How Different is China?

Chadwick C. Curtis

University of Notre Dame

Nelson C. Mark

University of Notre Dame and NBER

This research is a comparative analysis

- To what extent can the cyclical properties of the Chinese economy be understood with a very basic real business cycle model?
- How does this compare, say when the model is calibrated to Canada?
  - The model works reasonably well for both industrialized and emerging market economies.
  - If the model fails badly for China, what are the anomalies, and how should we refine the model to account for them?

Methodology

- Basis of comparison
  - (Small) open economy model. A variant of Mendoza (1991) who calibrates to Canada 1946-1985.
  - We calibrate to post-reform China 1979-2004.
  - Using (essentially) the same model as Mendoza, we can better isolate the differences between China, which has been under-researched, and Canada.

Major Findings from Business Cycle Analysis

- China is not so different. The business cycle model works about as well for China as it does for the U.S. or Canada.
  - Matching second moments (volatility, autocorrelation)
- The model's primary shortcoming is in explaining consumption and saving behavior.
  - The model predicts consumption to be too smooth and too high as compared to the data.

Examination of consumption behavior

- The primary explanation for consumption lies in the low amount of risk-sharing (we think).
- Test hypotheses about risk sharing
- Basis of comparison
  - Use provincial data on household consumption expenditures
  - Use same methodology as Crucini (1999) who ran risk-sharing tests on state-level data in the U.S. and on country-level data for large OECD.
- We find that there is about the same degree of risk sharing across Chinese provinces (1978-2004) as there was across G-6 countries during the 1980s, which is much lower than across U.S. states.
  - Capital controls were still in place during the 1980s.

Data Issues

- People question the data quality.
  - It is what it is.
  - The issues are too important to ignore until we have “high quality data.”
  - There is measurement in U.S. data too, but this doesn’t stop the research.

The business cycle model

- Representative consumer/producer maximizes discounted lifetime utility defined over consumption and leisure.
- A single good is produced with labor and capital. The good can be consumed or invested.
- The agent can trade with the rest of world a non-state contingent bond.

- Preferences $$E_t \sum_{j=0}^{\infty} \beta^j \frac{\left(c_{t+j} - \frac{h_{t+j}^{\omega}}{\omega}\right)^{1-\gamma} - 1}{1-\gamma},$$

- Budget Constraint (government runs balanced budget) $$c_t + \tau_t + i_t + \frac{b_{t+1}}{1+R_{t+1}} = y_t + b_t,$$

- Technology $$y_t = a_t k_t^{\alpha} h_t^{1-\alpha}$$
- Capital accumulation dynamics

$$k_{t+1} = (1-\delta)\, k_t + i_t - \frac{\phi}{2}\left(\frac{k_{t+1} - k_t}{k_t}\right)^2$$

- Shocks

$$\begin{aligned}
\ln(g_t) &= (1-\rho_g)\ln(\bar{g}) + \rho_g \ln(g_{t-1}) + \epsilon_t^g, \\
\ln(a_t) &= \rho_a \ln(a_{t-1}) + \epsilon_t^a, \\
r_t &= (1-\rho_r)\bar{r} + \rho_r r_{t-1} + \epsilon_t^r,
\end{aligned}$$

$$\epsilon_t^g \overset{iid}{\sim} N(0, \sigma_g^2),\ \epsilon_t^a \overset{iid}{\sim} N(0, \sigma_a^2),\ \text{and}\ \epsilon_t^r \overset{iid}{\sim} N(0, \sigma_r^2)$$

- Device to achieve stationary steady state: Country risk premium

$$R_{t+1} = r_{t+1} + \psi\left(\exp\left(\bar{b} - b_{t+1}\right) - 1\right)$$

- Equilbrium $$y_t = c_t + i_t + g_t + tb_t.$$
- Definitions $$ca_t = tb_t + \frac{R_t}{1 + R_t} b_t,$$

$$s_t = i_t + ca_t,$$

Calibration

- ϕ chosen to match investment volatility.
- ω from Mendoza
- $\gamma = 2$
- $\alpha = 1/3$

$$\beta = (1 + \bar{r})^{-1}$$

- δ=0.10
- Ψ from Schmitt-Grohe-Uribe

Table 3. Parameter Values

	Parameter	Value			
	β	0.978			
	ω	1.45			
	γ	2			
Preferences	α	0.33	Exogenous	ρ_a	0.600
	δ	0.1	Processes	ρ_g	0.809
	ψ	0.00074		ρ_r	0.434
	ϕ	2			
				σ_a	0.017
Bonds (SS)	$\bar{b}$	-0.05		σ_g	0.010
				σ_r	0.010

Model variants

1. The all shocks model, which has all three shocks (a_t, g_t, r_t) running.
2. The no government model, which allows productivity and interest rate shocks only.
3. The domestic shocks model model, which shuts down world interest rate shocks but leaves productivity and government shocks running.
4. The productivity shocks model, which shuts down interest rate and government spending shocks.

Implied Volatility

Table 4: Volatilities: Open Economy (1979-2007)

Series	Data	All Shocks	No Gov	Domestic Shocks	Prod Only
$\sigma(y)$	0.048	0.050	0.049	0.050	0.049
$\sigma(c)/\sigma(y)$	1.167	0.877	0.660	0.883	0.721
$\sigma(i)/\sigma(y)$	1.792	1.687	1.703	1.677	1.682
$\sigma(h)/\sigma(y)$	0.458	0.664	0.662	0.664	0.663
$\sigma(s)/\sigma(y)$	1.500	1.237	2.003	1.273	1.882
$\sigma(g)/\sigma(y)$	0.958	0.904		0.910	
$\sigma(nx/y)$	0.027	0.016	0.014	0.017	0.015
$\sigma(ca/y)$	0.033	0.013	0.015	0.012	0.013

Persistence

Table 5: AutoCorrelations: Open Economy (1978-2007)

	Data	All Shocks	No Gov	Domestic Shocks	Prod Only
GDP	0.730	0.722	0.724	0.720	0.719
Consumption	0.685	0.787	0.763	0.793	0.790
Employment	0.454	0.747	0.739	0.745	0.744
Investment	0.685	0.424	0.409	0.425	0.417
Saving	0.764	0.701	0.691	0.695	0.681
Cu.Acct/GDP	0.664	0.612	0.884	0.606	0.868
Net Exports/GDP	0.667	0.755	0.870	0.750	0.893

Correlations

Table 6: Correlations: Open Economy (1978-2007)

Series	Data	All Shocks	No Gov	Domestic Shocks	Prod Only
$\rho(y,c)$	0.834	0.933	0.985	0.916	0.942
$\rho(y,i)$	0.800	0.812	0.817	0.826	0.824
$\rho(y,s)$	0.829	0.994	0.993	0.992	0.993
$\rho(c,i)$	0.437	0.705	0.759	0.703	0.719
$\rho(c,s)$	0.384	0.910	0.987	0.879	0.907
$\rho(s,i)$	0.890	0.827	0.832	0.849	0.857
$\rho(y,g)$	0.391	0.399		0.398	
$\rho(nx/y,y)$	-0.098	0.058	0.529	0.025	0.439
$\rho(ca/y,y)$	-0.167	0.020	0.534	0.021	0.510

Compare to Canada

Mendoza

Volatility

	Can. data 46-85		Adj.cost model	
Variable	σ	ρ	σ	ρ
GDP	2.81 0	0.615	2.81	0.615
C	2.46	0.701	2.25	0.689
Sav	7.31	0.543	5.58	0.629
I	9.82	0.314	9.89	-0.017
Hours	2.02	0.541	1.94	0.615
prod	1.71	0.372	0.87	0.615
TB/Y	1.87	0.663	1.97	0.032

Compare to USA

Cooley–Prescott

Volatility		
Variable	US Data	model
Y	1.72	1.351
C	1.27	0.329
I	8.24	5.954
Hours	1.59	0.769
Prod		0.606

King-Plosser-Rebelo

Volatility				
	raw	data	raw	model
Variable	data	relative	model	relative
y	5.62	1	1.78	1
c	3.86	0.69	0.35	0.2
i	7.61	1.35	5.76	3.24
n	2.97	0.52	1.34	0.75
w	6.49	1.14	0.53	0.3

Consumption Levels

Table 7: Selected Steady State Ratios

Series	Data	All Shocks	Prod and Interest	Prod and Gov	Prod
c/y	0.465	0.600	0.732	0.597	0.734
i/y	0.335	0.268	0.269	0.268	0.269

EXAMINATION OF CONSUMPTION AND RISK SHARING

Risk Sharing within China

- A maintained assumption of real business cycle models is perfect within country risk sharing.
- This implies that the growth rate of consumption should be highly (perfectly?) correlated across individuals.
- Equivalence between competitive equilibrium and Pareto optimum instructs social planner how to allocate consumption.
  - Start with a look at planned and market economies.

