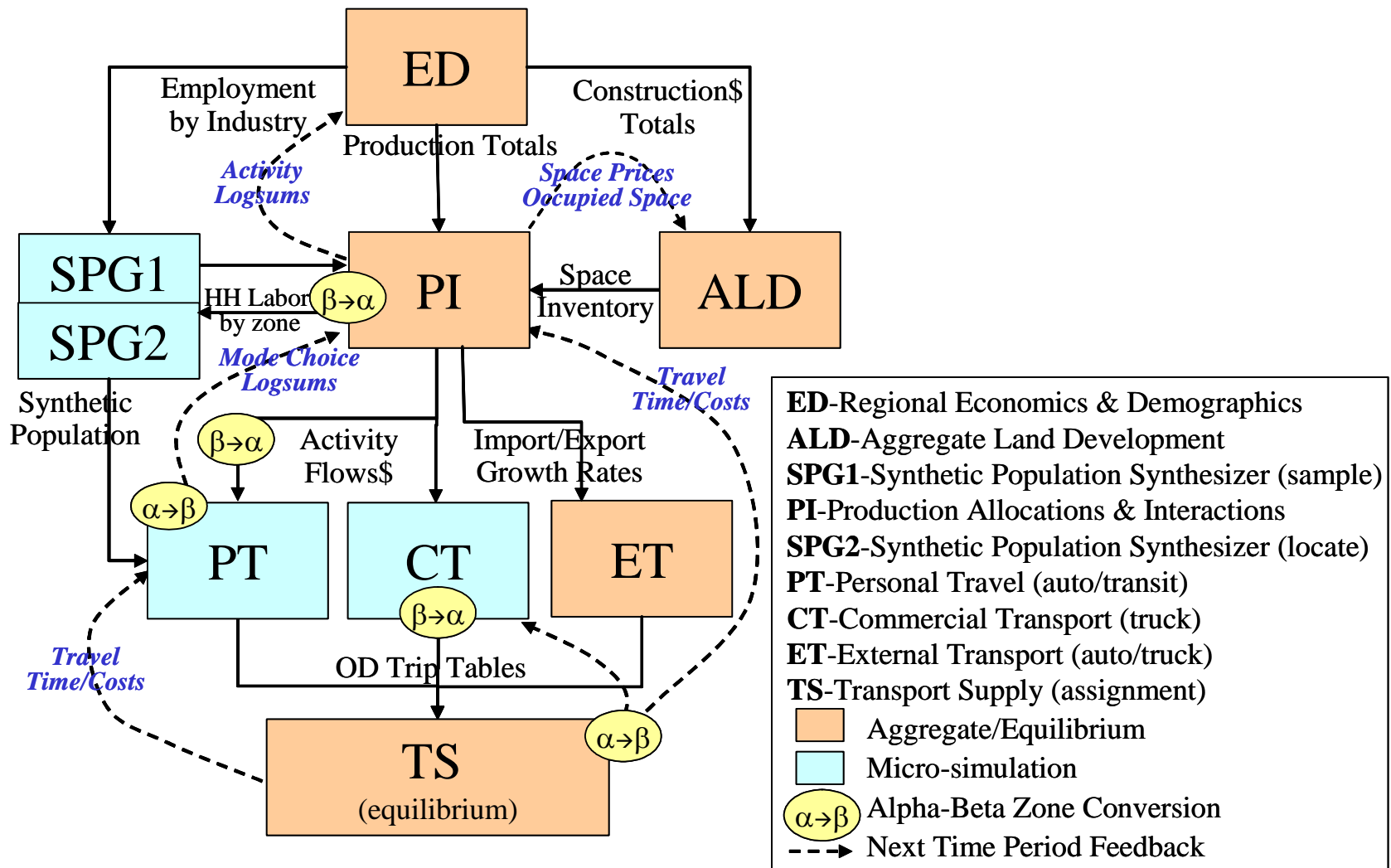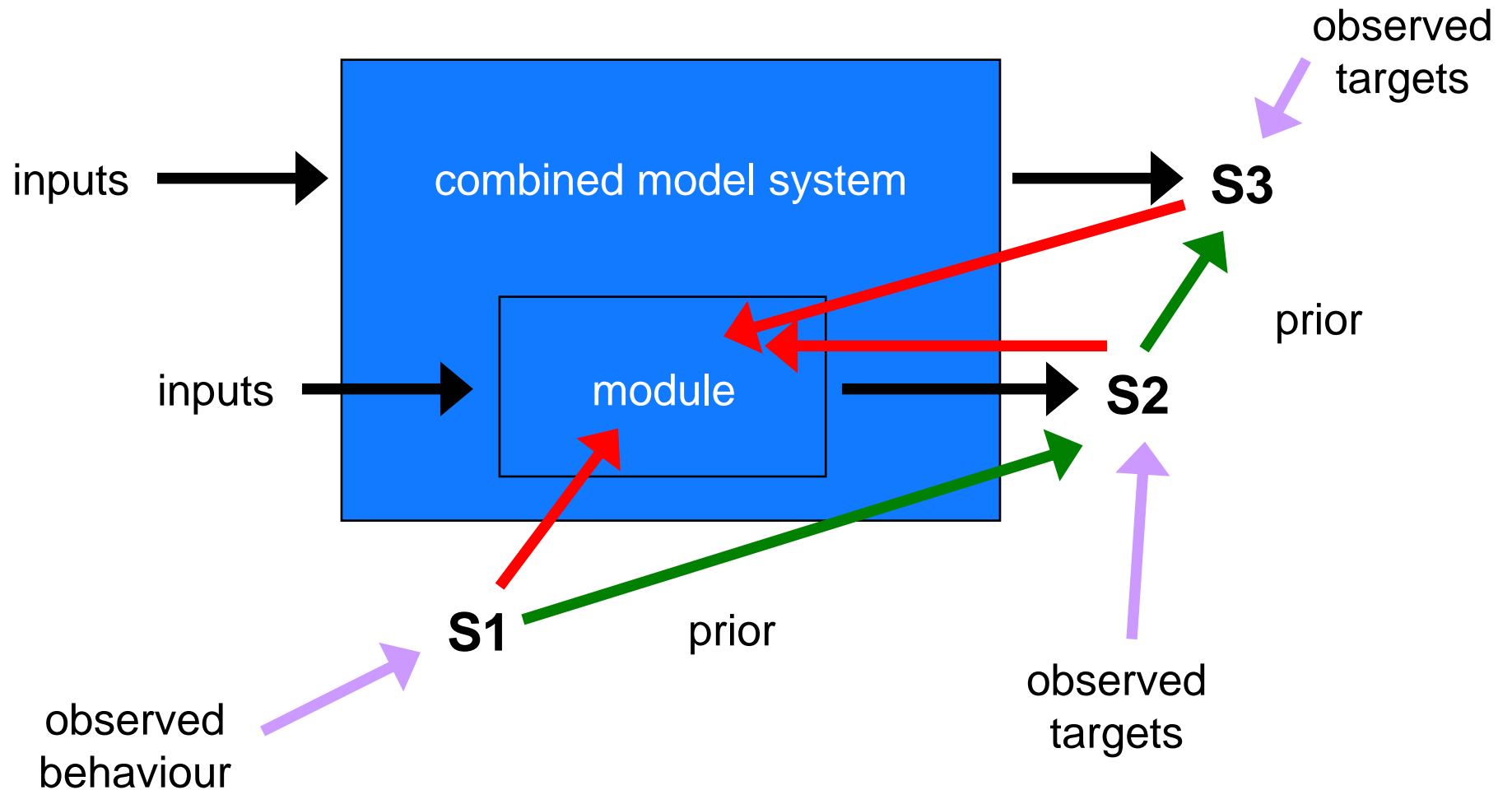# The Oregon Spatial Allocation Models

JE Abraham
JD Hunt
TJ Weidner
B Gregor
Jim Hicks
Carl Batten

Transitional Model structure

Three stage estimation and calibration (Bayesian)
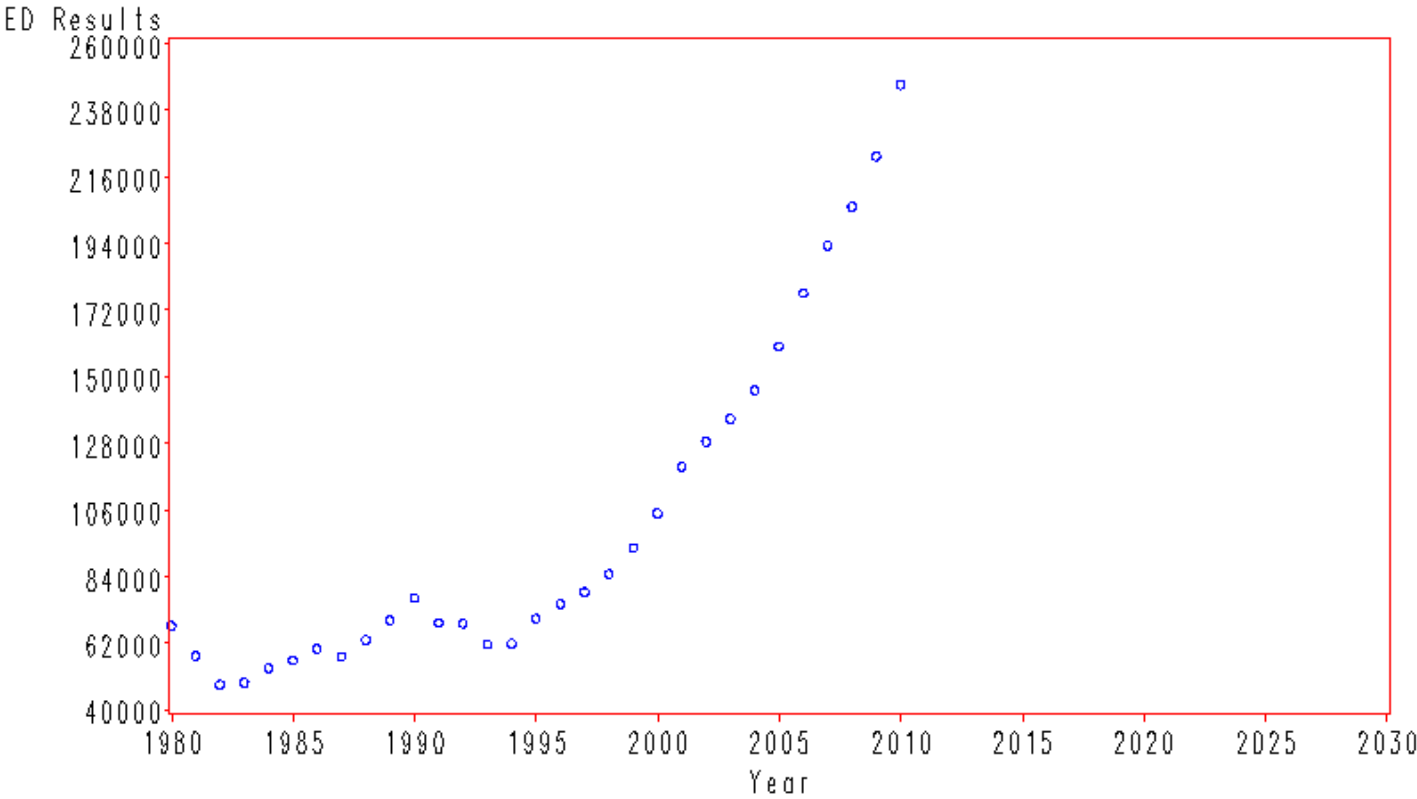
ED Module

