Measuring Capital Input in Chinese Industry and Implications for China's Industrial Growth Performance 1949–2005

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Structure/Objectives

- Main problems in the official statistics (II)
- Estimation of industry-level flows of investment at historical prices (IV)
- Construction of industry-level deflators (V)
- Estimation of the initial capital stock (VI)
- Estimation of economic depreciation (VI)
- Construction of net capital stocks by industry (VI)
- Estimation of capital services (VII)
- Discussion of the results, compared with those directly using official investment, and implications for China's industrial growth (VIII)

Data Problems: An Overview

- Improper industrial classification prior to 1985 (facilitating planning control rather than considering the nature of the industry, e.g. metal mining mixed up with smelting and pressing under the Ministry of Metallurgy)
- The official fixed asset investment data overstate the actual investment – based on "work load" of an investment project within the reporting period rather than actual transaction of a completed project from builders to investors/users (inconsistency between the national accounts and production accounts!)
- Industrial fixed assets are mixed with residential assets (dwelling) and assets for non-industrial activities
- Little information on service lives by asset, and no study on asset retirement pattern
- Little information on asset-specific price index for investment
- Limited investment and asset data on non-state sectors (more scarce at industry level; broken time series)
- No SNA-type IOT available prior to 1987 for measuring return to capital by industry

Data Problem: Further Explanation

- The SNA concept of "fixed capital formation" (***I***): …finished FA and transferred from producers/constructors to users (investors) in a given period
- The Chinese usage of this concept: ***M***=the "work load" of investment projects monitored and recorded by the planning authorities and ***N***="newly increased FA" in a given period (i = 0, 1, 2, … τ)

$$N_t = \sum_{i=0}^{\tau} \theta_{t-i} \cdot M_{t-i}$$

- A large part of ***M*** cannot be put into production in the year of investment, and some of ***M*** may never meet production standards and completely wasted, thus, ***N*** is better than *M*;
- But both ***M*** and ***N*** contain residential structures and exclude all investment projects less than half million yuan; and both could be over-/under-reported for political or technical

Data Problems…

- Also, to use ***N*** one needs to adjust it for residential structures (η) and missing/underreporting (λ) (assuming no over-reporting):

$$I_t = N_t \frac{1-\eta_t}{1-\lambda_t}$$

- Problems? Little information on η and λ; no detailed industry breakdown; ***N*** in a much shorter series compared with ***M***.
- Summary: the official data on "investment" or "newly increased fixed capital" cannot be accepted as the "investment" as defined in PIM

Data Used: An Overview

- This study attempts to make the best use of lately available data and information released from the archives of China's statistical and planning authorities, including
  - China's first asset census and re-evaluation in 1951 (State Archive)
  - DITS internal historical reports on fixed asset (stocks) at 2-digit industry level, 1952-93
  - DITS published 2-digit level of fixed asset (stocks), 1994-2005
  - 6-digit level of equipment and machinery price indices, 1984-98 (MOF)
  - Government documents on depreciation policy, asset service life and depreciation rate by industry, 1963, 1985, 1998
  - China's three industrial/economic censuses in 1985, 1995 and 2004 (DITS)
- Plus, importantly, the knowledge of statisticians from China's National Bureau of Statistics

Construction of Flows of Investment

- Recall that gross capital stock can be defined as:

$$K_t^G = \sum_{\tau=0}^{T} I_{t-\tau} - \sum_{\tau=0}^{T} S_{t-\tau}$$

- where ***S*** denotes scrapings; therefore, rearranging the equation, the current period investment should be:

$$I_t = K_t^G - K_{t-1}^G + S_t$$

- For the Chinese case, the investment flow can be derived as:

$$I_{i,t} = (1-\eta_{i,t}^{FA})(FA_{i,t}^G - FA_{i,t-1}^G + S_{i,t})$$

- End-year gross FA are "stock" data directly from the accounting book of firms included in the NBS reporting system, so "full coverage" (λ=0) is ensured