Figure 1. Provincial Per Capita Consumption Growth Rates

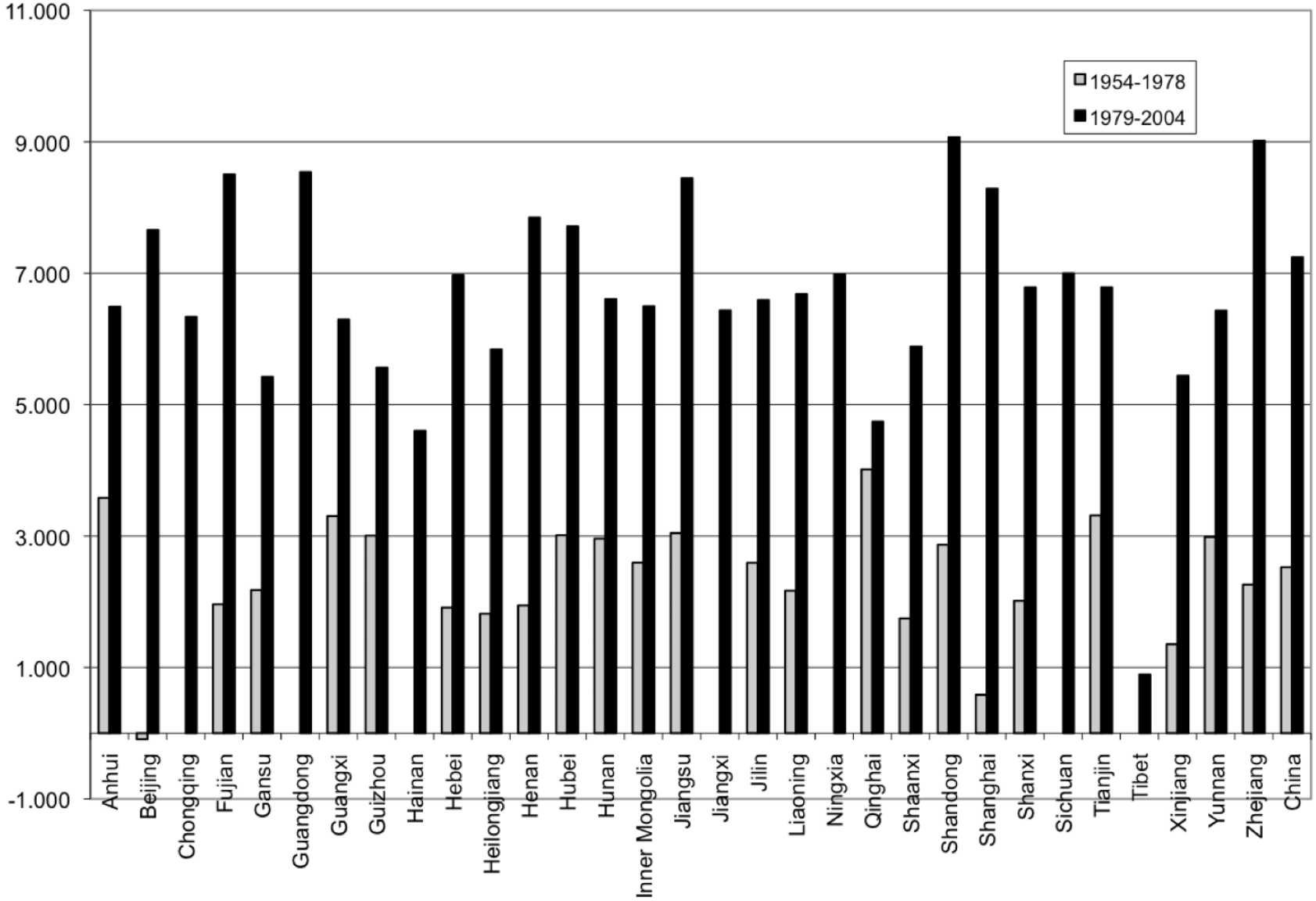


Figure 2. Provincial Volatility of Per Capita Consumption Growth

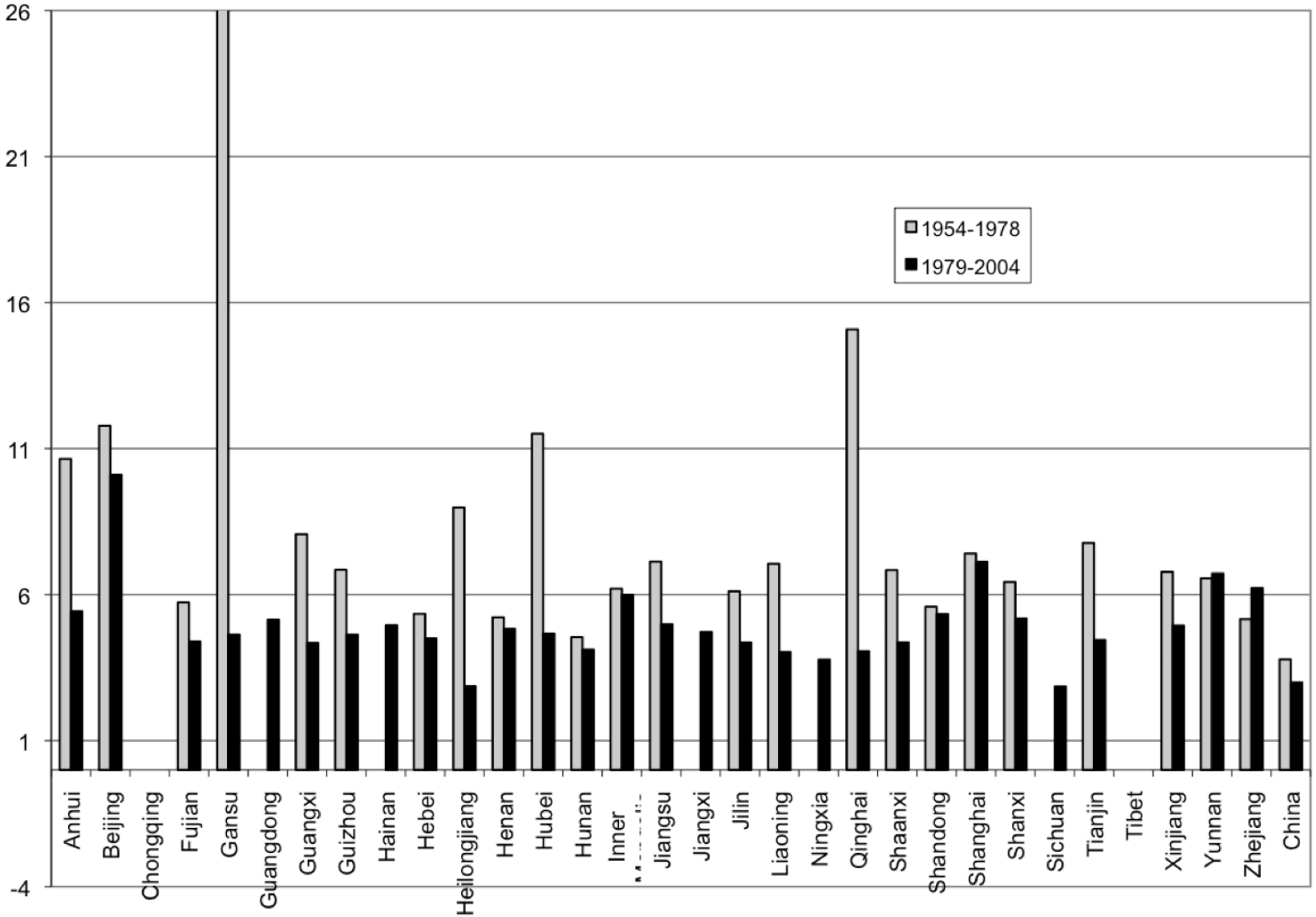


Figure 3: Provincial Per Capita Output Growth Rates

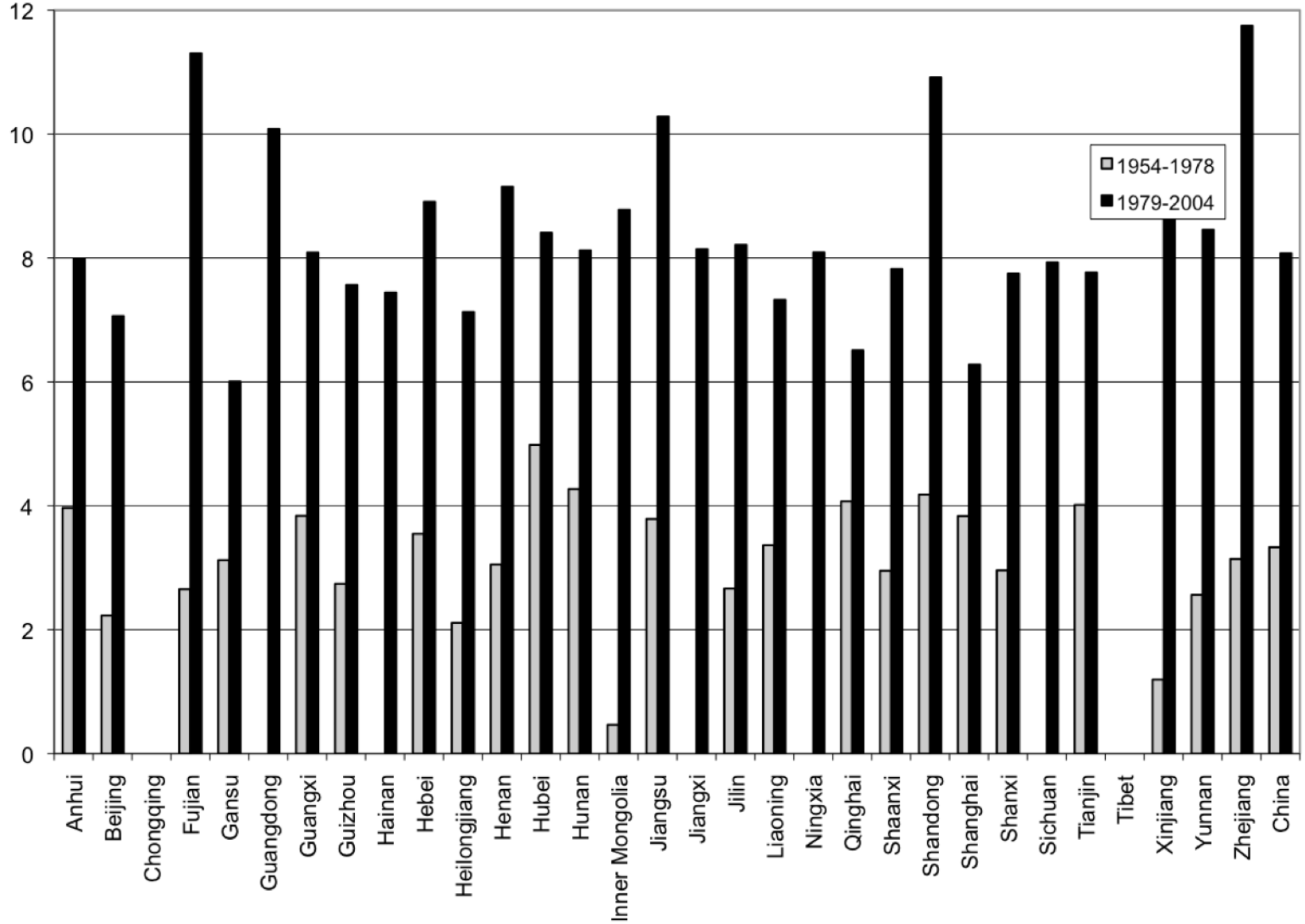