- Combined I/O and macro-economic model
  - Linearized time-series equations for
    - Various components of final demand (exports, consumption, investment, and state and local government)
    - The labor market
  - Input-output relationships for industry
- Solved simultaneously

ED Employment Forecast
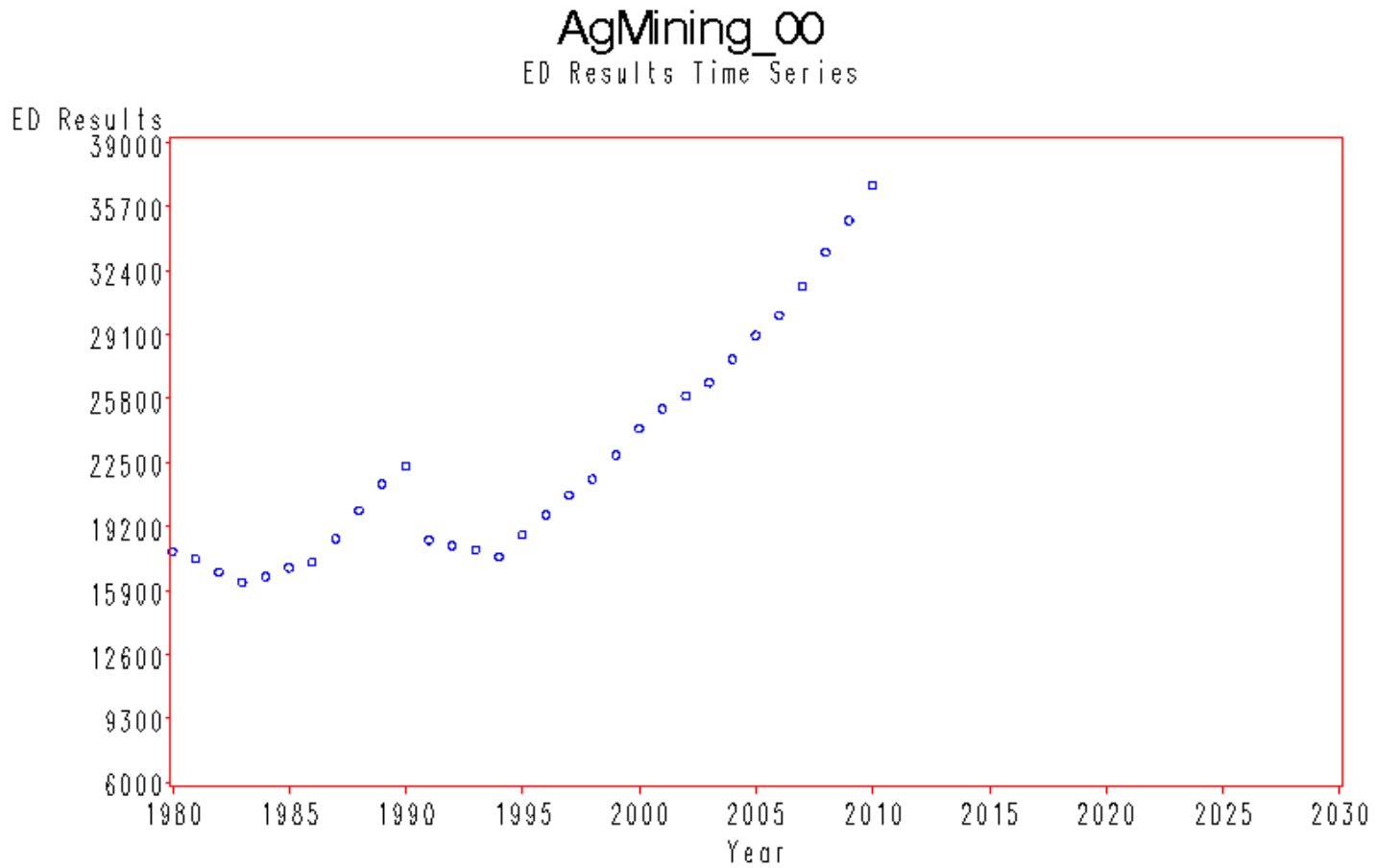
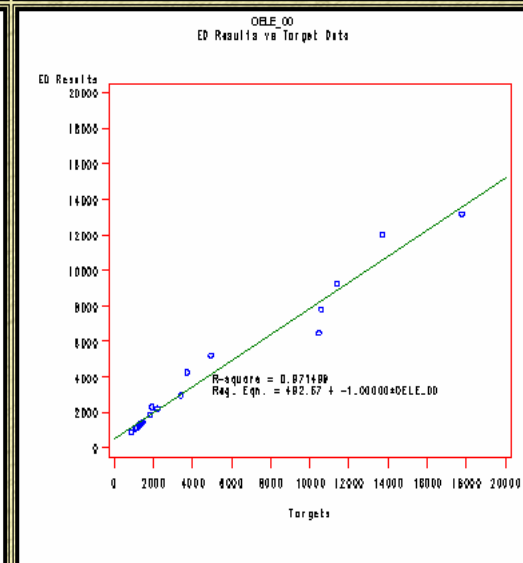# ED Employment Forecast

Construction_00
ED Results Time Series

ED Employment Forecast

FoodProducts_00
ED Results Time Series

ED calibration results

ED Model Changes

- Initially under-predicted population and lumber industry
  - Labor force participation rate equation changed
  - Lumber made constant after an initial decline
    - Trend of last 20 years would eliminate lumber soon

SPG Modules

- SPG1 repeats PUMS household records to supply labor required by industry
  - Matching number of jobs/household distributions
- SPG2 allocates the SPG1 population across zones

SPG Calibration

- Targets:
  - 1990 & 2000 US Census PUMS Employment by Occupation by PUMA
  - 1990 & 2000 US Census PUMS Households by Category by PUMA

SPG Targets

Observed vs Modelled Households in Region
Households by State, PUMA, IncomeSize and Workers
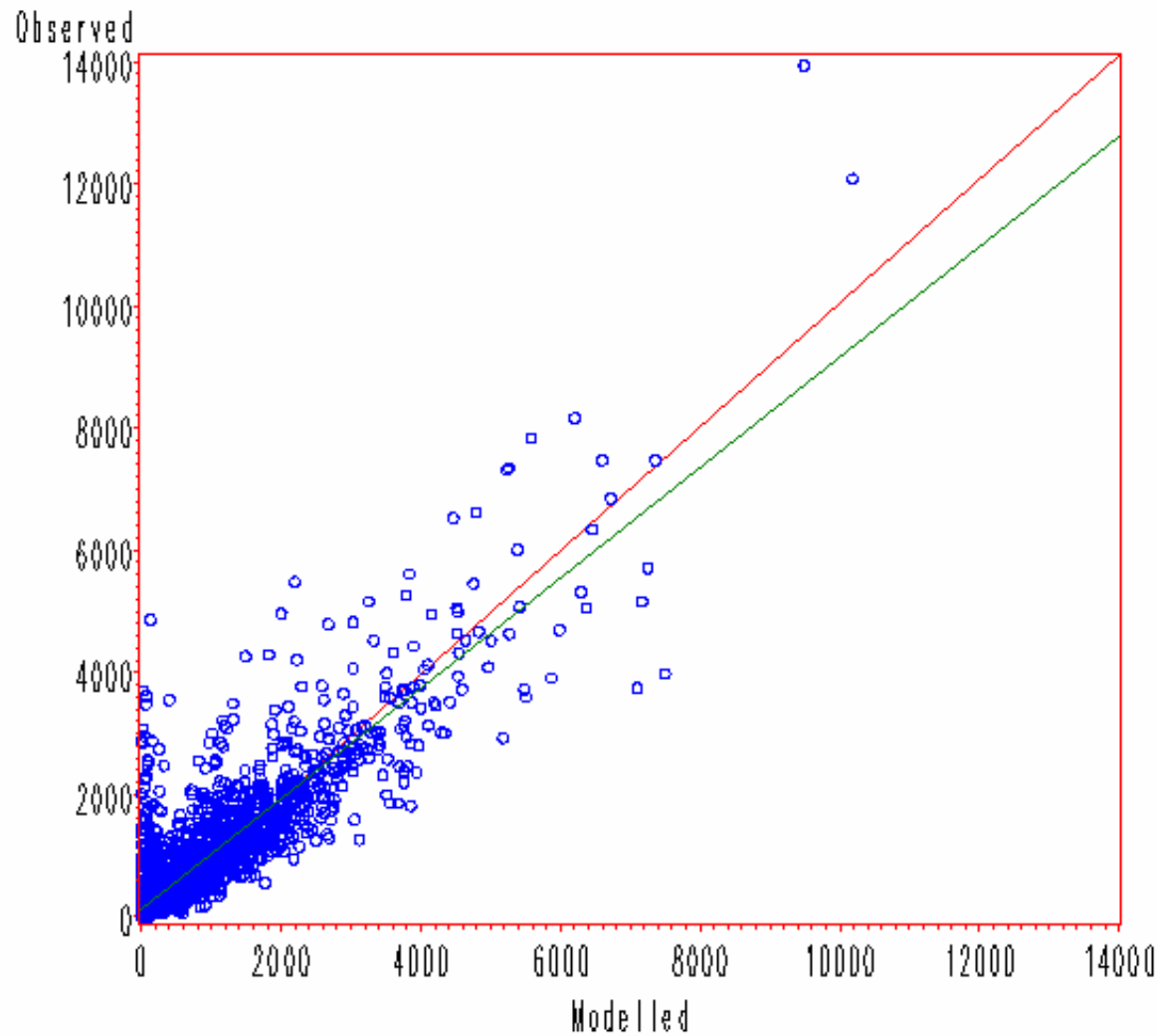
SPG Targets - Nevada

