# Is China Due for a Slowdown?

## Technical Appendix

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This technical appendix explains the estimation method used in *FRBSF Economic Letter* 2012-31, "Is China Due for a Slowdown?" by Israel Malkin and Mark M. Spiegel.
http://www.frbsf.org/publications/economics/letter/2012/el2012-31.html

### Data sources

- Chinese provincial data are from CEIC
- National income data are from Penn World Tables 7.1

### Convergence among Chinese provinces

Using the provincial level consumer price index, real gross domestic product, and population data, we calculate the real per capita income for each province. After converting the units to 2005 international dollars, we compare the level of per capita income calculated by the chain rule (real gross domestic product per capita, or rgdppc) in 2000 with the average annual growth rate from 2000 to 2011.

### The baseline model

We pool income data for Hong Kong, Japan, Korea, and Taiwan over the period 1950–2009. We then estimate the relationship between the level of per capita income and per capita income growth. To smooth any business cycle effects, we regress the average annual growth of per capita income over the following five years on its current level.[1] We fit a cubic function to the data, which satisfies

$$\Delta Y_{i,t} = 4.0 + 0.87E^{-3}Y_{i,t} - 7.02E^{-8}Y^2_{i,t} + 1.28E^{-12}Y^3_{i,t},$$

where $\Delta Y_{i,t}$ represents income growth in country $i$ in the five-year period beginning at time $t$. This gives us a prediction for income growth over the next five years given current income.

### Error correction model

We next use an error correction model to estimate the pace at which the countries in our sample converge towards the growth levels predicted by the baseline model. We obtain the following estimation results:

$$\Delta Y_{i,t} = -0.5 - 0.176 * (Gap_{i,t-1}) + \lambda_i + \delta_t,$$

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[1] For example, the level of rgdppc in 2000 is used to forecast the growth rate of rgdppc from 2000 to 2005.

where $\Delta Y_{i,t}$ represents the change in the average growth rate between the five-year period starting at time $t$ and the previous five-year period starting in $t-1$. The independent variable $Gap_{i,t}$ is a measure of the difference between the observed growth rate and the model-predicted rate for the five-year period starting at time $t-1$; $\lambda_i$ and $\delta_t$ are binary variables representing any country-specific or year-specific effects. The full estimation results are presented in the tables. The standard error on the gap variable is equal to 0.046, indicating that the correction rate we estimate is statistically significant.

## Stata output[2]

**Table 1**
**Baseline Model:** *reg y5_avg p1 p2 p3 if model=1*

| Source | SS | df | MS |
|---|---|---|---|
| Model | 742.030319 | 3 | 247.34344 |
| Residual | 672.558531 | 202 | 3.32949768 |
| Total | 1414.58885 | 205 | 6.90043342 |

| | |
|---|---|
| Number of observations | 206 |
| $F(3, 202)$ | 74.29 |
| Prob $> F$ | 0.0000 |
| R-squared | 0.5246 |
| Root mean-squared error | 1.8247 |

| y5_avg | Coefficient | Standard error | t | $P > |t|$ | 95% confidence interval | |
|---|---|---|---|---|---|---|
| p1 | 0.0008728 | 0.0001454 | 6.00 | 0.000 | 0.0005861 | 0.0011596 |
| p2 | –7.02e-08 | 1.09e-08 | –6.43 | 0.000 | –9.17e-08 | –4.86e-08 |
| p3 | 1.28e-12 | 2.27e-13 | 5.64 | 0.000 | 8.33e-13 | 1.73e-12 |
| _cons | 4.005013 | 0.4703973 | 8.51 | 0.000 | 3.077494 | 4.932531 |

**Table 2**
**Convergence Model:** *xtreg chg_y5 L1.gap i.year if model=1, fe*

| | | |
|---|---|---|
| Fixed effects (within) regression | Number of observations | 202 |
| Group variable: *cn_index* | Number of groups | 4 |
| R-squared | Within | 0.5054 |
| | Between | 0.3903 |
| | Overall | 0.5043 |
| Observations per group | Minimum | 44 |
| | Maximum | 54 |
| | Average | 50.5 |
| $F(54, 144)$ | | 2.73 |
| Prob $> F$ | | 0.0000 |
| corr($u_i$, Xb) | | –0.0342 |

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[2] Please refer to the Stata manual (http://www.stata.com/manuals/) for definitions of terms used in these tables.

Table 2 (continued)