Figure 5: Correlation Between Provincial and Aggregate Output Growth

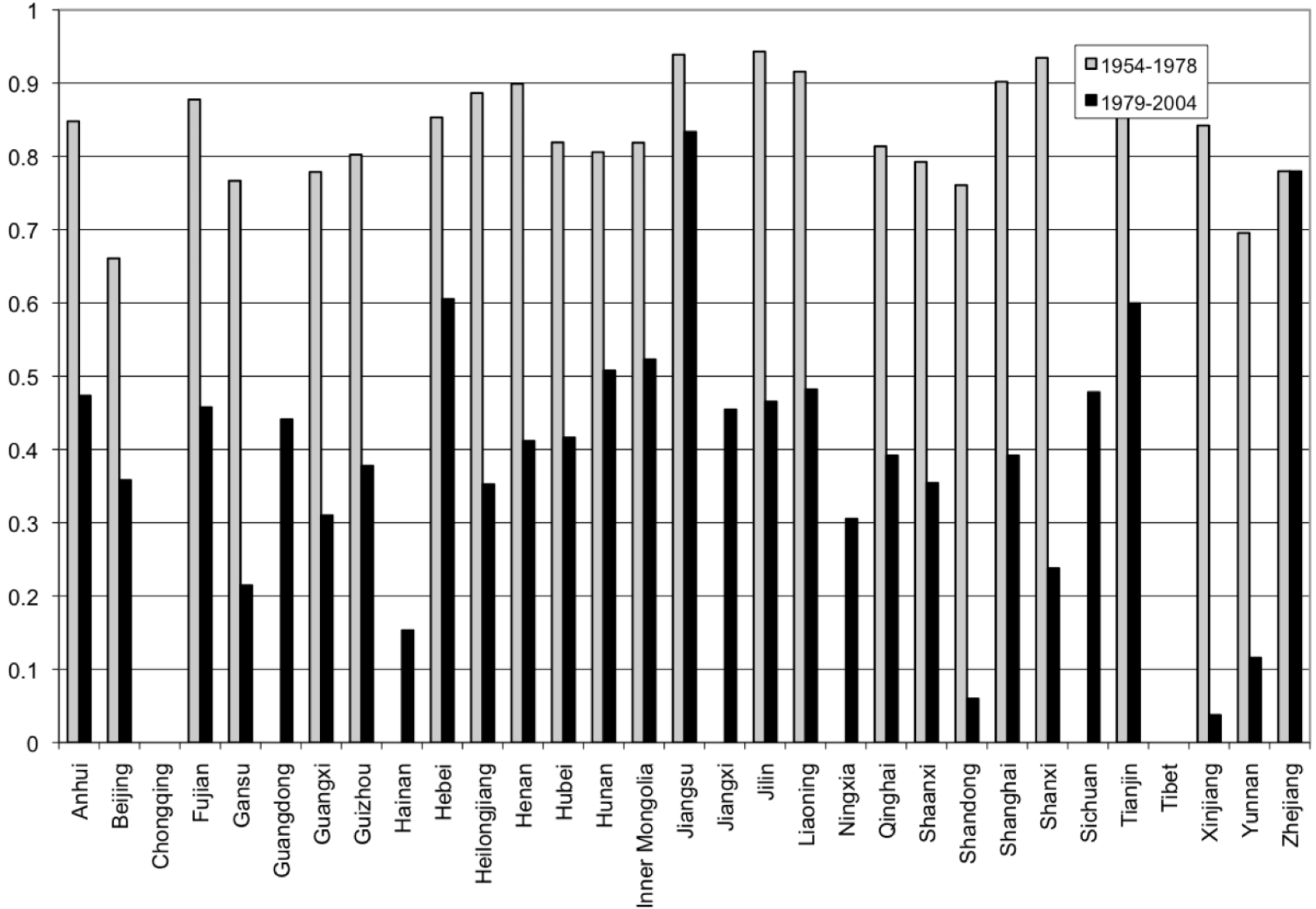


Figure 6: Correlation Between State and Aggregate Output Growth

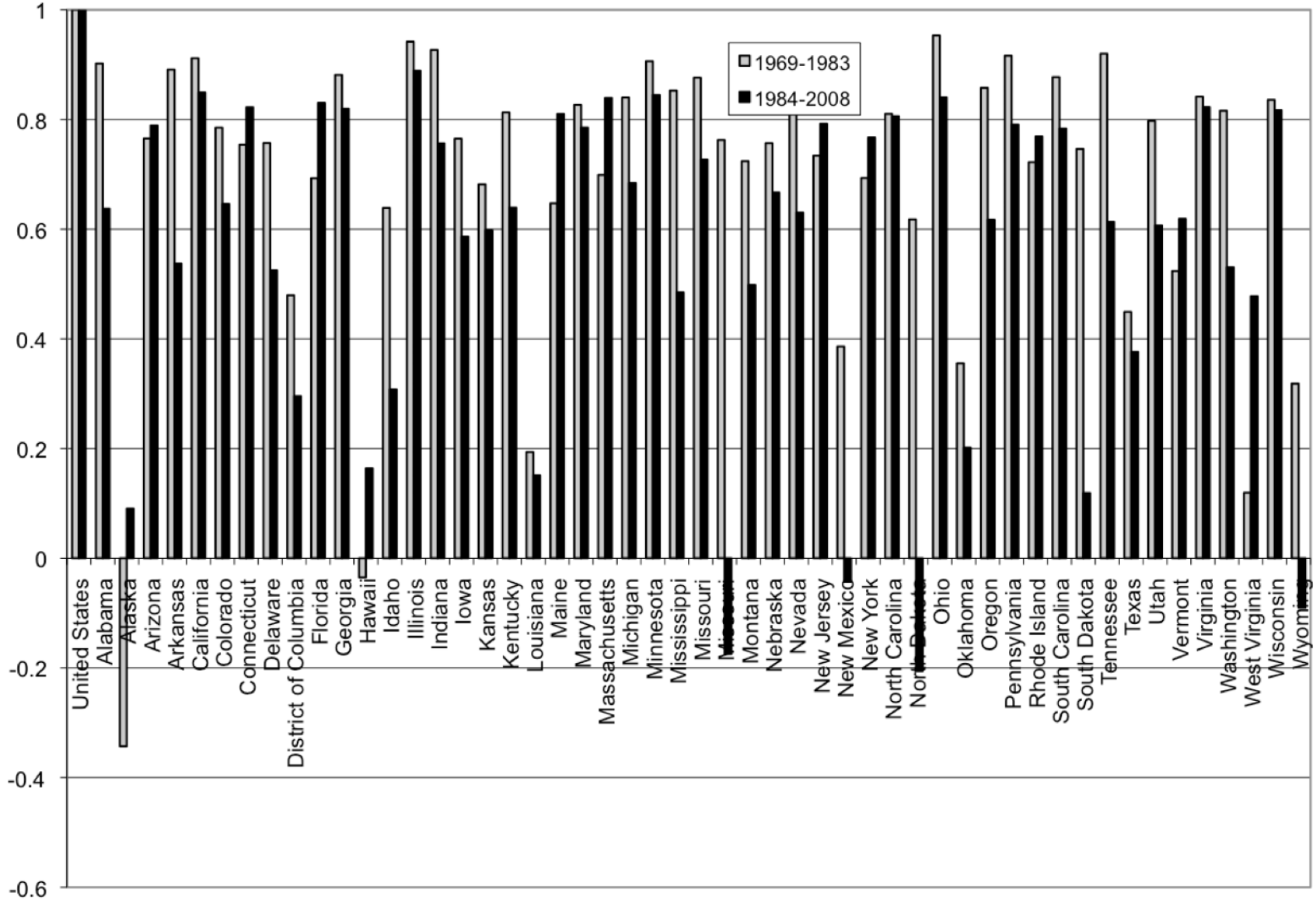


Figure 7: Correlation Between Provincial and Aggregate Per Capita Consumption Growth