Observed vs Modelled Households in Nevada
Households by PUMA, IncomeSize and Workers
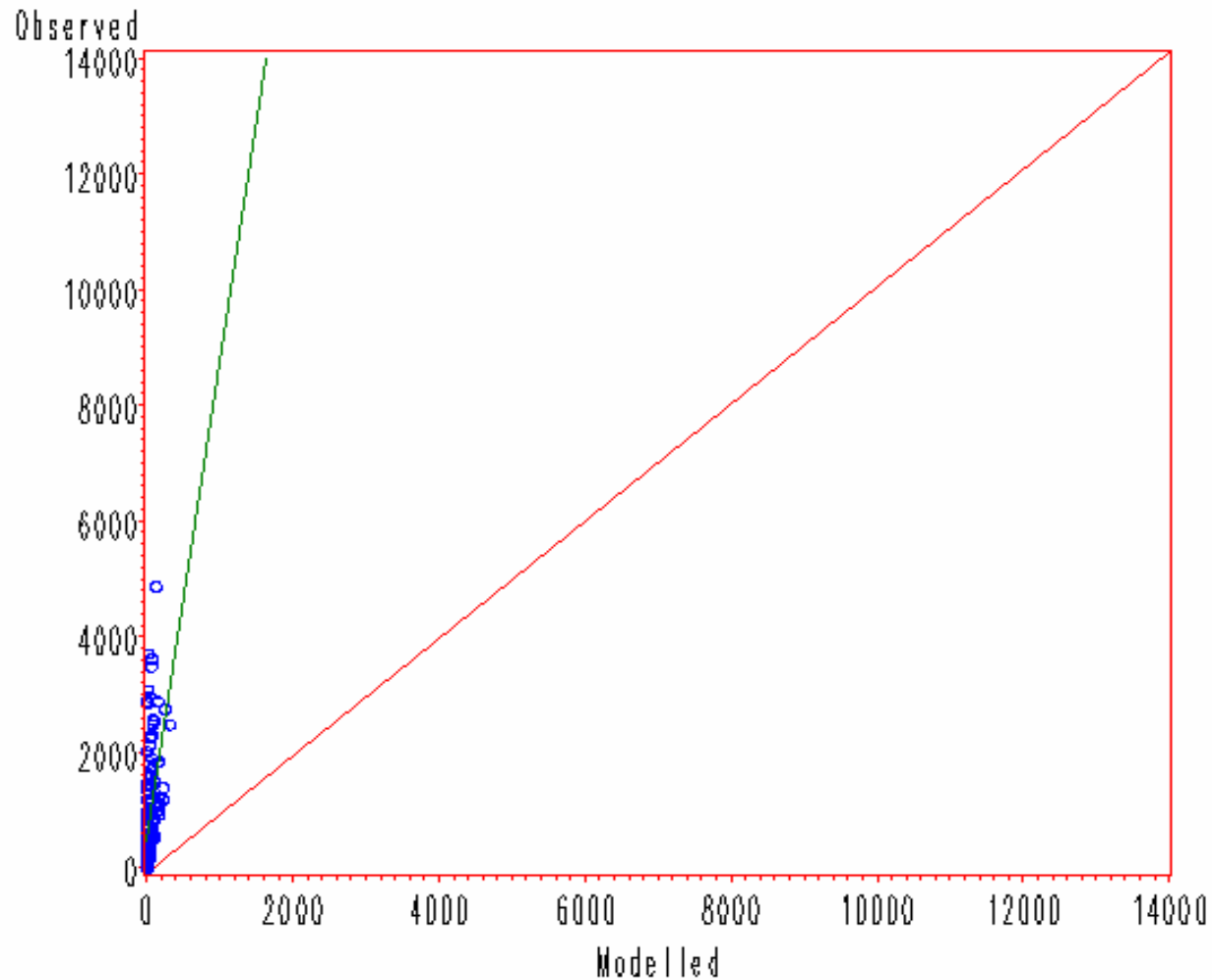
SPG Person Type Targets

Observed vs Modelled Households in Region
Persons by State, PUMA, Industry and Occupation

SPG Calibration

Observed vs Modelled Households in Region
Number of Workers in the Household
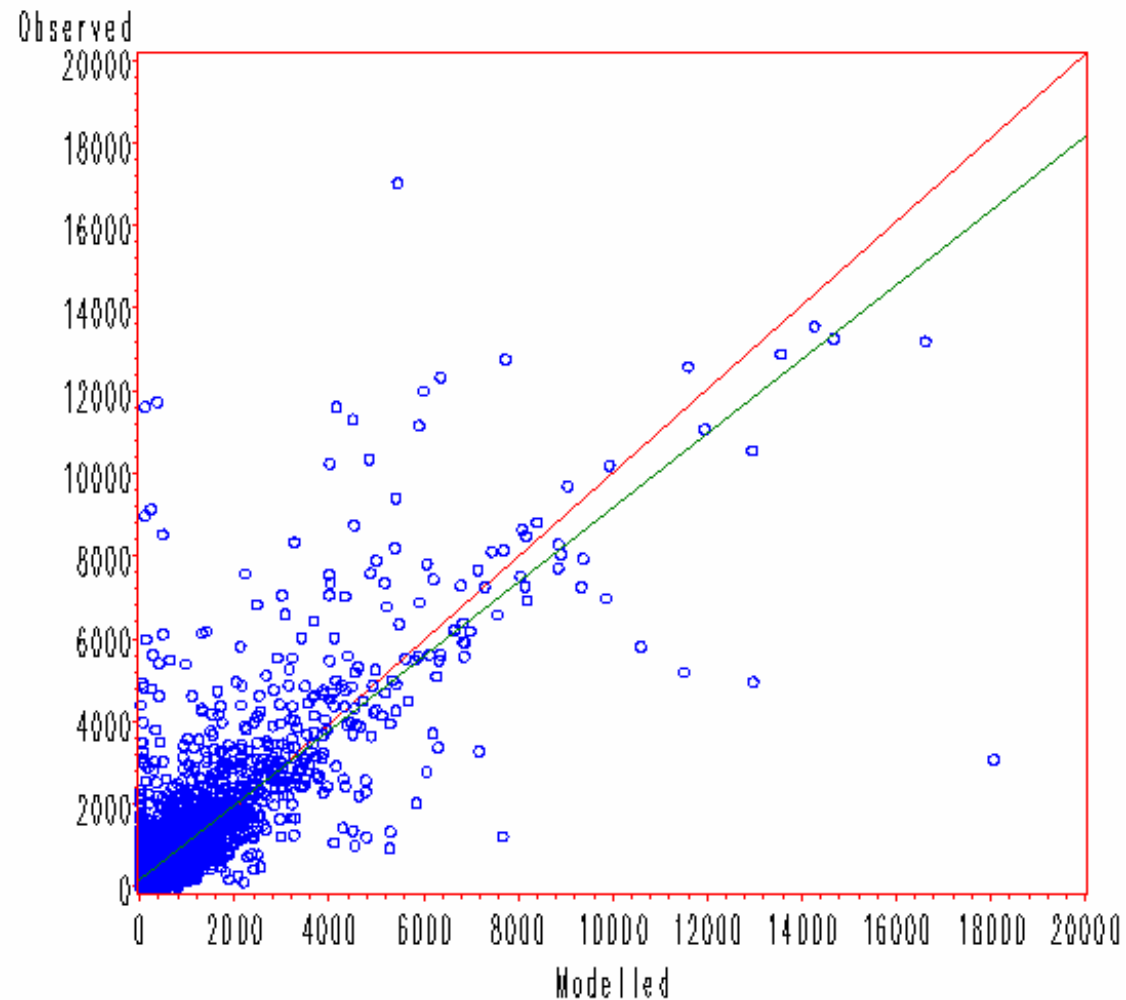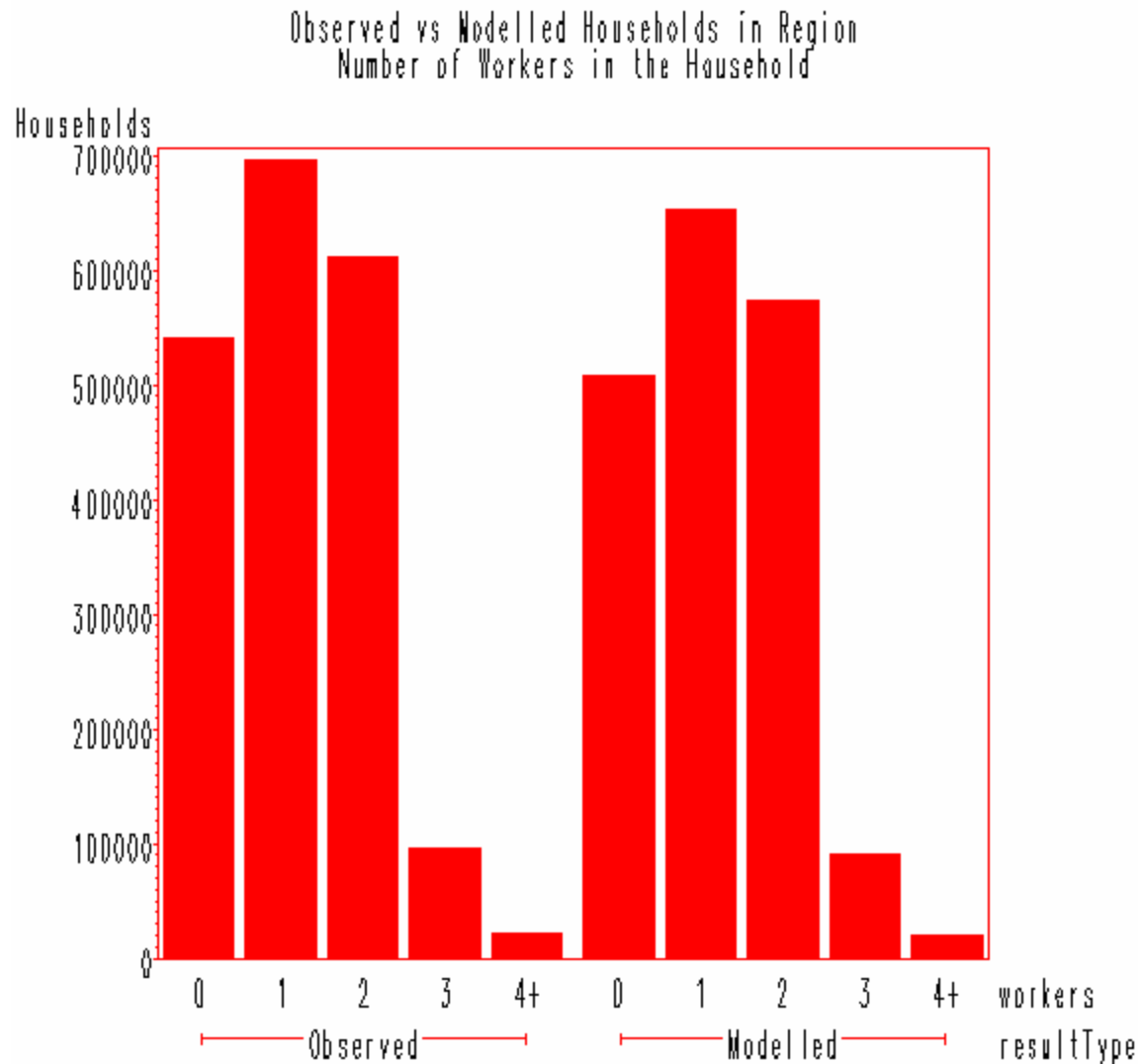
SPG1 Labor Calibration