| chg_y5_avg | | | | | | |
|---|---|---|---|---|---|---|
| Year | Coefficient | Standard error | t | P > |t| | 95% confidence interval | |
| L1.gap | −0.1761566 | 0.046311 | −3.80 | 0.000 | −0.2676952 | −0.084618 |
| 1952 | −0.2574343 | 1.095807 | −0.23 | 0.815 | −2.423378 | 1.90851 |
| 1953 | −0.0778236 | 1.097889 | −0.07 | 0.944 | −2.247884 | 2.092237 |
| 1954 | 0.1722224 | 1.039556 | 0.17 | 0.869 | −1.882538 | 2.226983 |
| 1955 | −0.0805845 | 1.039971 | −0.08 | 0.938 | −2.136165 | 1.974996 |
| 1956 | 0.6037493 | 1.041804 | 0.58 | 0.563 | −1.455454 | 2.662952 |
| 1957 | −0.0723232 | 1.039621 | −0.07 | 0.945 | −2.127212 | 1.982566 |
| 1958 | 1.073285 | 1.041401 | 1.03 | 0.304 | −0.985122 | 3.131691 |
| 1959 | 1.146055 | 1.03736 | 1.10 | 0.271 | −0.9043663 | 3.196475 |
| 1960 | 0.5578946 | 1.035132 | 0.54 | 0.591 | −1.48812 | 2.60391 |
| 1961 | 1.349271 | 1.002759 | 1.35 | 0.181 | −0.6327566 | 3.331299 |
| 1962 | 0.6228221 | 1.00377 | 0.62 | 0.536 | −1.361204 | 2.606848 |
| 1963 | 0.0135186 | 1.003178 | 0.01 | 0.989 | −1.969339 | 1.996376 |
| 1964 | 0.8157965 | 1.002414 | 0.81 | 0.417 | −1.165549 | 2.797142 |
| 1965 | 0.8338225 | 1.002414 | 0.83 | 0.407 | −1.147523 | 2.815168 |
| 1966 | 0.5163745 | 1.002441 | 0.52 | 0.607 | −1.465025 | 2.497774 |
| 1967 | 1.158969 | 1.002411 | 1.16 | 0.250 | −0.8223721 | 3.140311 |
| 1968 | 1.167709 | 1.002677 | 1.16 | 0.246 | −0.8141575 | 3.149576 |
| 1969 | −0.921168 | 1.003381 | −0.92 | 0.360 | −2.904425 | 1.062089 |
| 1970 | −0.7345733 | 1.003037 | −0.73 | 0.465 | −2.717151 | 1.248004 |
| 1971 | 0.6327739 | 1.006526 | 0.63 | 0.531 | −1.3567 | 2.622248 |
| 1972 | 0.5777391 | 1.00534 | 0.57 | 0.566 | −1.409391 | 2.564869 |
| 1973 | 0.3458338 | 1.004438 | 0.34 | 0.731 | −1.639513 | 2.331181 |
| 1974 | 1.471889 | 1.004457 | 1.47 | 0.145 | −0.5134947 | 3.457273 |
| 1975 | 0.7726648 | 1.002579 | 0.77 | 0.442 | −1.209008 | 2.754338 |
| 1976 | −0.3159501 | 1.002452 | −0.32 | 0.753 | −2.297372 | 1.665471 |
| 1977 | −0.6751836 | 1.003743 | −0.67 | 0.502 | −2.659157 | 1.308789 |
| 1978 | −0.5682555 | 1.0075 | −0.56 | 0.574 | −2.559655 | 1.423144 |
| 1979 | 0.1626079 | 1.011572 | 0.16 | 0.873 | −1.836841 | 2.162057 |
| 1980 | 0.3103486 | 1.010723 | 0.31 | 0.759 | −1.687422 | 2.308119 |
| 1981 | 0.8799665 | 1.008984 | 0.87 | 0.385 | −1.114365 | 2.874299 |
| 1982 | 1.652669 | 1.005495 | 1.64 | 0.102 | −0.3347665 | 3.640104 |
| 1983 | 1.238803 | 1.002544 | 1.24 | 0.219 | −0.7427998 | 3.220405 |
| 1984 | 0.4518312 | 1.002527 | 0.45 | 0.653 | −1.529739 | 2.433401 |
| 1985 | 1.288738 | 1.002457 | 1.29 | 0.201 | −0.6926938 | 3.270169 |
| 1986 | 0.4717125 | 1.003278 | 0.47 | 0.639 | −1.511343 | 2.454768 |
| 1987 | −0.2581797 | 1.003065 | −0.26 | 0.797 | −2.240814 | 1.724455 |
| 1988 | −0.2014402 | 1.002415 | −0.20 | 0.841 | −2.18279 | 1.779909 |
| 1989 | 0.5513212 | 1.00266 | 0.55 | 0.583 | −1.430512 | 2.533154 |
| 1990 | 0.0633486 | 1.002536 | 0.06 | 0.950 | −1.91824 | 2.044937 |
| 1991 | 0.1473782 | 1.002874 | 0.15 | 0.883 | −1.834878 | 2.129634 |
| 1992 | 0.4641602 | 1.003124 | 0.46 | 0.644 | −1.51859 | 2.446911 |
| 1993 | −1.110926 | 1.00287 | −1.11 | 0.270 | −3.093174 | 0.8713214 |
| 1994 | 0.0823254 | 1.007173 | 0.08 | 0.935 | −1.908428 | 2.073079 |
| 1995 | 0.6447927 | 1.006909 | 0.64 | 0.523 | −1.345439 | 2.635025 |
| 1996 | −0.428386 | 1.004823 | −0.43 | 0.671 | −2.414495 | 1.557723 |
| 1997 | 0.3027037 | 1.007243 | 0.30 | 0.764 | −1.688188 | 2.293595 |
| 1998 | 1.584347 | 1.006353 | 1.57 | 0.118 | −0.4047853 | 3.57348 |
| 1999 | 0.540625 | 1.003043 | 0.54 | 0.591 | −1.441964 | 2.523214 |
| 2000 | 0.2811054 | 1.002631 | 0.28 | 0.780 | −1.70067 | 2.26288 |
| 2001 | 1.624028 | 1.002702 | 1.62 | 0.107 | −0.357888 | 3.605945 |
| 2002 | 0.9694935 | 1.002728 | 0.97 | 0.335 | −1.012473 | 2.95146 |
| 2003 | 0.3424103 | 1.003574 | 0.34 | 0.733 | −1.641228 | 2.326049 |
| 2004 | −0.8751224 | 1.002798 | −0.87 | 0.384 | −2.857229 | 1.106984 |
| _cons | −0.5041461 | 0.8983053 | −0.56 | 0.576 | −2.279714 | 1.271422 |