Construction of Flows…

- Reclassified to ensure consistency over 1972, 85, 94 and 2002 CSIC; gaps are filled according to unpublished data or information from the NBS archives
- Assuming "bell shape" distribution of scrapings and different timing of scrapings for the planning (1952-93) and "reform" (1994-2005) periods
  - No premature scrapings for the planning period and the "planned scraping process" lasted for 9 years (beginning at T=the end of an asset's service life/industry specific)
  - During the "reform period" (defined as the period of market-based scraping behavior), scraping began 3 years earlier (T+3) and lasted for 7 years
- Main asset types (equipment, non-residential structures, dwellings) are decomposed using information for state firms (flows; available for 1954, 1974, 1980-83, 1985-93 for the planning period; and 1994-2000 for the reform period); gaps are filled; dwellings are removed; "others" are allocated to equipment and non-residential structures; assuming no dwellings for non-state firms
- Results: investment flows of 38 mining, manufacturing and utility industries (with further aggregation – to match my labour input data – the results are organised into 24 industries (4 mining, 19 manufacturing and 1 utilities)

Construction of Industry Deflators

- For equipment
  - Level of coverage: 2-digit level of industries
  - 1985-98: geometric mean of 6-digit level asset prices from a dataset of asset evaluation by Ministry of Finance (released in 2003)
  - 1952-84: extrapolated using aggregate price index for investment in equipment and the above industry specific indices for 1985
  - 1999-2005: extrapolated using the above industry specific indices for 1998 and 2-digit level PPI for machinery industry
  - Checked and reconciled with aggregate price index for investment in equipment since 1990
- For non-residential structures
  - Level of coverage: aggregate only
  - 1952-89: price index of "construction and installation"
  - 1990-2005: price index for investment in structures (no distinction between production and residential structures)
  - All related indices are checked and reconciled

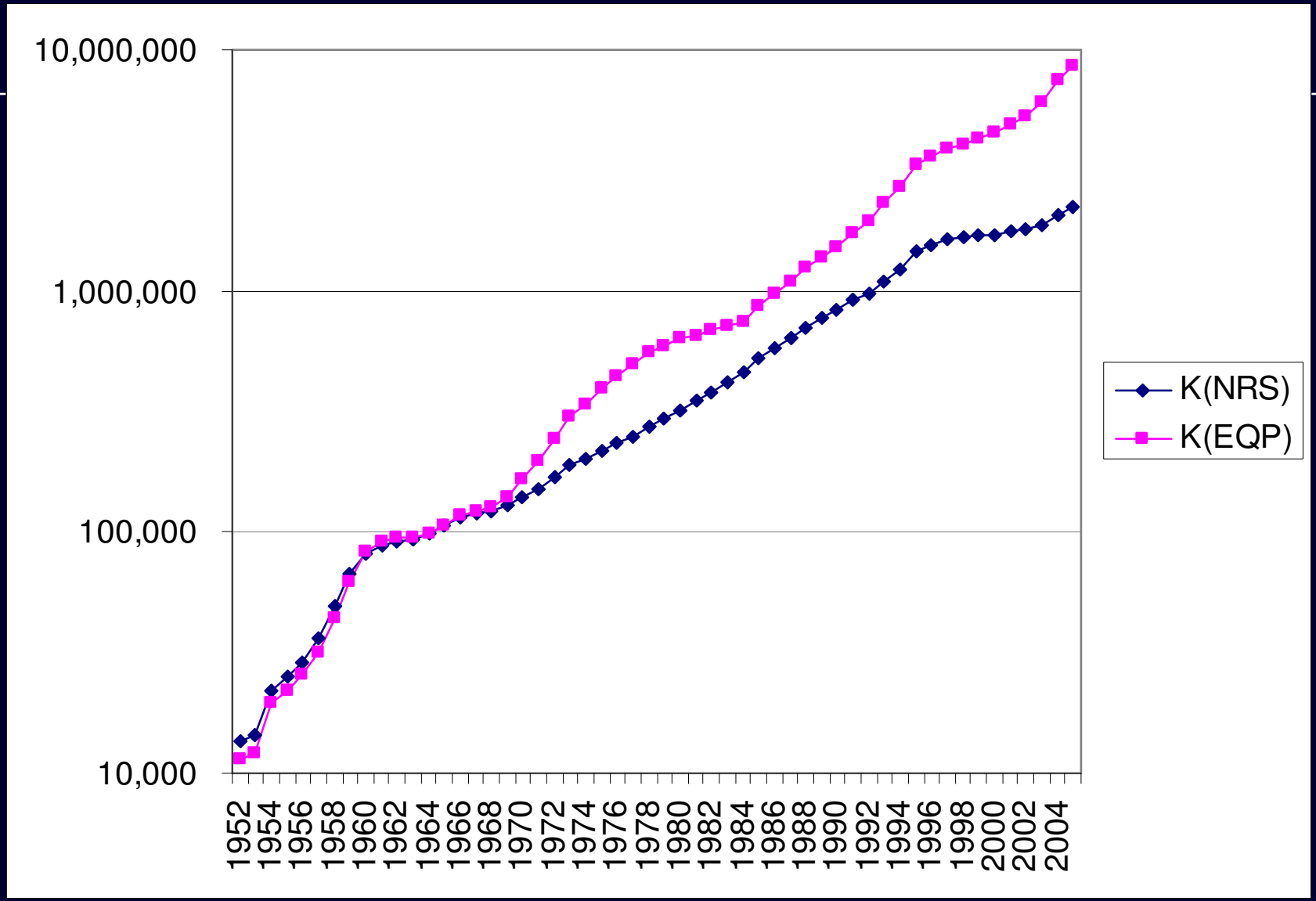
Estimation of the Initial Capital Stock by Industry