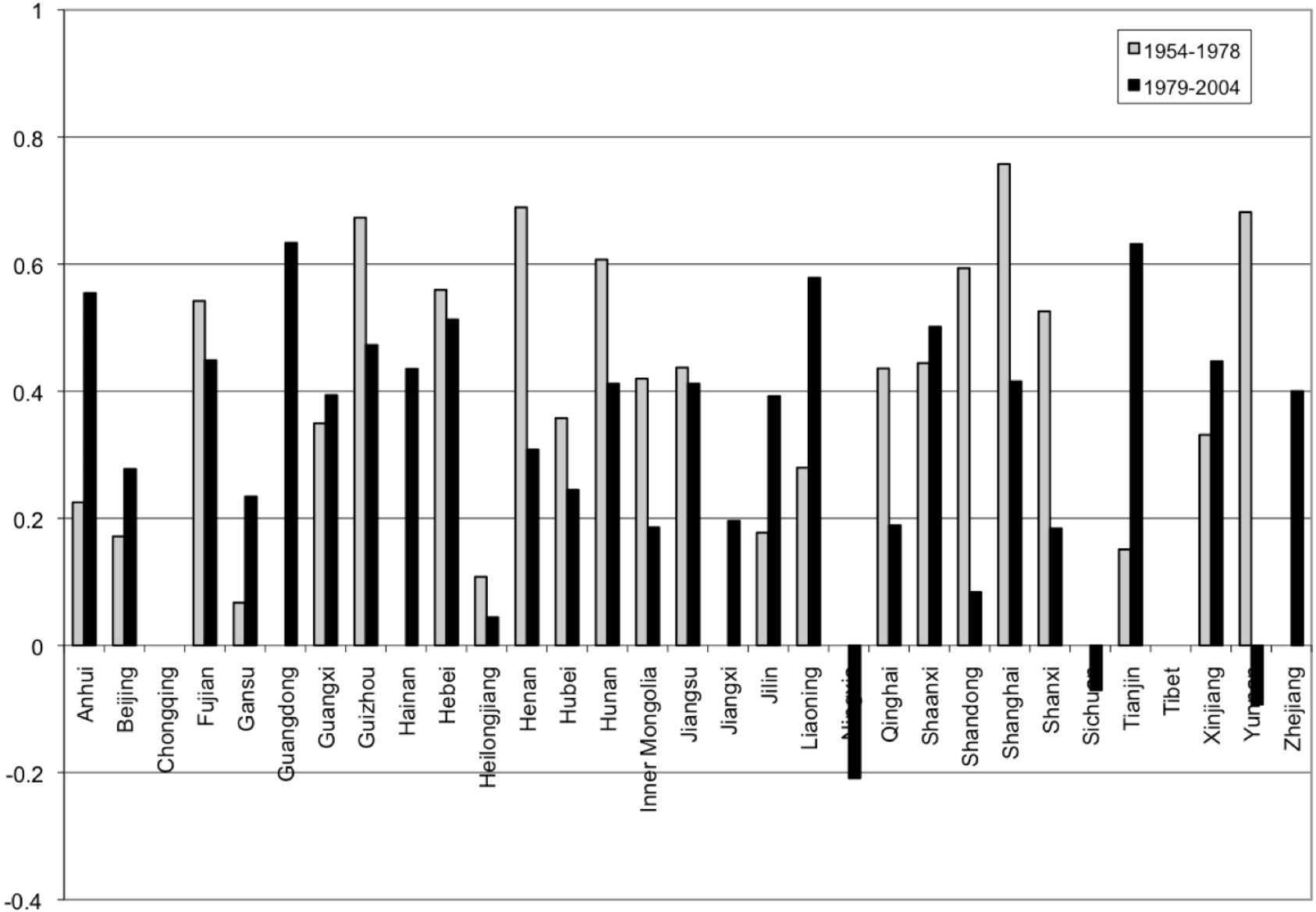


Figure 8: Correlations of Provincial Consumption and Output Growth Aggregates 1954-1978

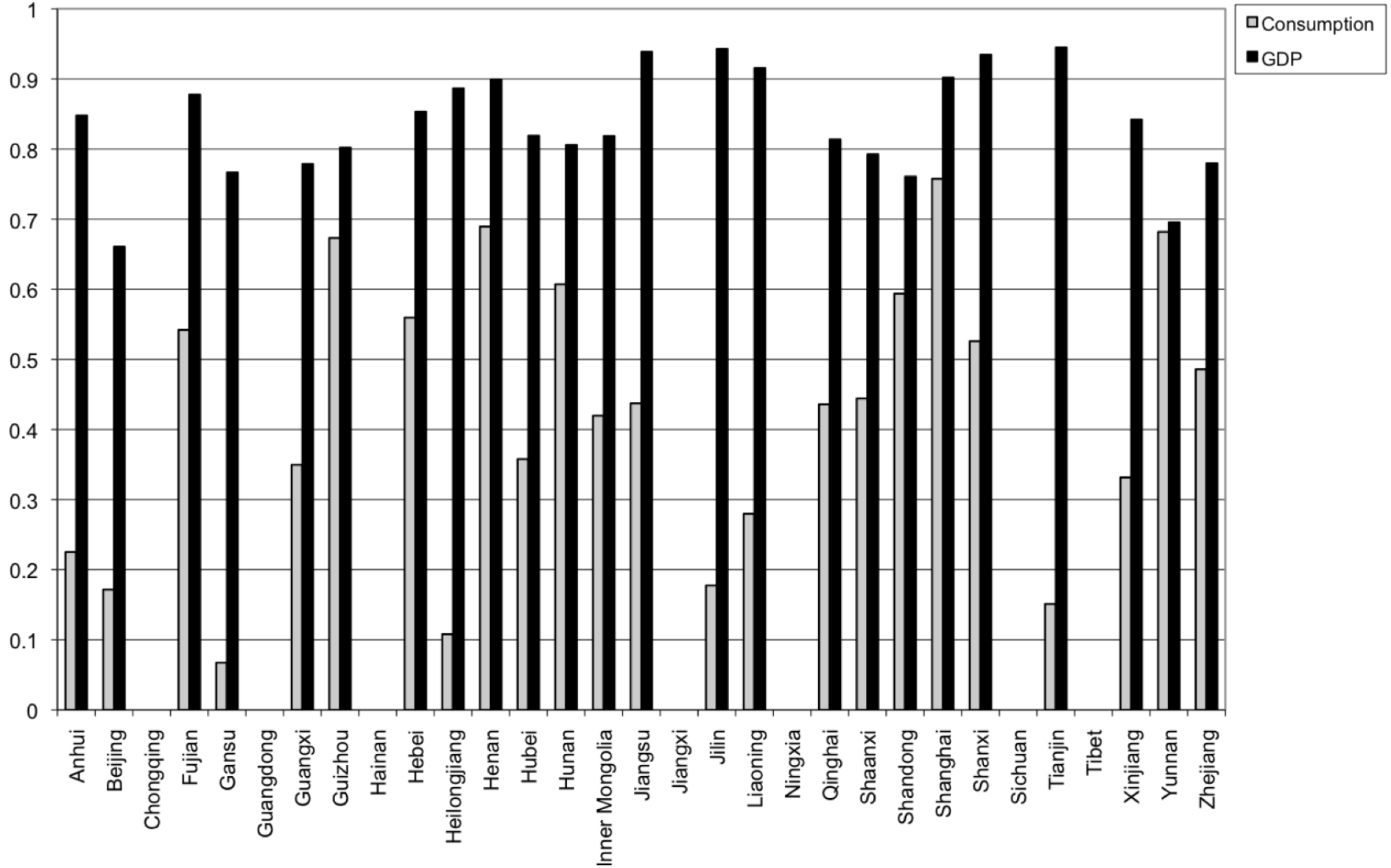
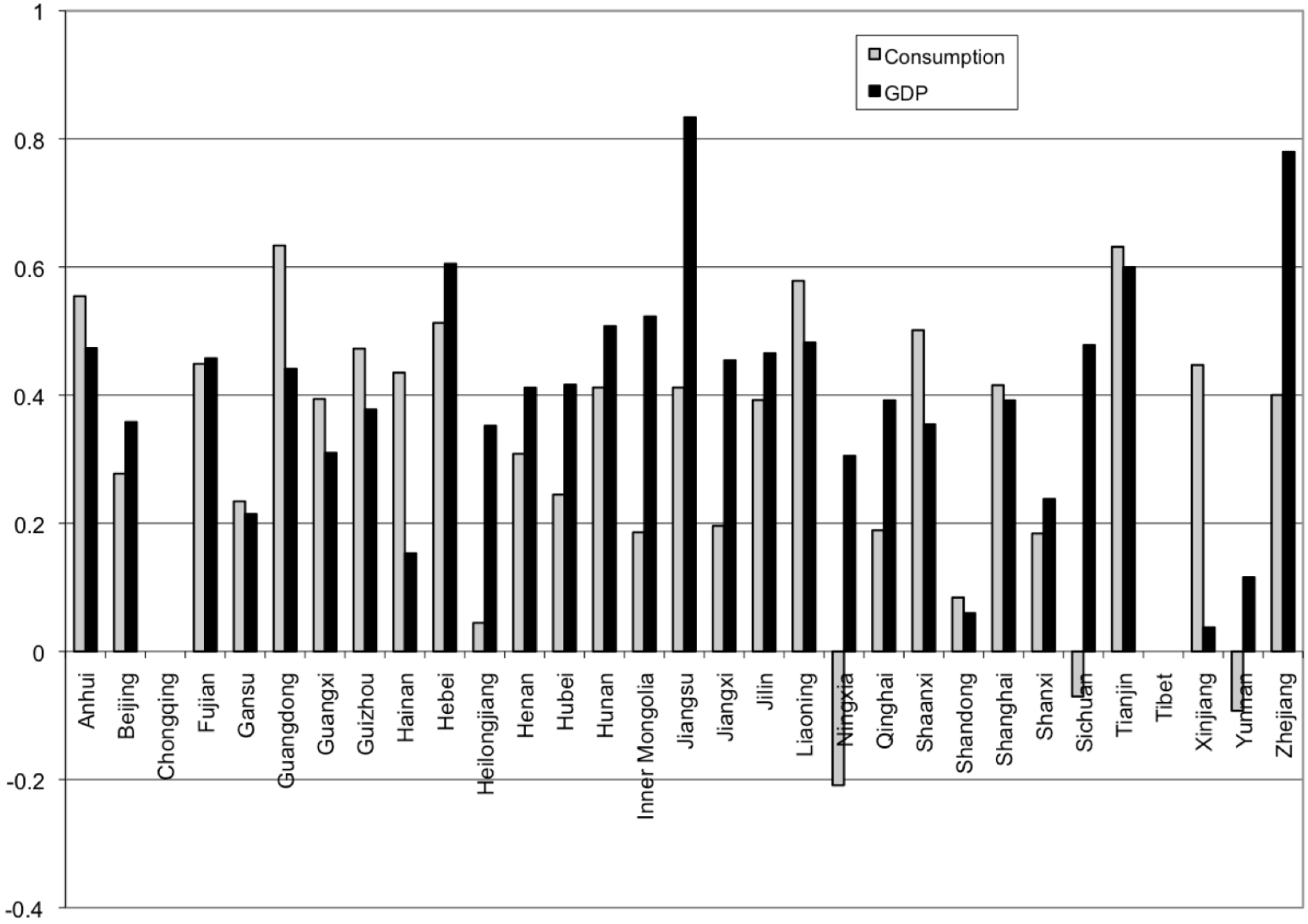