- Two much labor produced in PI
  - As compared to consumption of labor by industries in PI
- Possible causes
  - Bad PI S1 coefficient calculations
  - SPG broken
  - Changing labor productivity over time
  - ED broken
- Inconsistency between BEA data which counts jobs and census which counts workers
  - Had to adjust ED/SPG link to account for jobs/worker
- Data understanding problem, not model functionality problem
  - Difficult to know in advance whether to adjust parameters to chase goodness of fit or try to understand reasons for lack of fit.

PI Model

LEVEL 1: Location choice

LEVEL 2: Technology Choice

LEVEL 3: Buying & Selling Exchange Choice

exchange locations
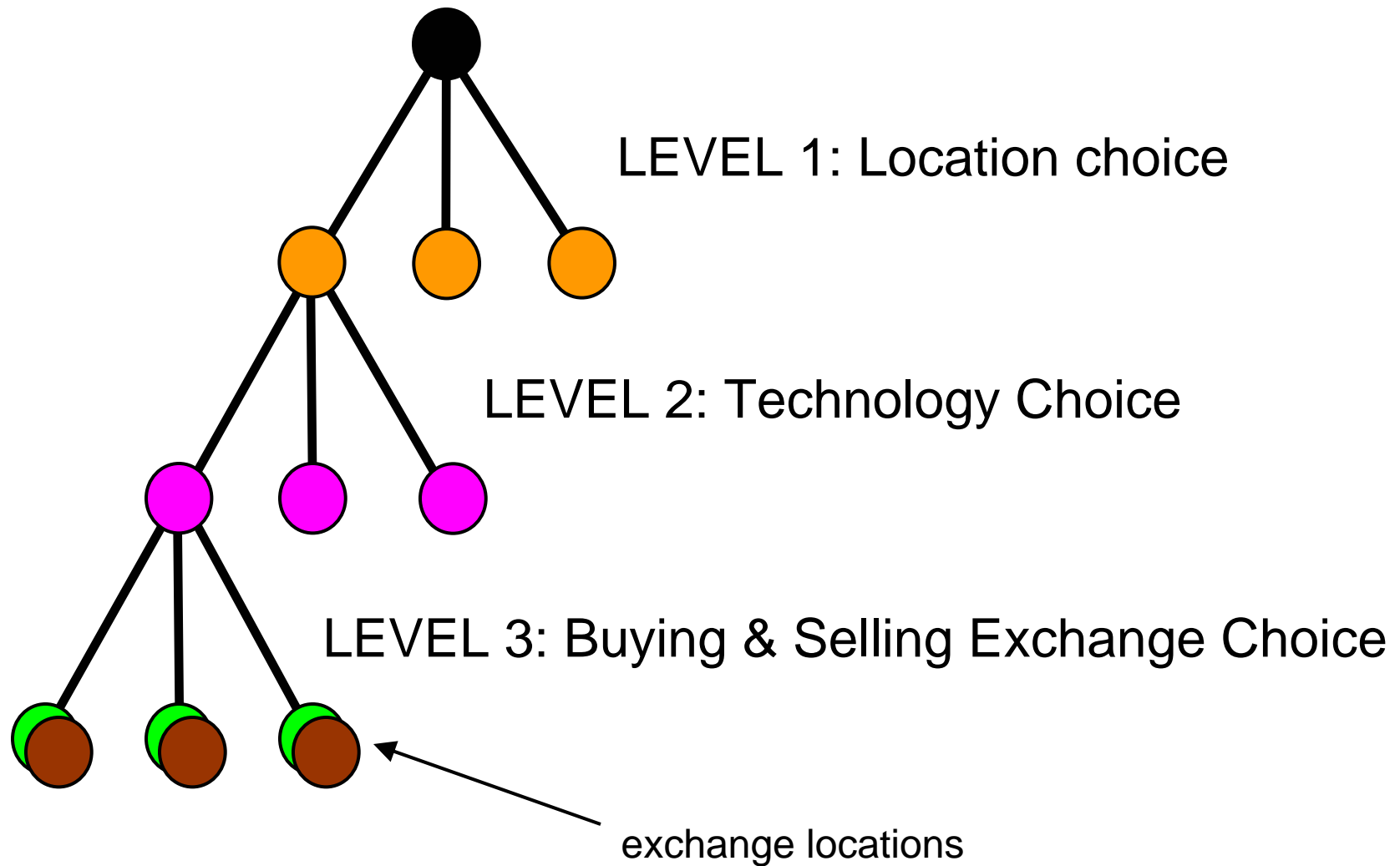
PI Industrial Activities

Accomodations	
Agriculture and mining	Production and offfice
Communication and utilities	Light industry and office
Construction	
Electronics and Instruments	Light Industry and office
FIRE and business and professional services	
Food products	Heavy industry, light industry and office
Forestry and logging	
Government administration	Support and office
Health services	Institutional and office
Higher education	
Home based services	
Lower education	Grade school and office
Lumber and wood products	Heavy industry and office
Other durables	Heavy industry
Other non-durables	Light industry and office
Personal and other services and amusements	
Pulp and paper	Heavy industry and office
Retail trade	Retail and office
Transport	Depot and office
Wholesale trade	Warehouse and office

PI Other Activities

Capitalists
GovInstitutions
HH0to5k1to2
HH0to5k3plus
HH5to10k1to2
HH5to10k3plus
HH10to15k1to2
HH10to15k3plus
HH15to20k1to2
HH15to20k3plus
HH20to30k1to2
HH20to30k3plus
HH30to40k1to2
HH30to40k3plus
HH40to50k1to2
HH40to50k3plus
HH50to70k1to2
HH50to70k3plus
HH70kUp1to2
HH70kUp3plus

PI Commodities: Goods

SCTG01: Live animals and live fish

SCTG02: Cereal grains

SCTG03: Other agricultural products

SCTG04: Animal feed and products of animal origin n.e.c.

SCTG05: Meat fish seafood and their preparations

SCTG06: Milled grain and bakery products

SCTG07: Other prepared foodstuffs and fats and oils

SCTG08: Alcoholic beverages

SCTG09: Tobacco products

SCTG10: Monumental or building stone

SCTG11: Natural sands

SCTG12: Gravel and crushed stone

SCTG13: Nonmetallic minerals n.e.c.

SCTG14: Metallic ores and concentrates

SCTG15: Coal

SCTG16: Natural Gas & Crude Petroleum

SCTG17: Gasoline and aviation turbine fuel

SCTG18: Fuel oils

SCTG19: Coal and petroleum products n.e.c.

SCTG20: Basic chemicals

SCTG21: Pharmaceutical products

SCTG22: Fertilizers

SCTG23: Chemical products and preparations n.e.c.

SCTG24: Plastics and rubber

SCTG25: Logs and other wood in the rough

SCTG26: Wood products

SCTG27: Pulp newsprint paper and paperboard

SCTG28: Paper or paperboard articles

SCTG29: Printed products

SCTG31: Nonmetallic mineral products

SCTG32: Base metal in primary or semi-finished forms and finished basic shapes

SCTG33: Articles of base metal

SCTG34: Machinery

SCTG35: Electronic/electrical equipment and components

SCTG36: Motorized and other vehicles (including parts)

SCTG37: Transportation equipment n.e.c.