- The 1951 national census on fixed assets (book value, accumulated depreciation, replacement value by broad sector) conducted by ministries, which supports the published data on fixed assets and investment in 1949-52, aggregate
- The 1949-52 fixed asset data are decomposed according to the industry share of 1952 (the end of the civil war recovery period)

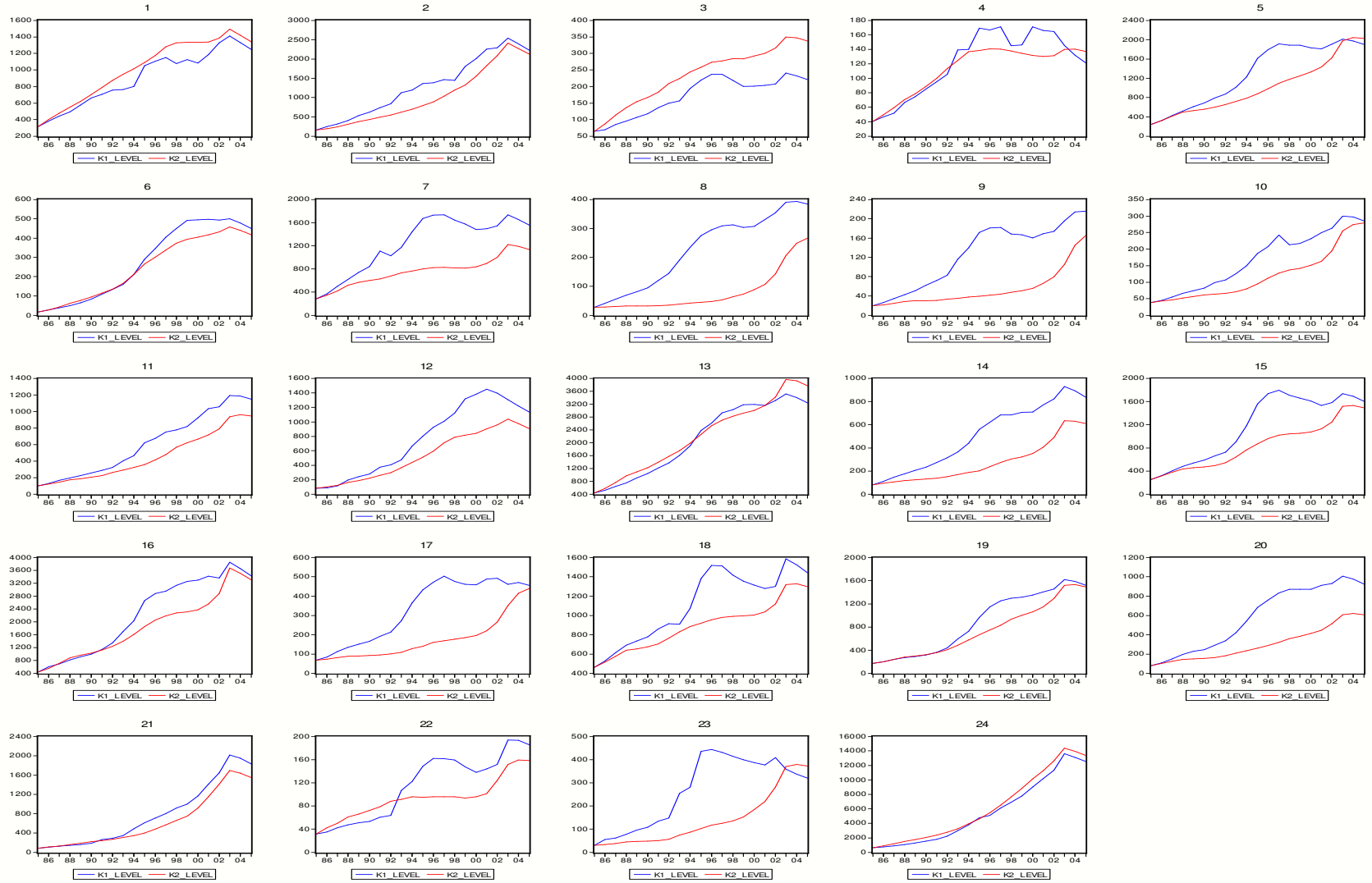
Estimation of Depreciation Rate

- The estimation is based on designated service lives (T) and BEA declining balance rates of fixed assets (R), following the relationship below as used in Hulten and Wykoff (1981)
  - $\delta = R/T$
- Two sets of information on officially designated service life of assets are available (internally), one was implemented in 1963 (for broad industries/sectors) and the other in 1993 (more detailed level of industries)