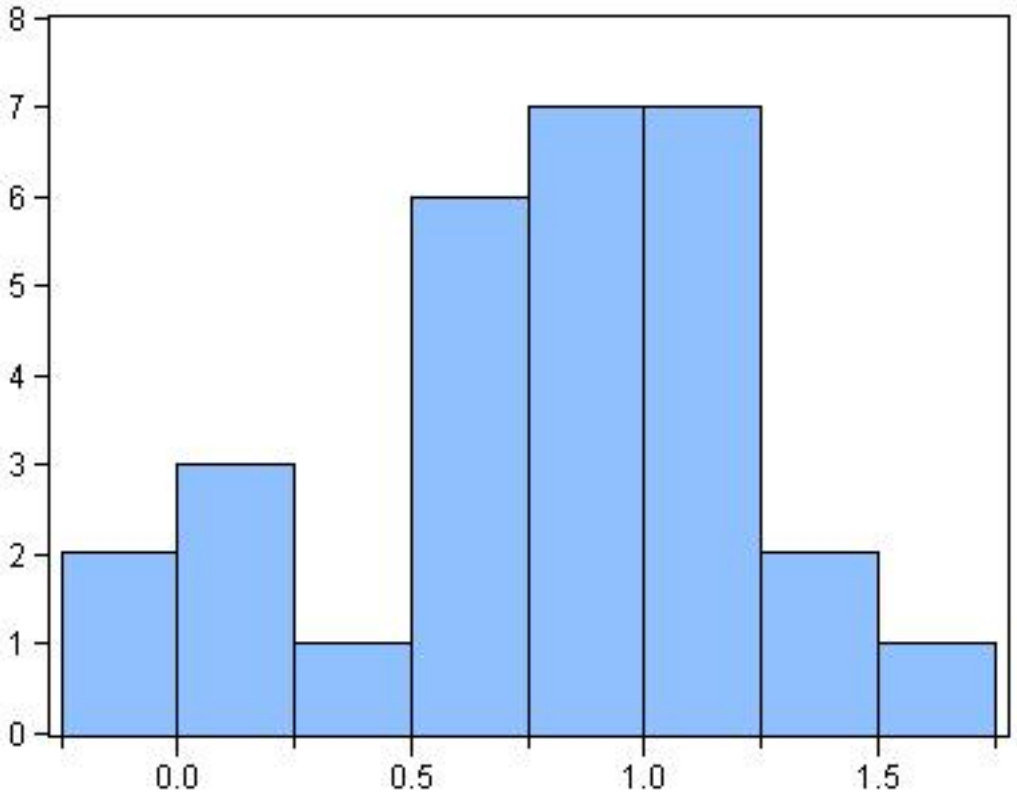
Figure 9: Consumption and Output Growth Correlations with Aggregates, 1979-2004



Mean growth 1980-2008 by state from Consumer Expenditure Survey

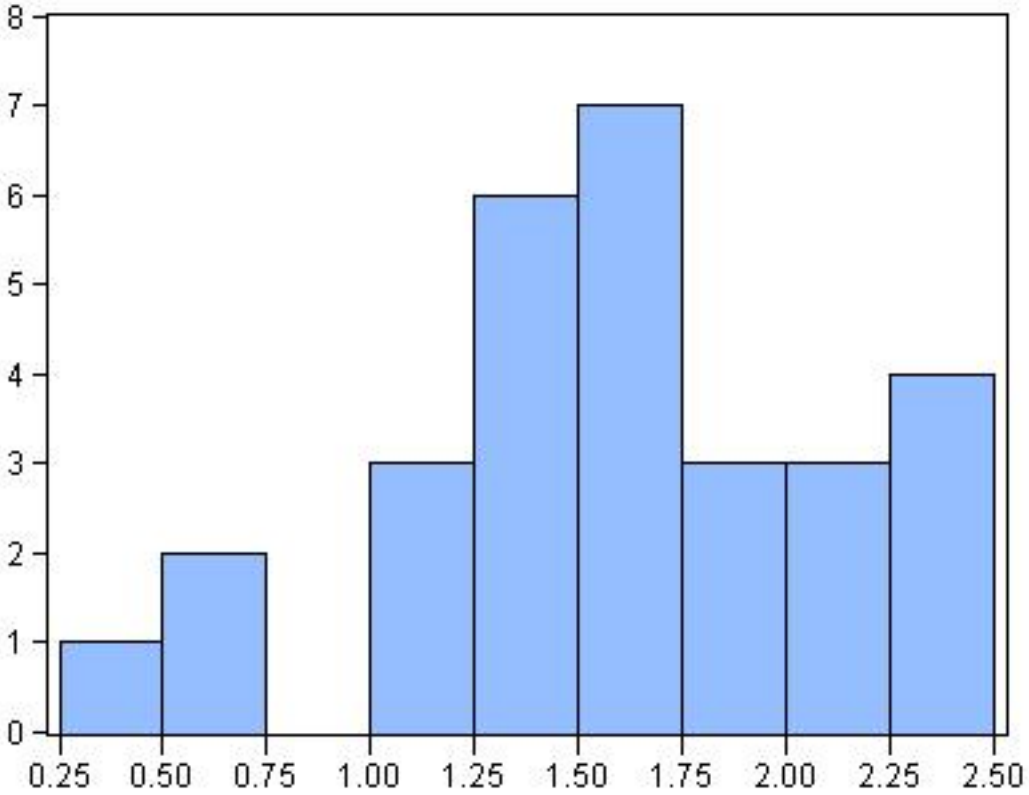
Identifier	Mean growth	Identifier	Mean growth	Identifier	Mean growth
GR46	0.32	GR15	-0.49	GR30	0.20
GR1	-1.10	GR16	1.97	GR31	0.45
GR2	-0.17	GR17	0.58	GR32	0.38
GR3	0.91	GR18	9.29	GR33	-3.08
GR4	-1.22	GR19	-0.26	GR34	1.12
GR5	0.09	GR20	-4.63	GR35	0.80
GR6	-0.32	GR21	0.62	GR36	0.12
GR7	0.23	GR22	0.59	GR37	-0.18
GR8	11.92	GR23	-0.32	GR38	-0.31
GR9	-0.79	GR24	0.70	GR39	-0.85
GR10	-0.26	GR25	0.19	GR40	-3.12
GR11	0.14	GR26	1.22	GR41	-0.38
GR12	-0.45	GR27	-1.69	GR42	0.96
GR13	1.03	GR28	10.44	GR43	-1.56
GR14	0.57	GR29	0.10	GR44	-0.19
				GR45	-0.40

Growth rate Real PCE (USA)



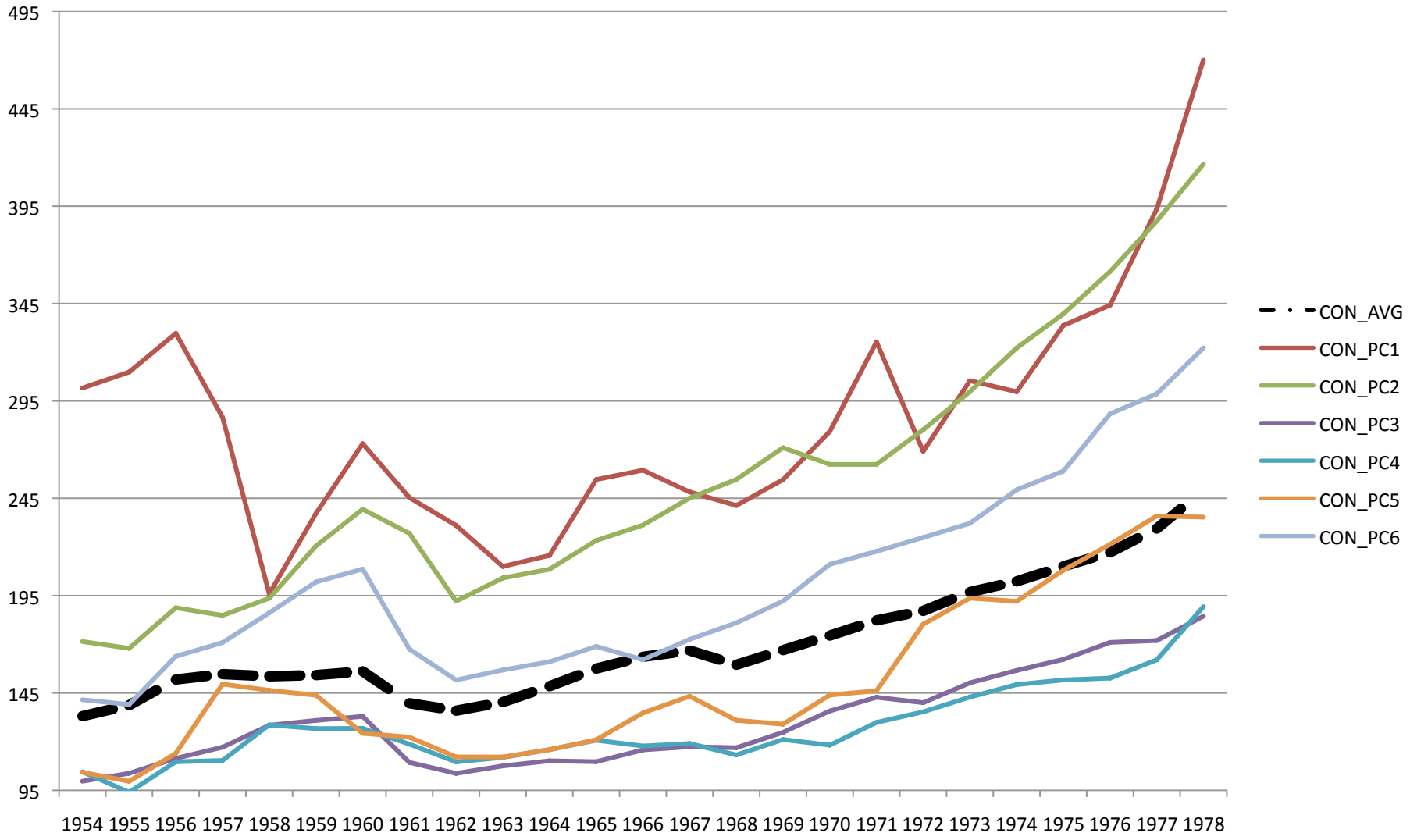
Series: RPCE	
Sample 1980 2008	
Observations 29	
Mean	0.775000
Median	0.850000
Maximum	1.600000
Minimum	-0.100000
Std. Dev.	0.424211
Skewness	-0.413643
Kurtosis	2.635304
Jarque-Bera	0.987696
Probability	0.610273