SCTG38: Precision instruments and apparatus

SCTG30: Textiles leather and articles of textiles or leather

SCTG39: Furniture mattresses and mattress supports lamps lighting fittings and illuminated signs

SCTG40: Miscellaneous manufactured products

SCTG41: Waste and scrap

N/A (Money and unclassified goods)

PI Commodities: Service

Internal Management Services	Transport
Fire, Business, And Professional Services	Communications And Utilities
Personal And Other Services And Amusements	Construction
Health Services	Government Administration
Accommodations	Higher Education
Real Estate	Lower Education
Home Based Services	
Retail Trade	
Wholesale Trade	

PI Commodities: Labor occupation

1_ManPro: Managers/Professionals
1A_Health: Health Workers
2_PstSec: Post-Secondary Teachers
3_OthTchr: Other Teachers
4_OthP&T: Other Professional/Technical Office
5_RetSls: Retail Sales Workers
6_OthR&C: Other Retail/Clerical Office
7_NonOfc: Non-Office workers

PI Utility Function

$$U^a_{lpe_1e_2\ldots e_n} = (\quad + \quad + \quad) + \sum_{n=1\cdots N}(\quad + \quad)$$

- **Location** *l* (residence or business establishment)

- **Production option or lifestyle** *p* described by a set of technical coefficients $\alpha_p = \{\alpha_{p1}, \alpha_{p2}, \ldots \alpha_{pn}, \ldots, \alpha_{pN_p}\}$ and commodity list $c_p = \{c_{p1}, c_{p2}, \ldots, c_{pn}, \ldots, c_{pN_p}\}$. for how much of Commodity c_{pn} is produced (or consumed, if α_{pn} negative) per unit of activity *a*

- **Exchange location** e_n for each commodity exchanged

PI Target data for S2 calibration

| |
|---|
| 1998/1999 Real Estate Report Floorspace Prices and Vacancy Rates for Selected Urban Areas |
| 1994/96 Oregon Travel Behavior Survey Labor/Personal Services Trip Length Distributions |
| 2003 Ohio Establishment Survey Business Services Average Trip Lengths |
| 1993, 1997, and 2002 US Commodity Flow Survey Goods Average Trip Lengths |
| 2003 Oregon Commodity Flow Survey county-county goods flows (in dollars) |
| 1998 IMPLAN Imports and Exports by Commodity |
| 1998 IMPLAN employment by industry/occupation |

PI Calibration – Trip Lengths

- Match Average Trip Lengths
  - goods

$$U^a_{lpe_1e_2\ldots e_n} = \left(V^a_l + \varepsilon^a_l\right) + \left(V_p + \varepsilon_{lp}\right) + \sum_{n=1\cdots N_p}\left|\alpha_{pn}\right|s_{pn}\left(V_{e_nl} + \right.$$
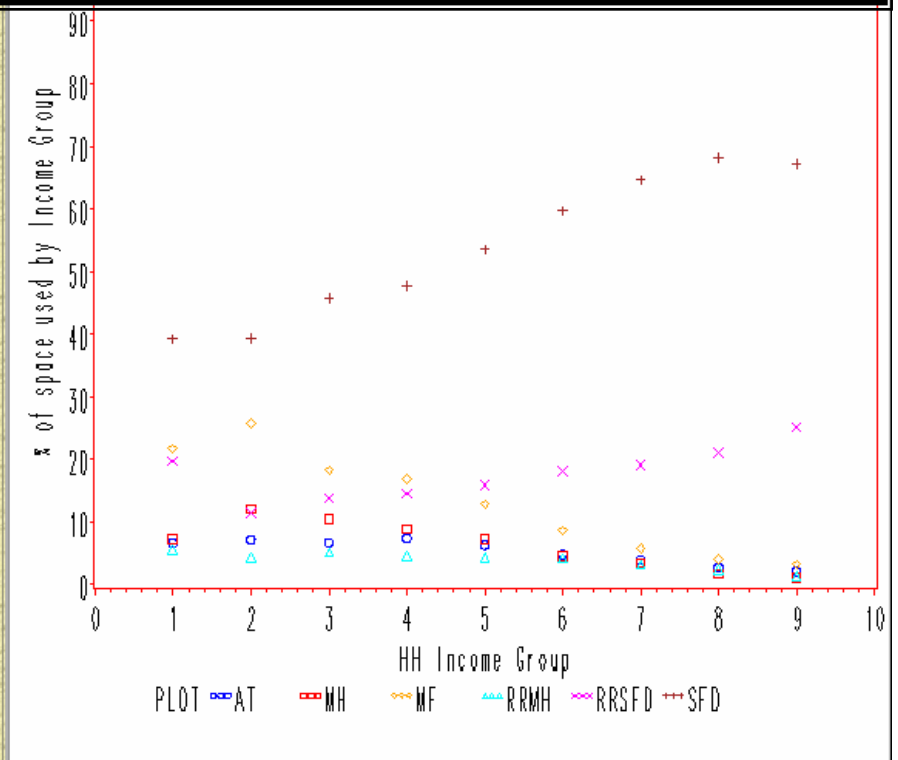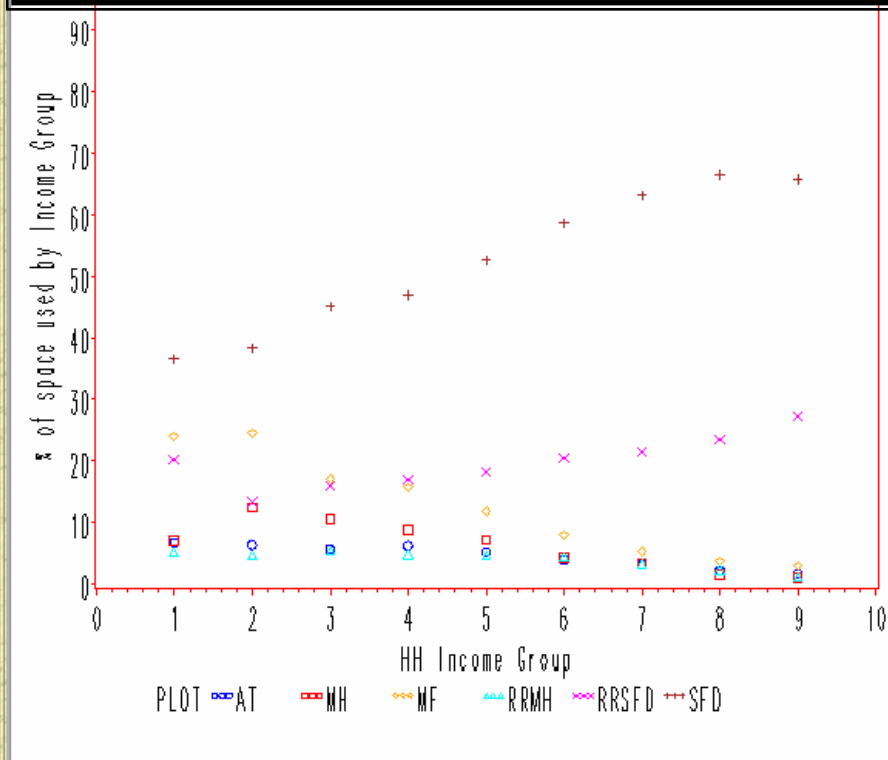
goods (in dollars)

Adjust buying/selling dispersion parameters$_{b/s,a}$

GOODS
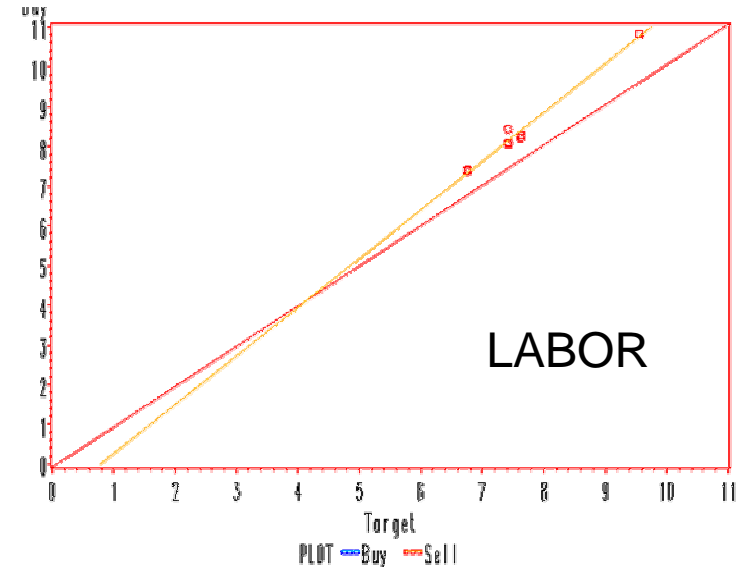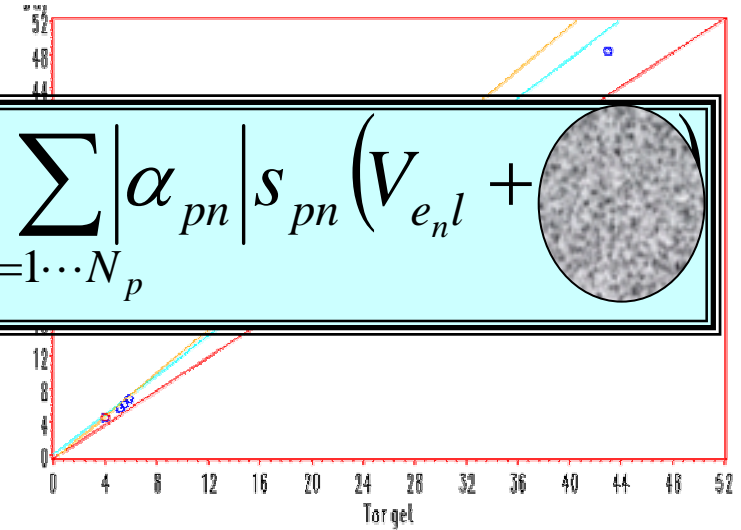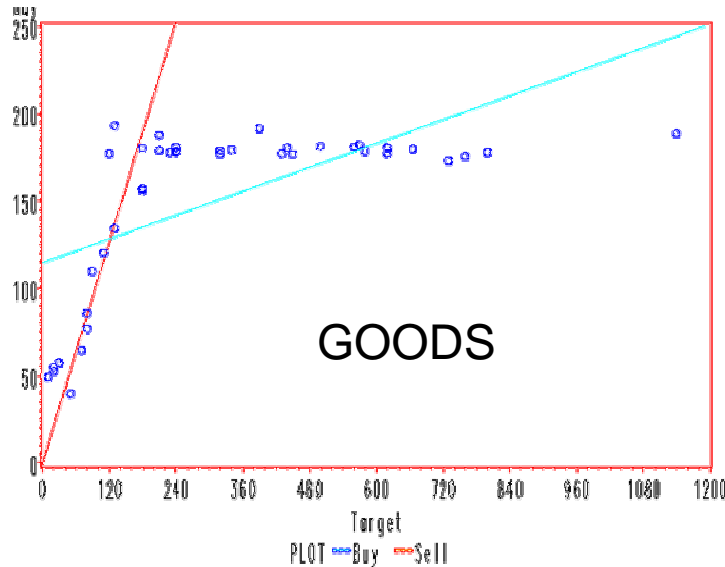
LABOR