- The 1963 service life data are used for deriving industry δ for 1952-83, the 1993 data for deriving δ for 1993-2005, and the average of the two δs is used for the period in between (1984-92), thus allowing constant δ for a given period (a policy regime), but variant δ over different periods
- The so-estimated δ is then adopted in the perpetual inventory method. Using our derived flows and estimated initial stocks, with the assumption of geometric depreciation function, we obtained net capital stocks for 38 industries, which are organised into 24 industries (4 mining, 19 manufacturing and 1 utilities)

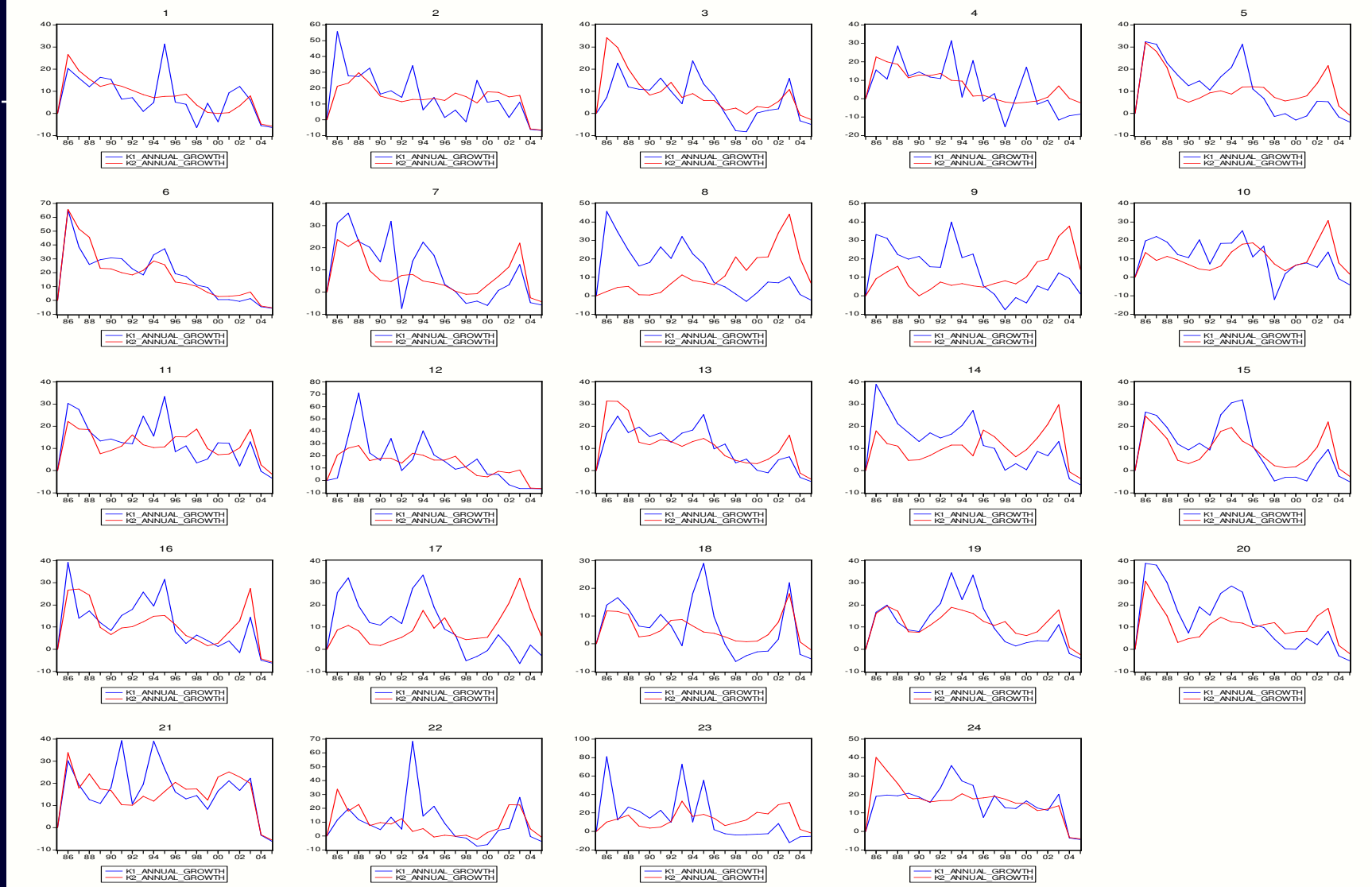
Annual Growth of Industry Net NRS and EQP stocks is 10% and 13% over 1952-2005