Growth rate real NDS (USA)

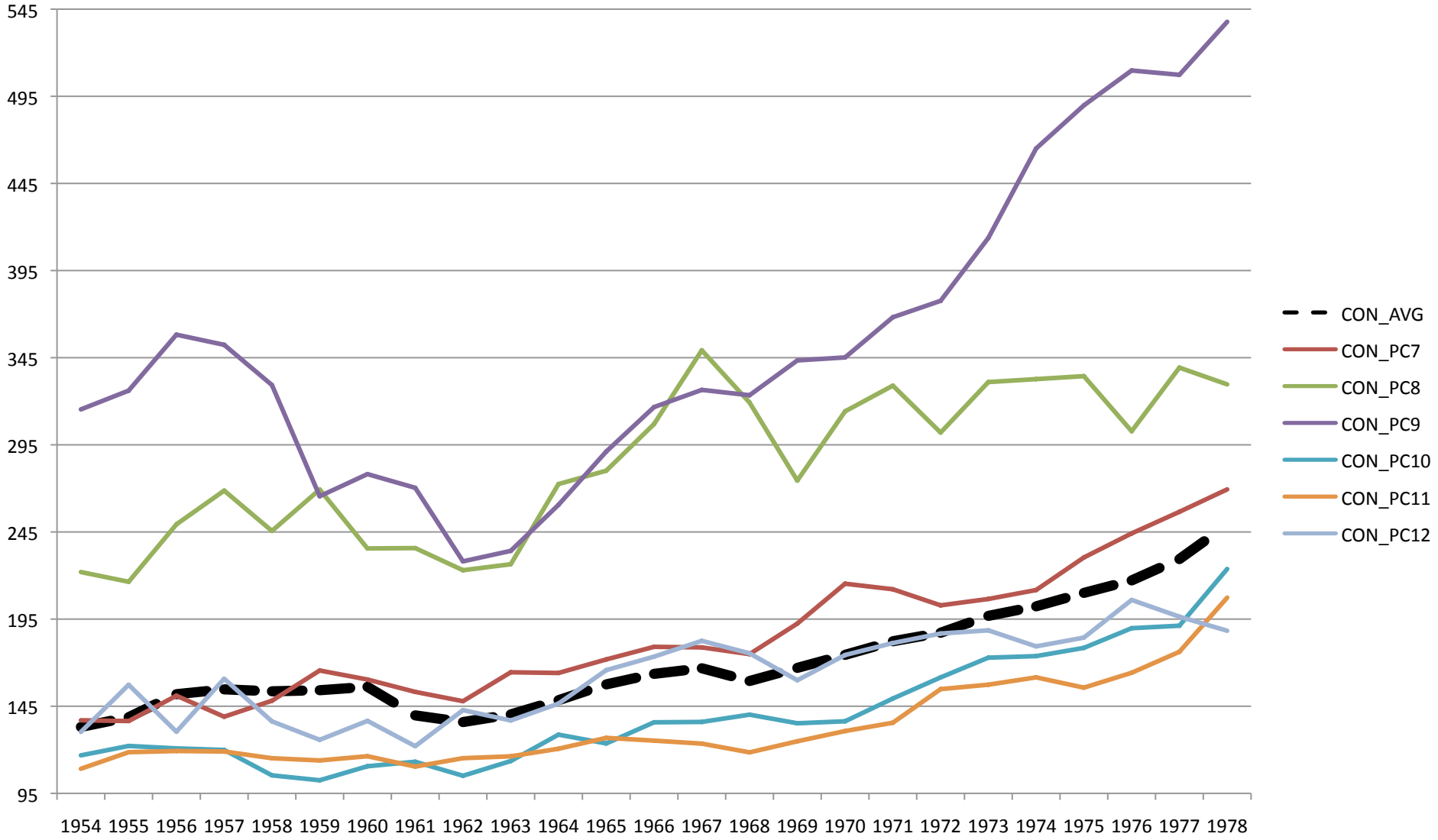


Series: REALNDS	
Sample 1980 2008	
Observations 29	
Mean	1.602734
Median	1.682339
Maximum	2.424935
Minimum	0.334645
Std. Dev.	0.535601
Skewness	-0.363402
Kurtosis	2.651904
Jarque-Bera	0.784711
Probability	0.675464