PI Calibration - Floorspace Usage

- Modelwide Vacancies
- Floorspace usage by HH group
- Urban area Prices/Vacancies

$$U^a_{lpe_1e_2\ldots e_n} = \left(V^a_l + \varepsilon^a_l\right) + \left(+ \varepsilon_{lp}\right) + \sum_{n=1\cdots N_p}\left|\alpha_{pn}\right| s_{pn}\left(V_{e_n l} + \varepsilon_{e_n lp}\right)$$

PI Calibration - Labor Make/Use

- Scale Labor Use Tech Coefficients
- Match Wages by HH Income Group
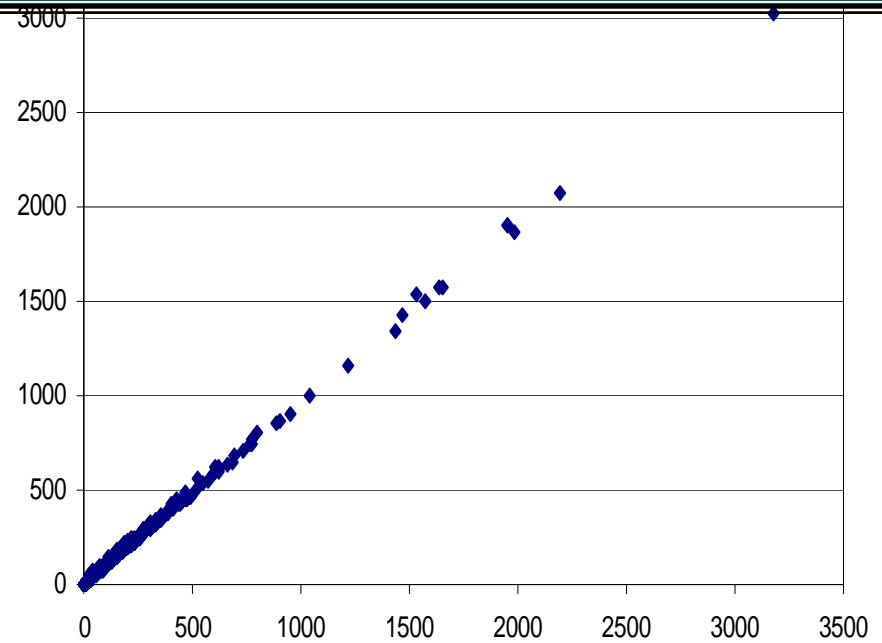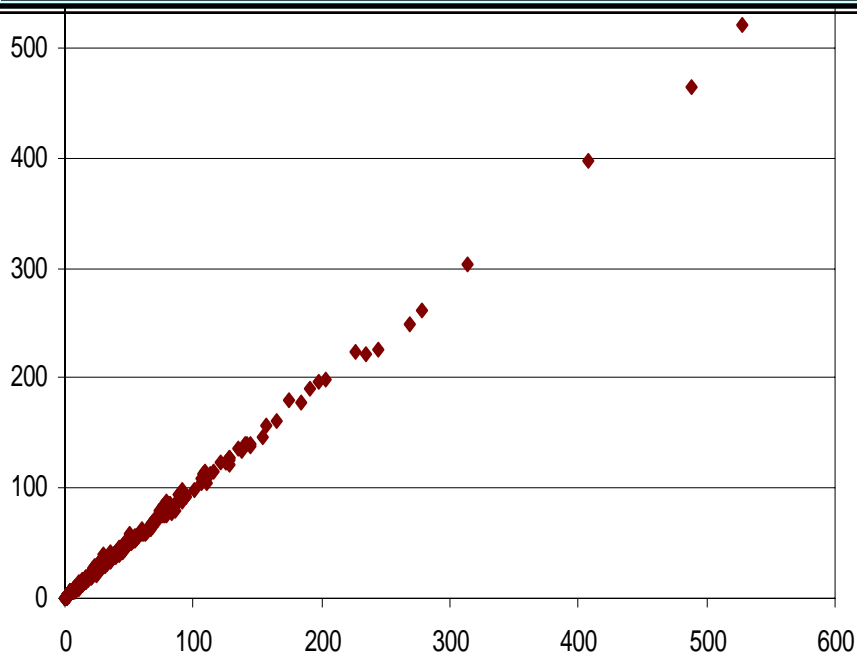
Adjust utility offset$_{c,a}$,($\lambda_{u,a}$)

Year	BEA/ED Activity$M	BEA/ED Jobs	productivity (jobs/$Mactivity)	Labor Make scaling factor	%Health	%Svc	Hlth Per SPG HH
1991	$215,358	2,582,191	0.083	1.13	4.2%	37%	4,887
1992	$220,686	2,607,892	0.085	1.11	4.4%	37%	
1993	$232,749	2,676,706	0.087	1.08	4.3%	37%	
1994	$246,103	2,805,824	0.088	1.07	4.2%	37%	
1995	$257,538	2,905,691	0.089	1.06	4.2%	36%	
1996	$272,579	3,022,647	0.090	1.04	4.1%	35%	
1997	$287,247	3,123,530	0.092	1.02	4.0%	35%	
1998	**$299,410**	**3,180,840**	**0.094**	**1.00**	**4.0%**	**35%**	**3,972**
1999	$309,660	3,228,357	0.096	0.98	4.0%	36%	
2000	$324,968	3,297,765	0.099	0.96	4.1%	35%	5,608

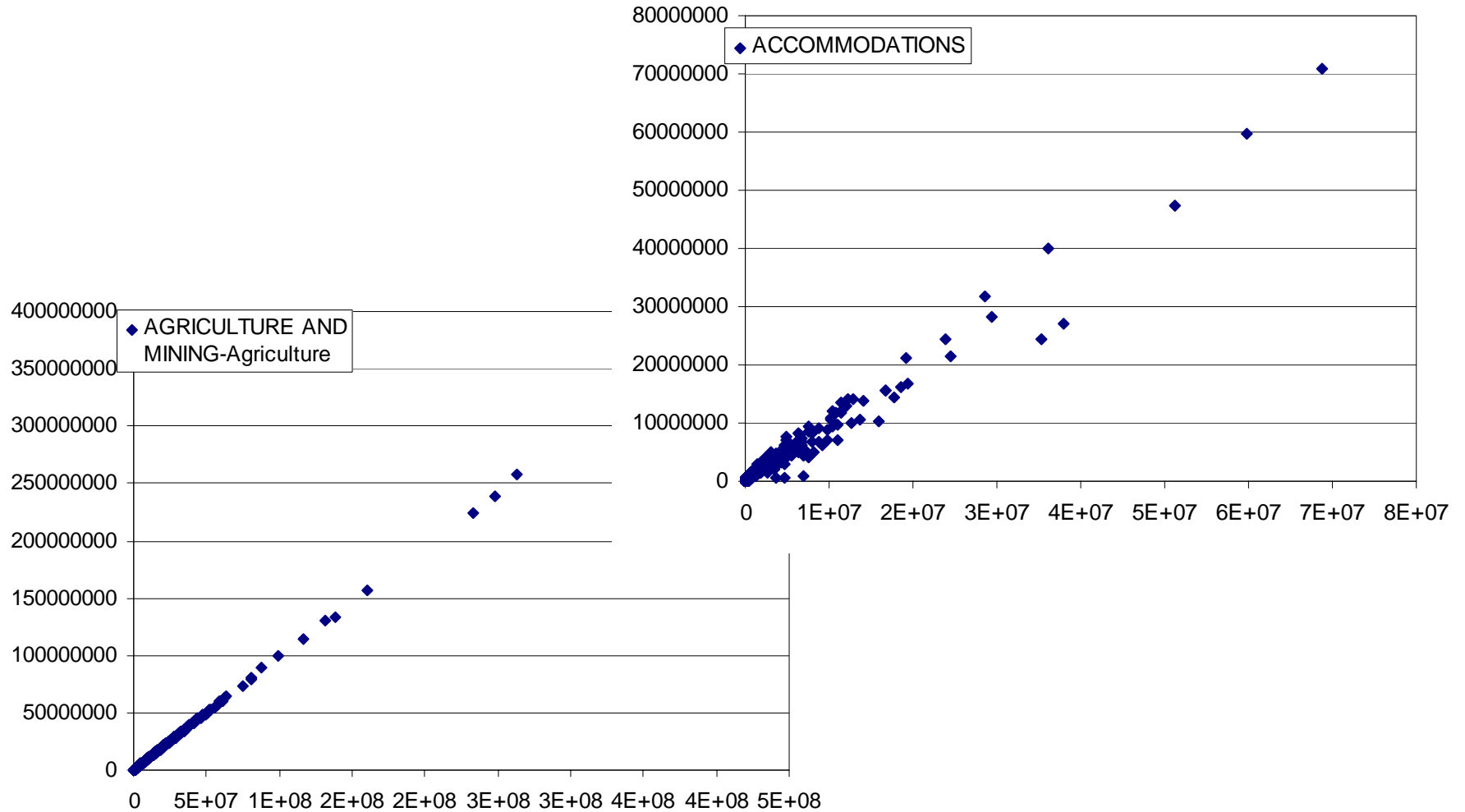| Occupation	HH Labor Make$	90 PUMS Target
1_ManPro	17%	21%
1a_Health	14%	5%
2_PstSec	6%	1%
3_OthTchr	11%	4%
4_OthP&T	15%	17%
5_RetSls	7%	3%
6_OthR&C	11%	11%
7_NonOfc	19%	38%
Total	100%	100%
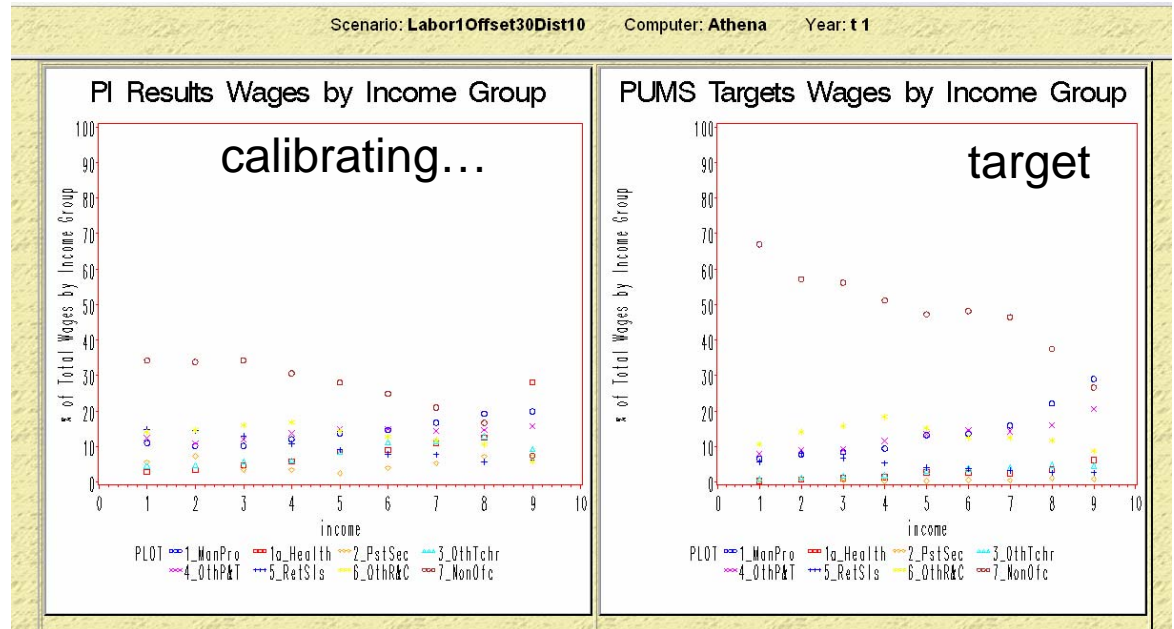
PI Calibration Zonal Constants