Estimated Net Capital Stock by Industry: Wu (K1/Blue) vs Official (K2/Red) (1985=100)



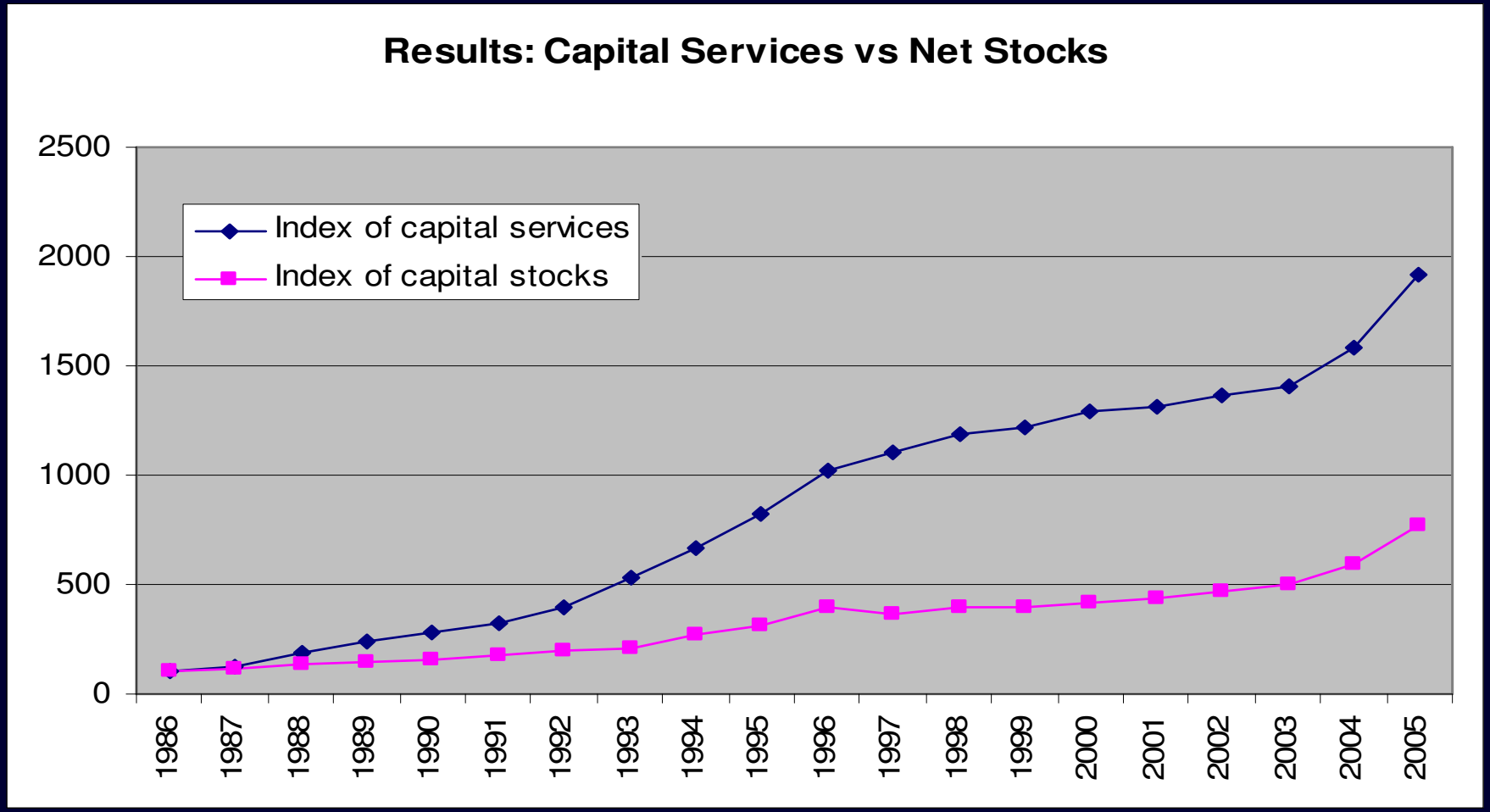
Annual Change of Net Capital Stock by Industry: Wu (K1/Blue) vs Official (K2/Red)