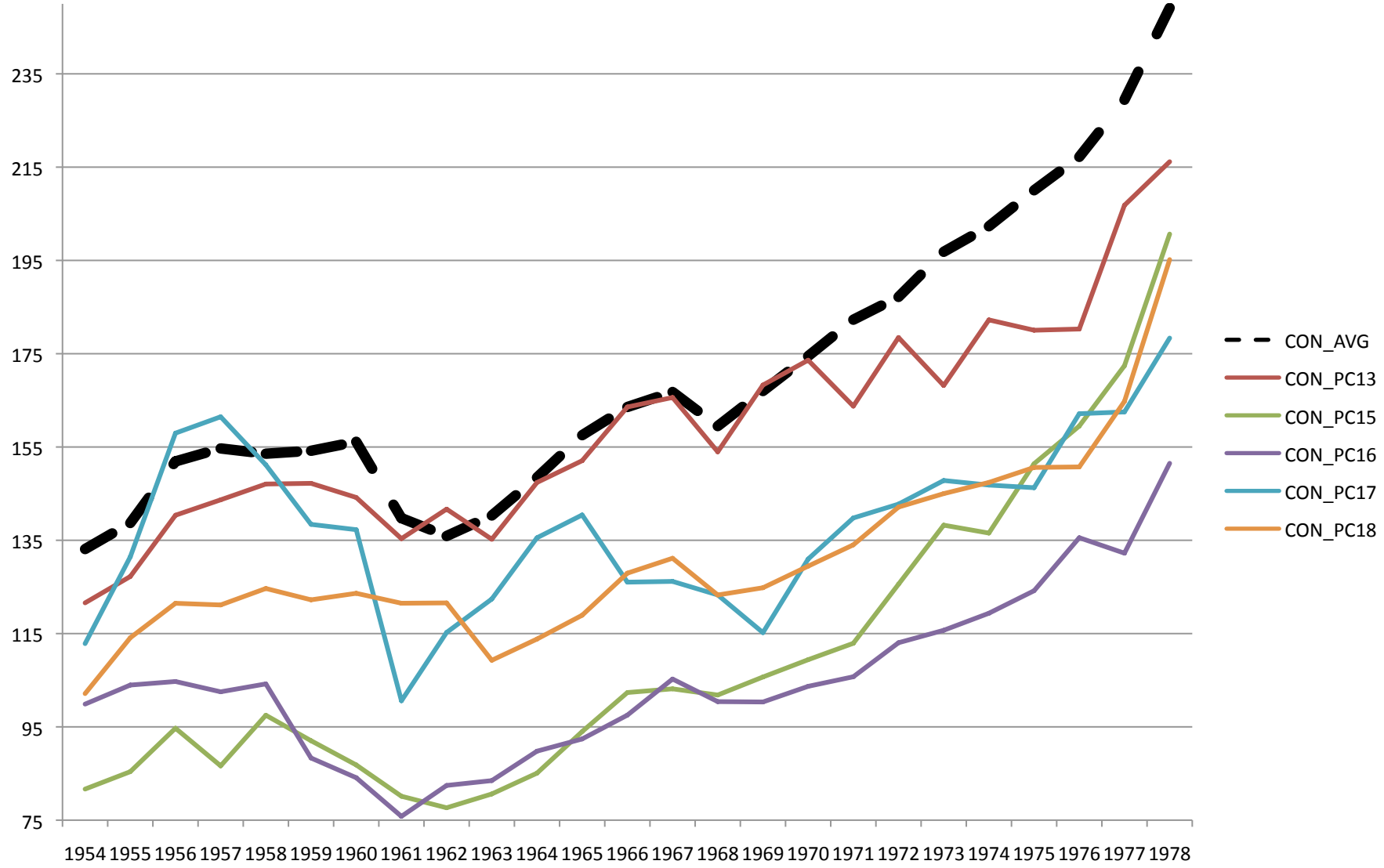
Per capita consumption 1954-1978



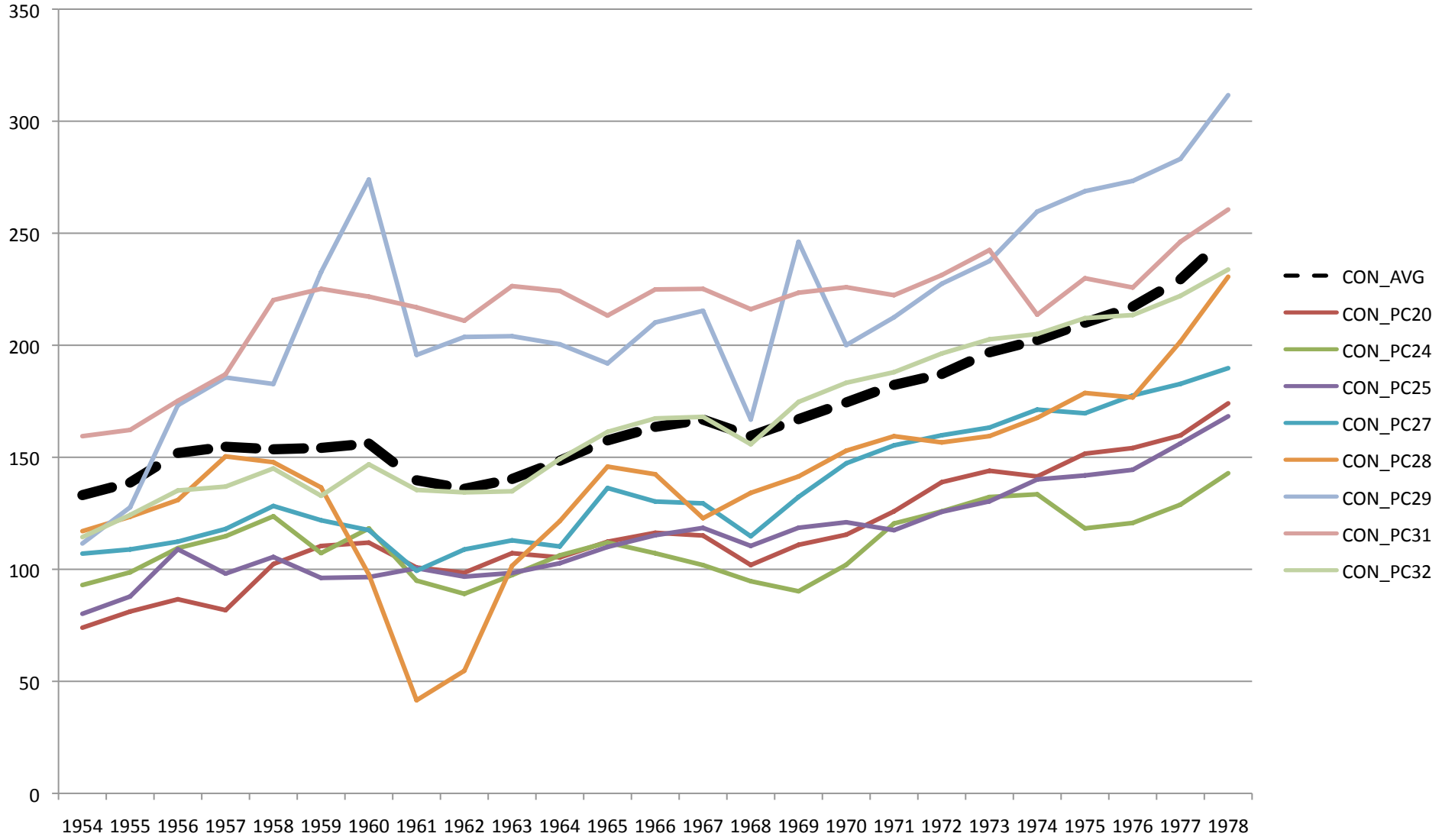
Log per capita consumption 1954-1978



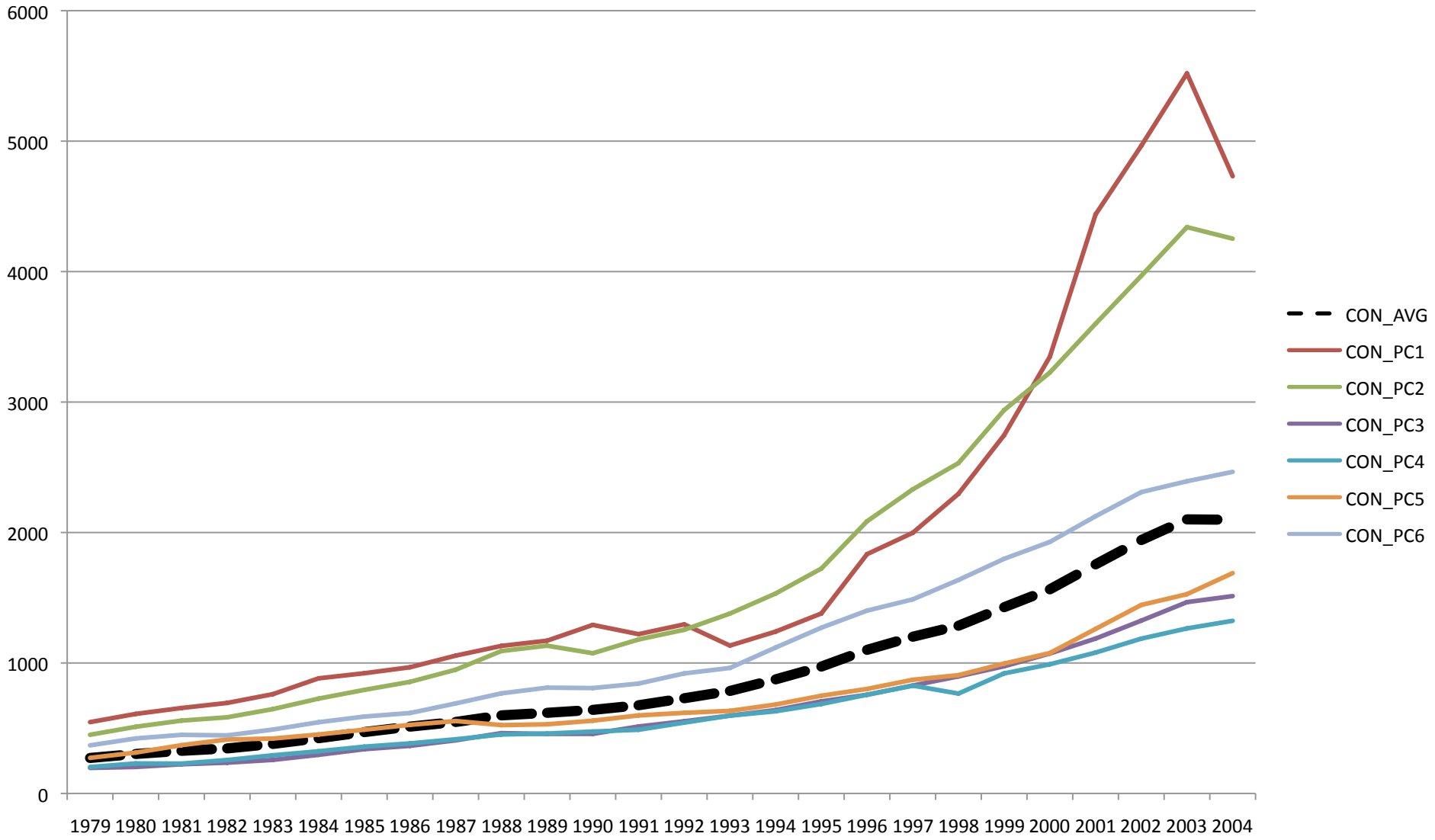
Per capita consumption 1954-1978



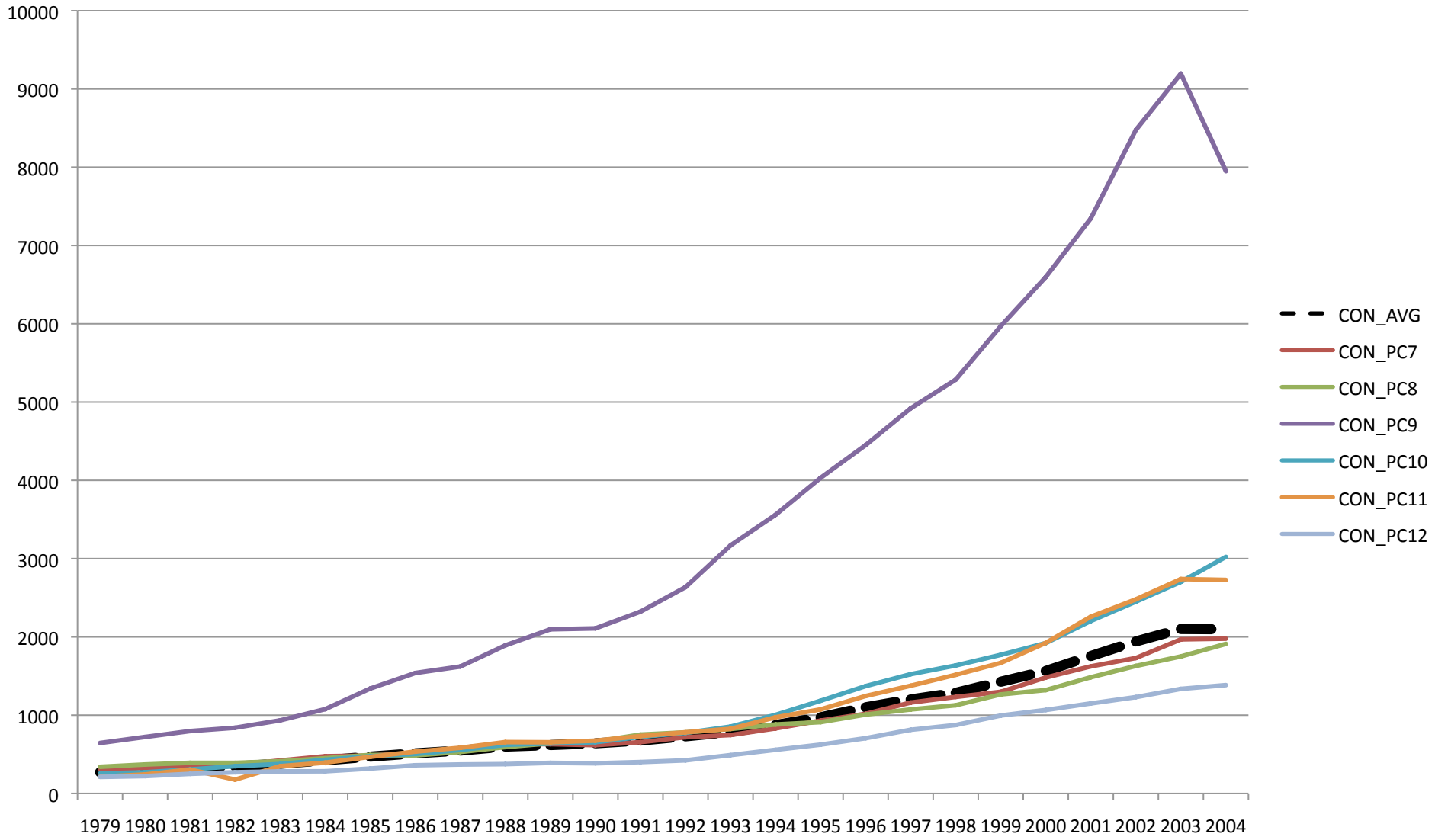
Per capita consumption 1979-2004



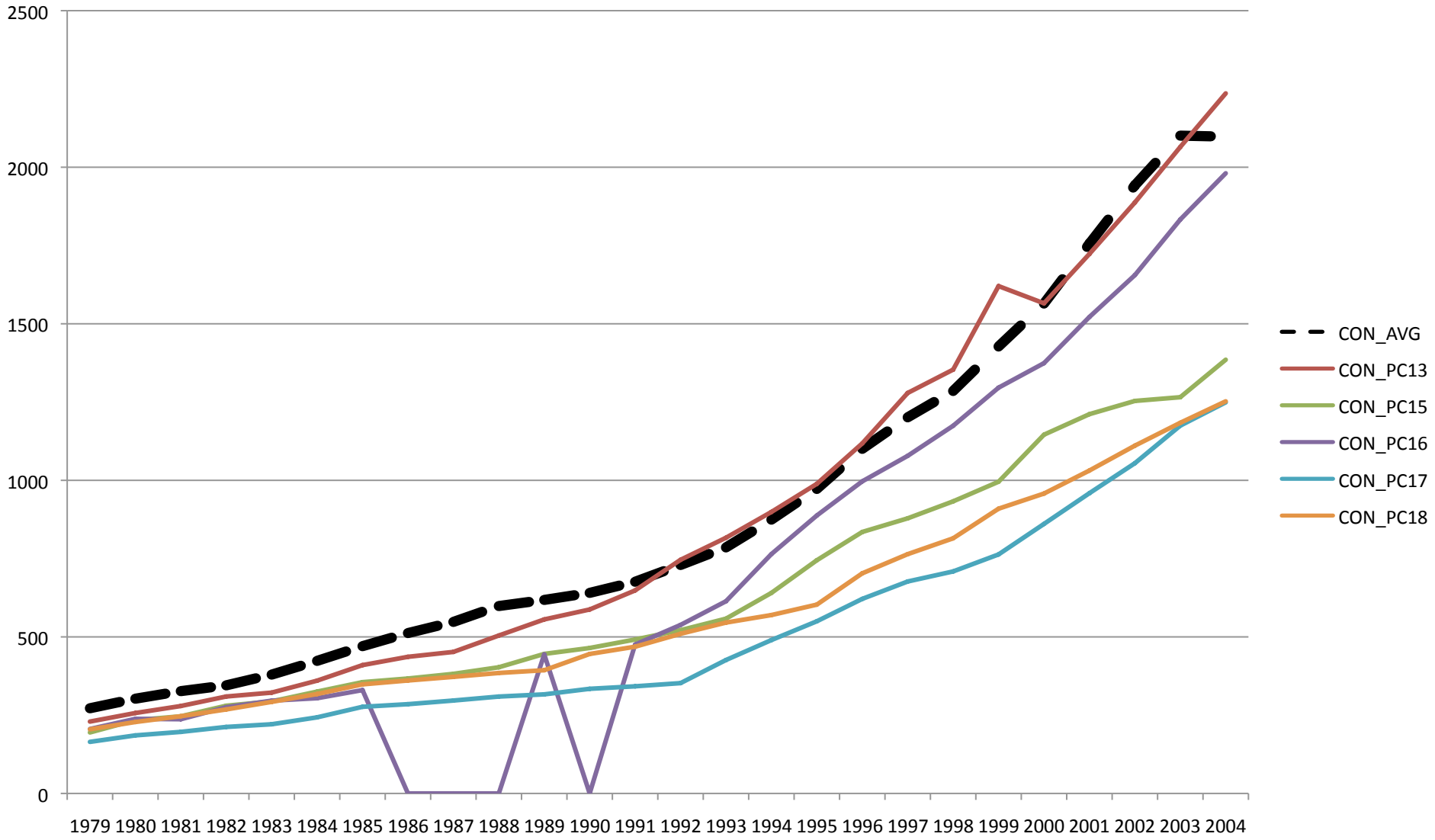
Per capita consumption 1979-2004



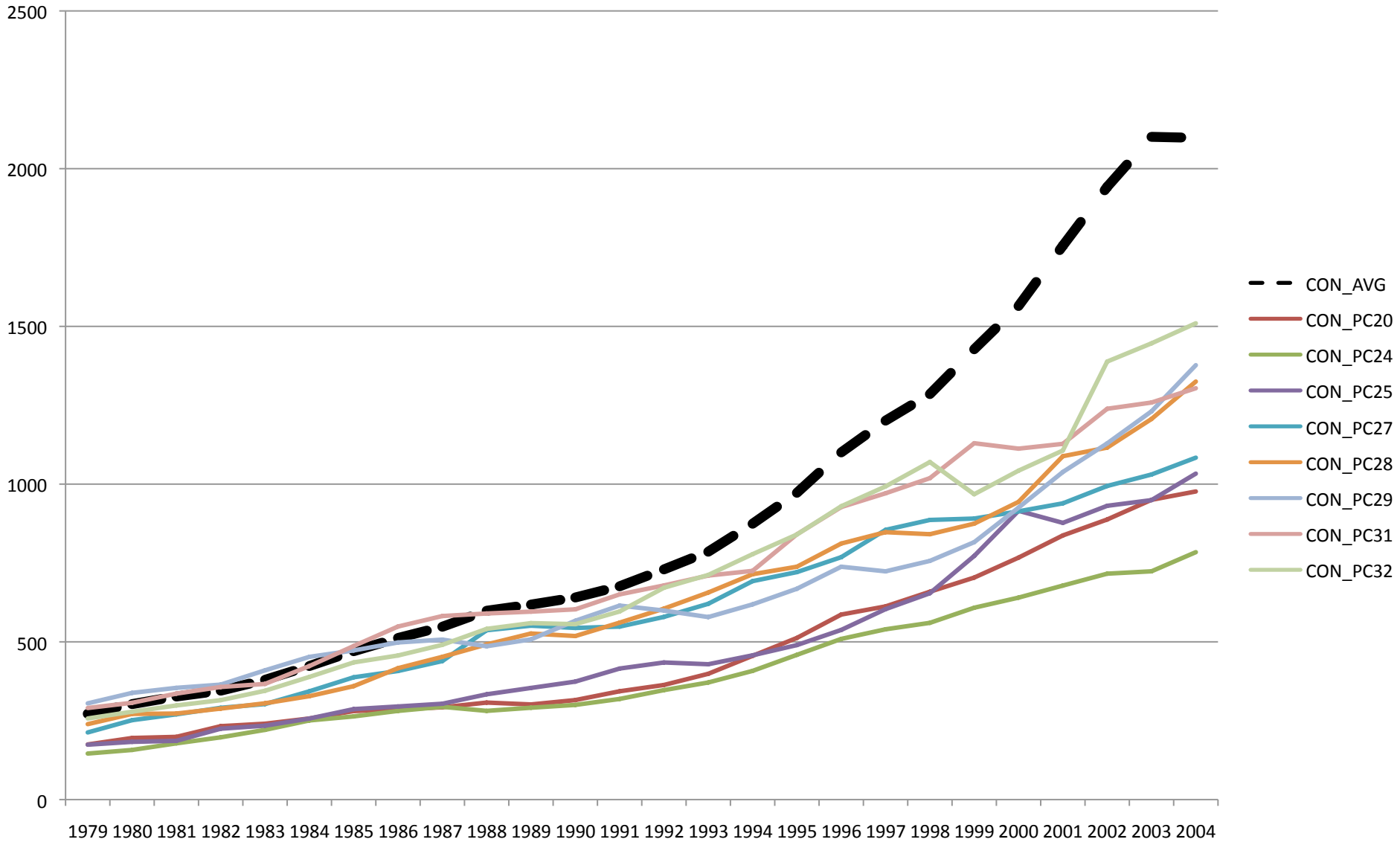
Per capita consumption 1979-2004



Per capita consumption 1979-2004



Per capita consumption 1979-2004



Testing the null hypothesis of perfect risk sharing

Let c_{jt} be log real per capita consumption of province j in year t, and C_t be log aggregate real per capita consumption. If there is perfect risk sharing, provincial consumption growth should be perfectly correlated with aggregate consumption growth. A

regressors will be zero. Let Δy_{jt}^p be the innovation (unexpected change) to province $j's$ permanent income. Crucini (1999) suggest running the regression

$$\Delta c_{jt} = \alpha_j + \lambda_j \Delta C_t + (1 - \lambda_j)\, \Delta y_{jt}^p + \epsilon_{jt} \tag{1}$$

and testing the null hypothesis (perfect risk sharing) that $\lambda_j = 1$ against the alternative hypothesis (imperfect risk sharing) that $0 < \lambda_j < 1$. The innovation to permanent income

Results

Table 1. Tests of Perfect Risk Sharing on 24 Chinese Provinces