$$U^a_{lpe_1e_2\ldots e_n} = \left(\text{ } + \varepsilon^a_l \right) + \left(V_p + \varepsilon_{lp} \right) + \sum_{n=1\cdots N_p} \left| \alpha_{pn} \right| s_{pn} \left(V_{e_nl} + \varepsilon_{e_nlp} \right)$$

PI Calibration – Zonal constants for industry

Forecast location constants using Environmental Variables

- Collect zonal data representing "not modelled" components of location utility
  - School quality
  - Housing quality
  - Amenities (parks, open space)
- (along with data representing "already modelled" components of location utility)
  - Activities within zone (shopping, work)
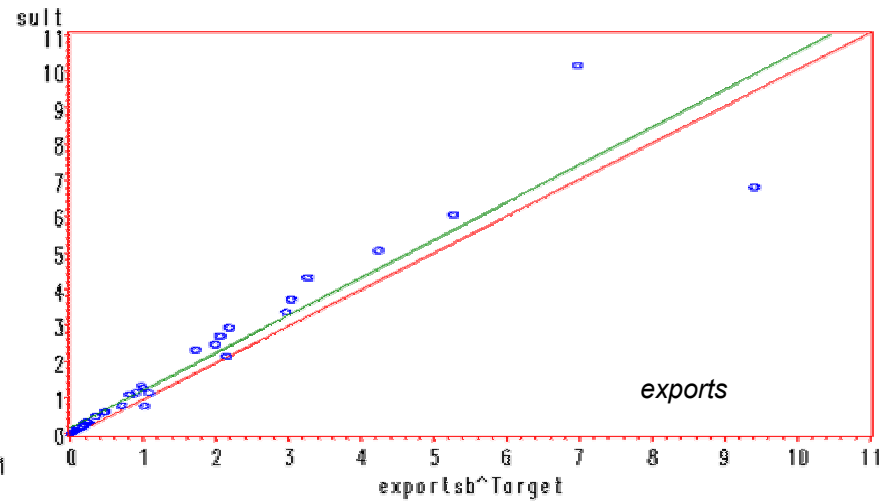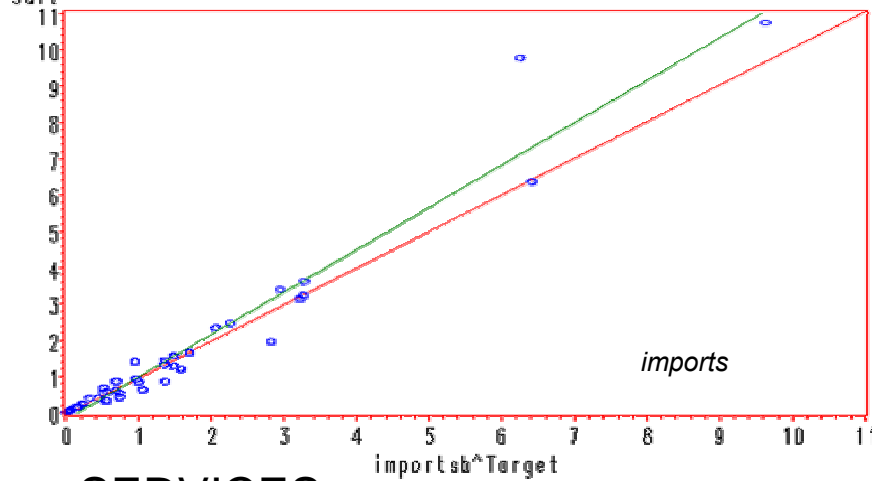 - Housing price
- Use regression against zone constants

PI Calibration - Imports/Exports

- Match 1998 IMPLAN modelwide target by commodity
- Distribution by bzone   Price-Quantity curve
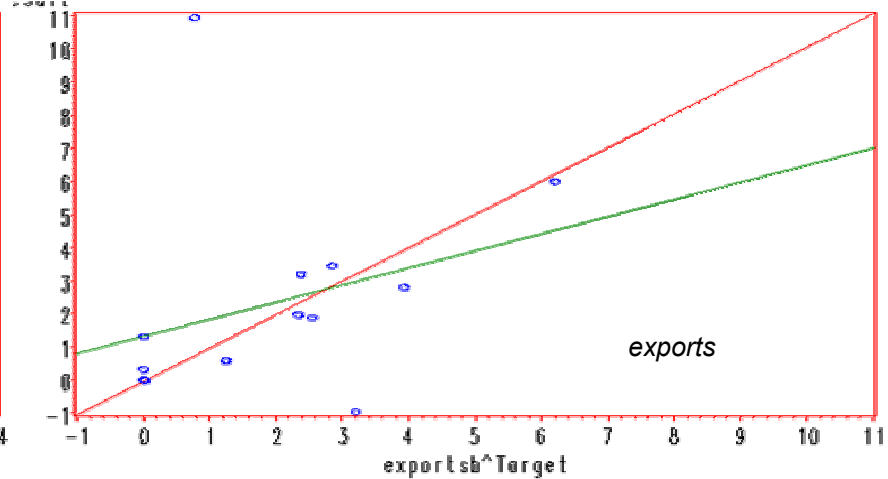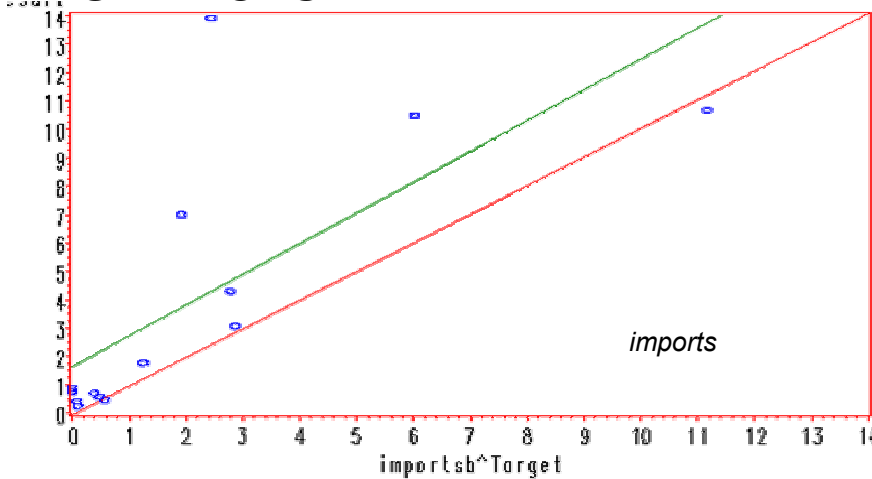
Adjust midpoint, slope, η, Δ

price-quantity curve

imports

exports

Other Goods......

Other Services......