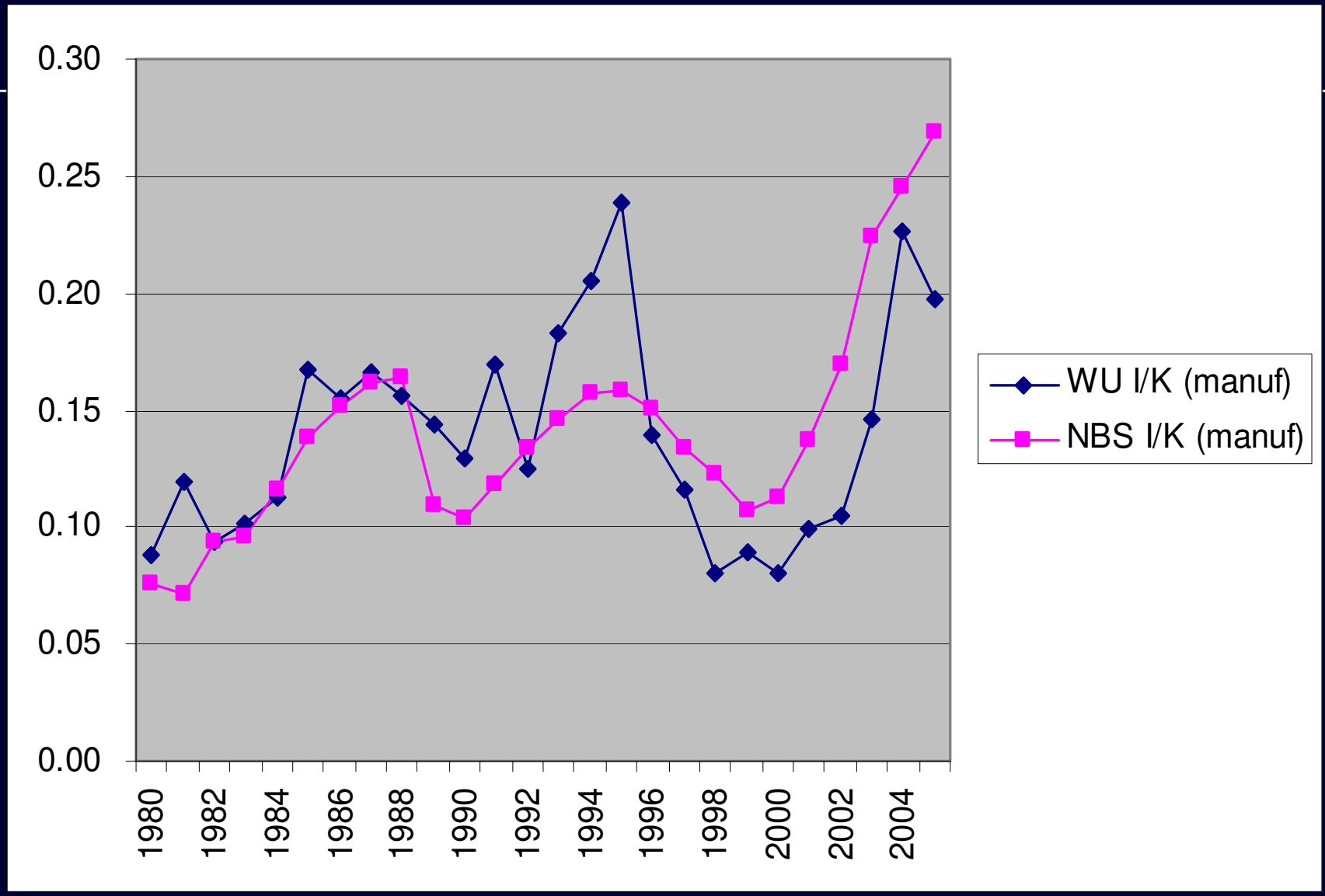
Estimation of Capital Services

- Following Jorgenson (1973), we estimated the "user cost" of or "rental price" of capital in nominal terms (obtained by adding the return to capital and depreciation minus price change)
- V is used as the weights to aggregate the "non-residential structure" and "equipment" within an industry and to aggregate the net stocks of all industries to obtain capital services for the industrial sector as a whole
- Estimation of "return on capital"
  - For the period 1981-2005 the compensation to capital is estimated based on the benchmark Chinese IOTs and interpolations between