Income Model	$\hat{\lambda}$	Average Values s.e.$\left(\hat{\lambda}\right)$	R^2	No. of provinces for which a 95% confidence interval contains the value of λ such that $\lambda = 1$	$0 < \lambda < 1$	$\lambda = 0$	$\lambda = 0$ or 1
				1954-1978			
I	0.45	0.43	0.38	6	2	8	8
II	0.39	0.40	0.42	6	1	9	8
III	0.33	0.38	0.43	5	2	11	6
				1979-2004			
I	0.50	0.32	0.26	9	2	5	7
II	0.49	0.32	0.27	8	1	7	8
III	0.43	0.31	0.27	6	1	10	7

Compare to US States and G-7

Table 2. Tests of Perfect Risk Sharing on U.S. States and G-7 Countries

Source: Crucini (1999)

Income Model	$\hat{\lambda}$	Average Values s.e.$\left(\hat{\lambda}\right)$	R^2	No. of provinces for which a 95% confidence interval contains the value of λ such that $\lambda = 1$	$0 < \lambda < 1$	$\lambda = 0$	$\lambda = 0$ or 1
U.S. States, 1972-1990							
I	0.94	0.31	0.51	31	3	2	9
II	0.84	0.34	0.50	29	2	3	13
III	0.88	0.32	0.50	33	3	2	10
G-7 Countries, 1970-1987							
I	0.60	0.26	0.45	2	2	2	1
II	0.44	0.44	0.57	1	2	4	0
III	0.37	0.37	0.57	1	2	4	0

Conclusions

- At the business-cycle frequency, the primary difference between China and more extensively studied economies lies in consumption/saving behavior
- Low consumption growth correlations within China is consistent with low opportunities for risk sharing.
- China should be amenable to business cycle modeling if the model is modified to allow for this.
- The precautionary saving motive that emerges may be the force behind balance of trade issues.