Accommodations Service
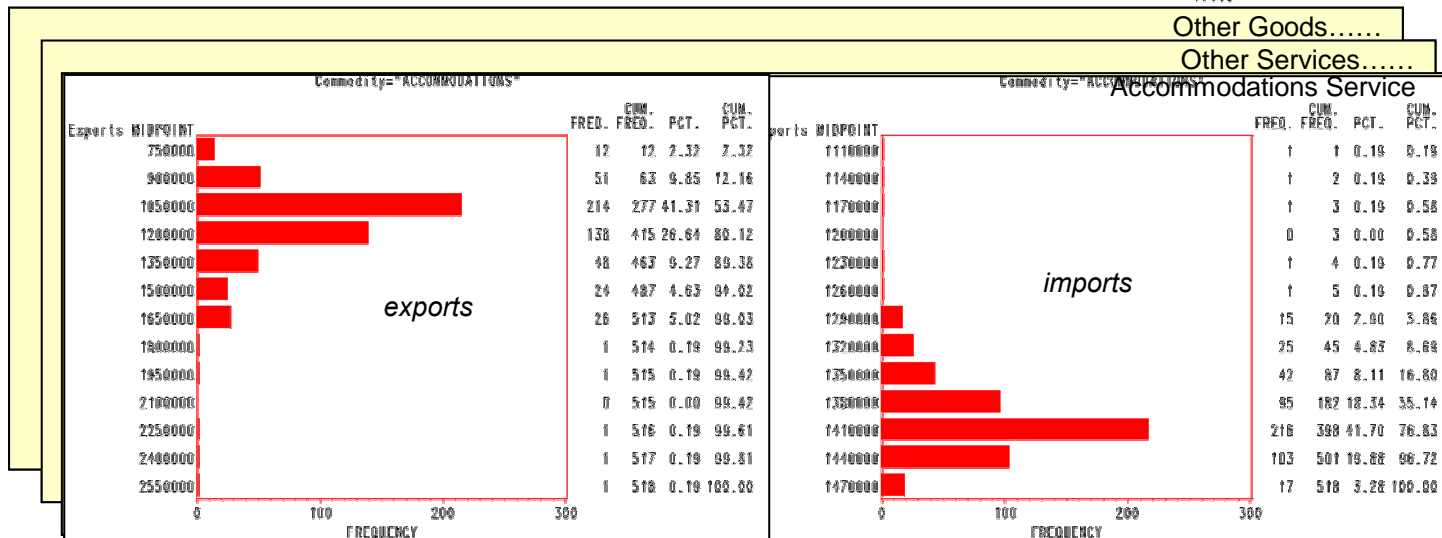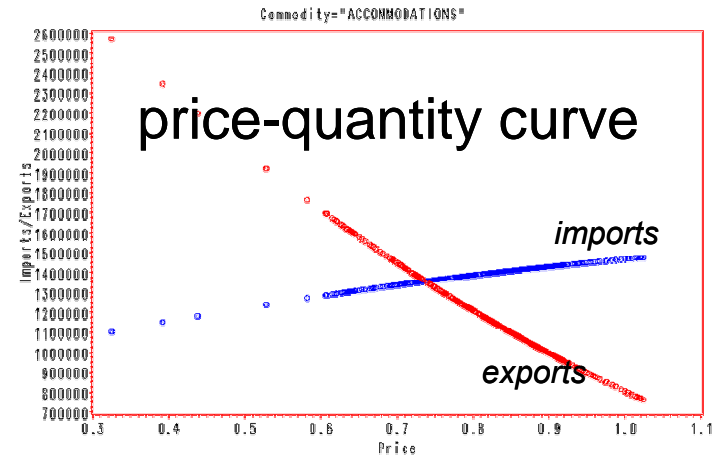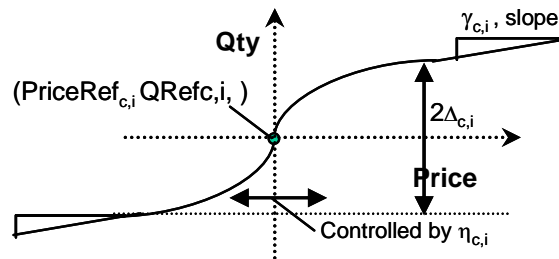
exports

imports

PI Calibration - Imports/Exports

ALD components

- Aggregate allocation of construction $ model wide (logit)
- Calculation of capacities from zoning
- Allocation of construction to zones (increase and decrease) (Cobb-Douglas)
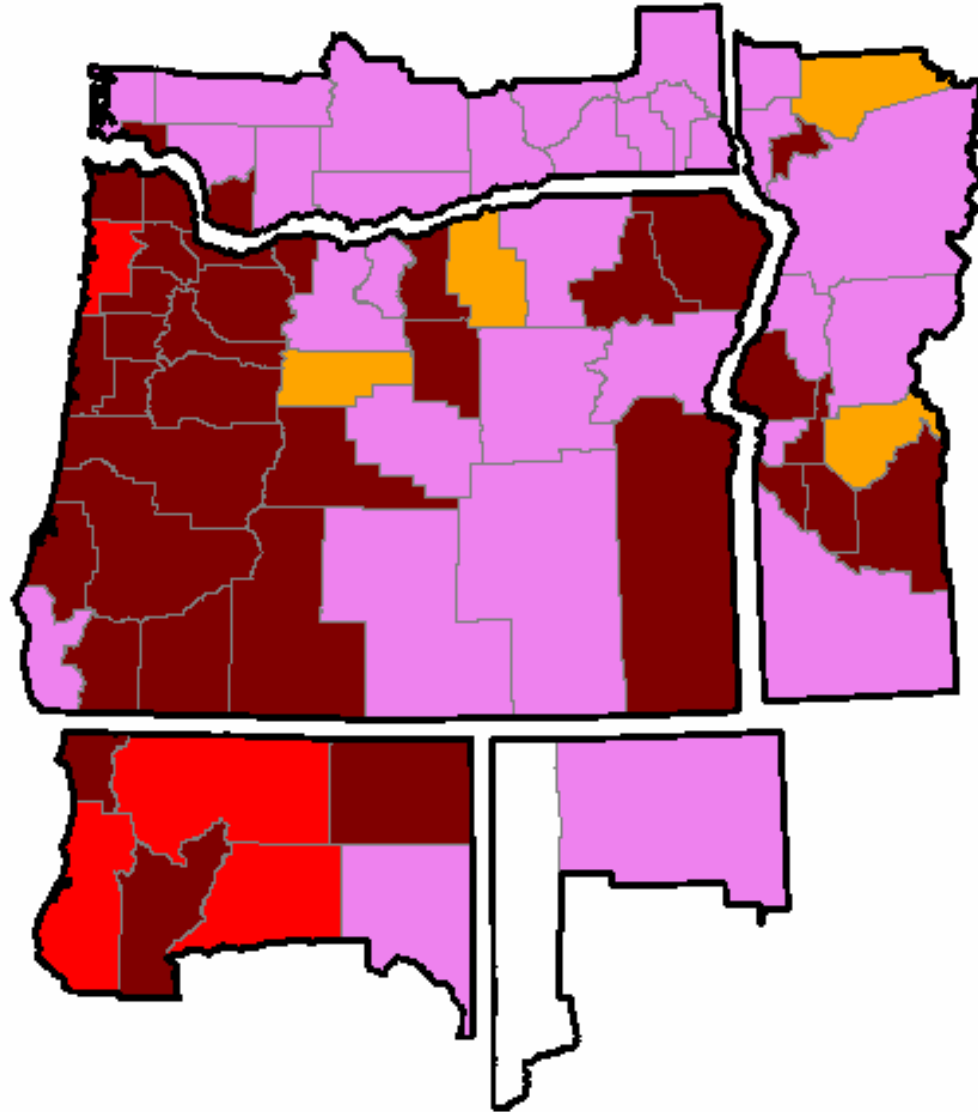- R module

ALD Calibration

- Limited "S2" Calibration
  - Poor observed data on prices and vacancy rates
  - Waiting for S3 calibration, so that PI can produce synthetic prices and vacancy rates calibrated to (sparse) observations

ALD Calibration charts
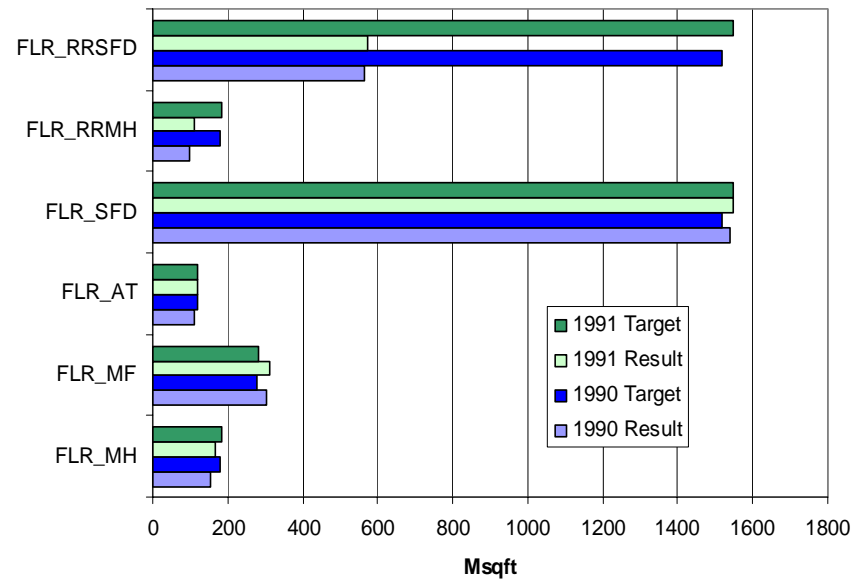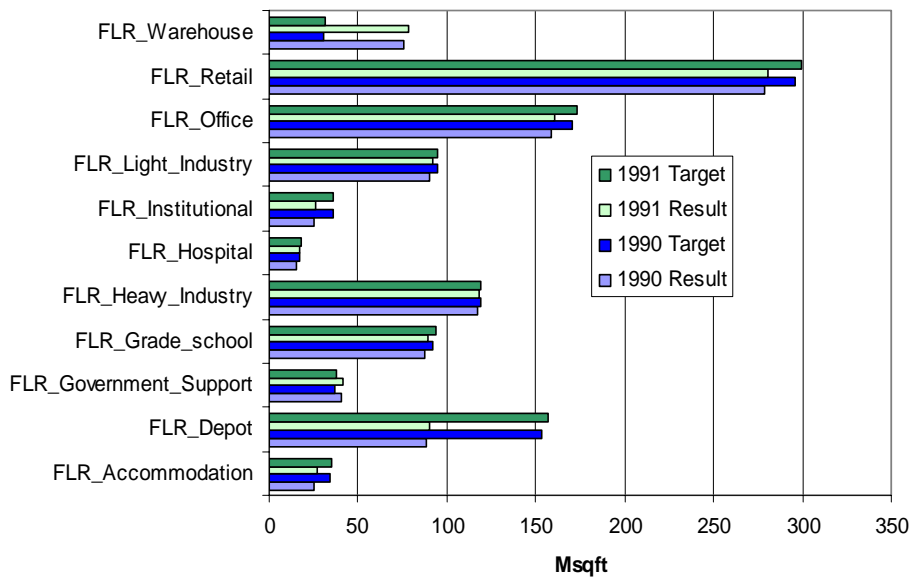
ALD Calibration Maps

New functionality

- "Technology adjustment" from ED to PI
- Periodic review of zoning regulation for ALD

Conclusions

- Three stage calibration (statistical estimation in S1, the adjustment of parameters in S2 and S3) assigns a theory to common practice
  - Model improves gradually as performance is investigated
- Much of S2 and S3 calibration involves adjusting Alternative Specific Constants and error term sizes (dispersion parameters) to match aggregate shares and variance
- Focus is on model performance
  - Not on model design/theory/software/algorithms
- pbxm.com website is a new "open" approach to calibration
- Looking forward to model application
  - and resuming work on HA and LD microsimulation components