the benchmarks (1987, 92, 97, 2002/SNA/full tables; 1981/MPS, 90, 95, 2000, 05/SNA/reduced tables)
  - For the period 1952-1981, industry-level value-added and the compensation to labour are estimated and used to derived the compensation to capital
- See part of the results… (total industry only)

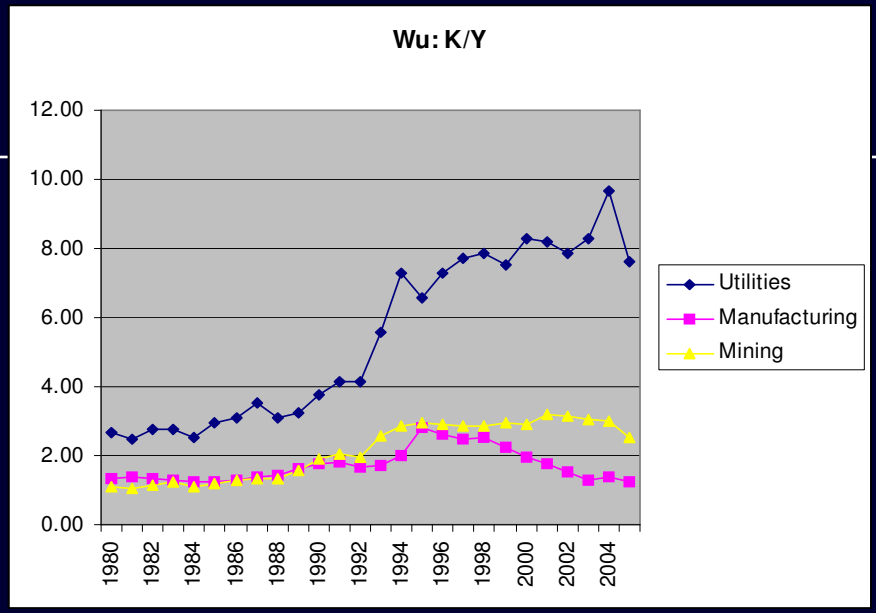
Index of capital services vs index of capital stocks, 1986=100
(The growth of K services is 17% p.a. and K is 11% p.a.)
This implies that based on the official industrial GDP growth 9.3% p.a. and assuming L input 1%, then TFP=2.3% p.a. if only net stocks are used, but -1.3% if the measured services are used

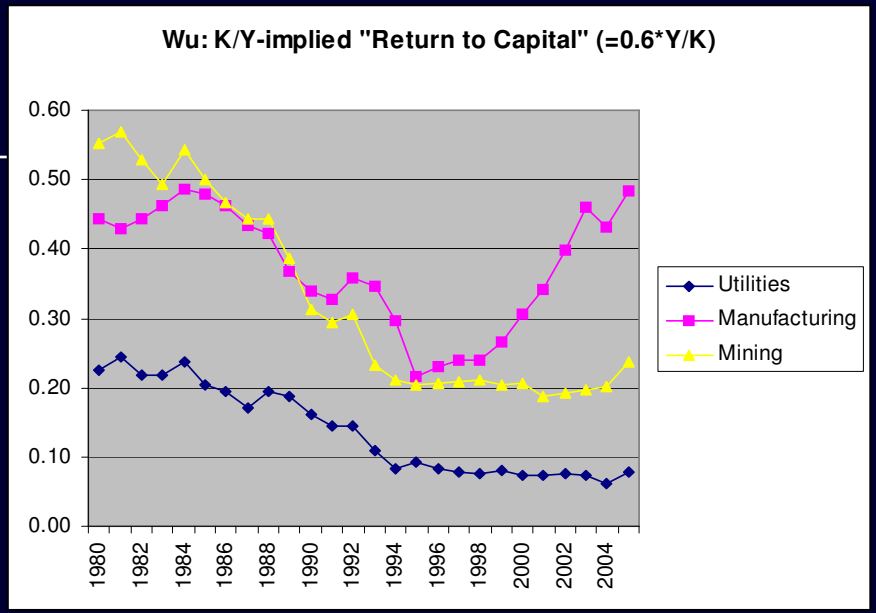


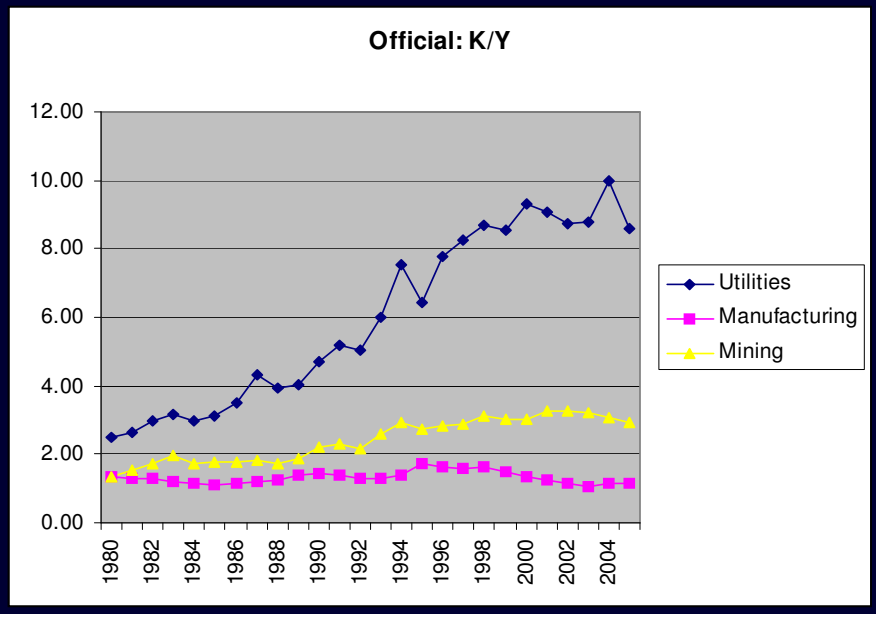
Ratio of Flows to Stocks: Wu vs Official
(Official I suggests some smoothing business?)

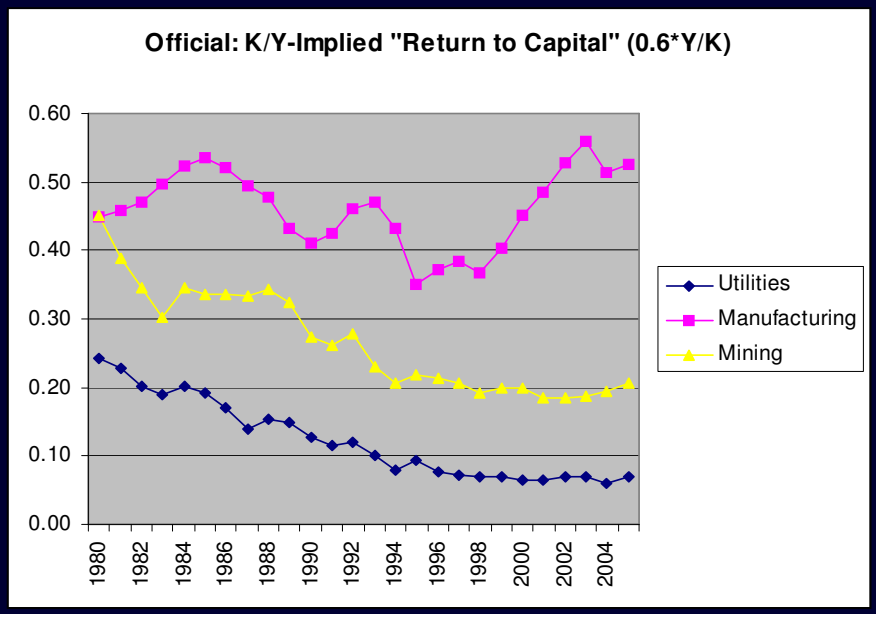


Implications of the results: Wu vs Official









Thanks!

The complete draft with a full list of references will be available in June 2008.