# The Growth of Chinese Exports:

## How Industrial Policy and Good Luck Created a Manufacturing Powerhouse

Brett D. Berger and Robert F. Martin

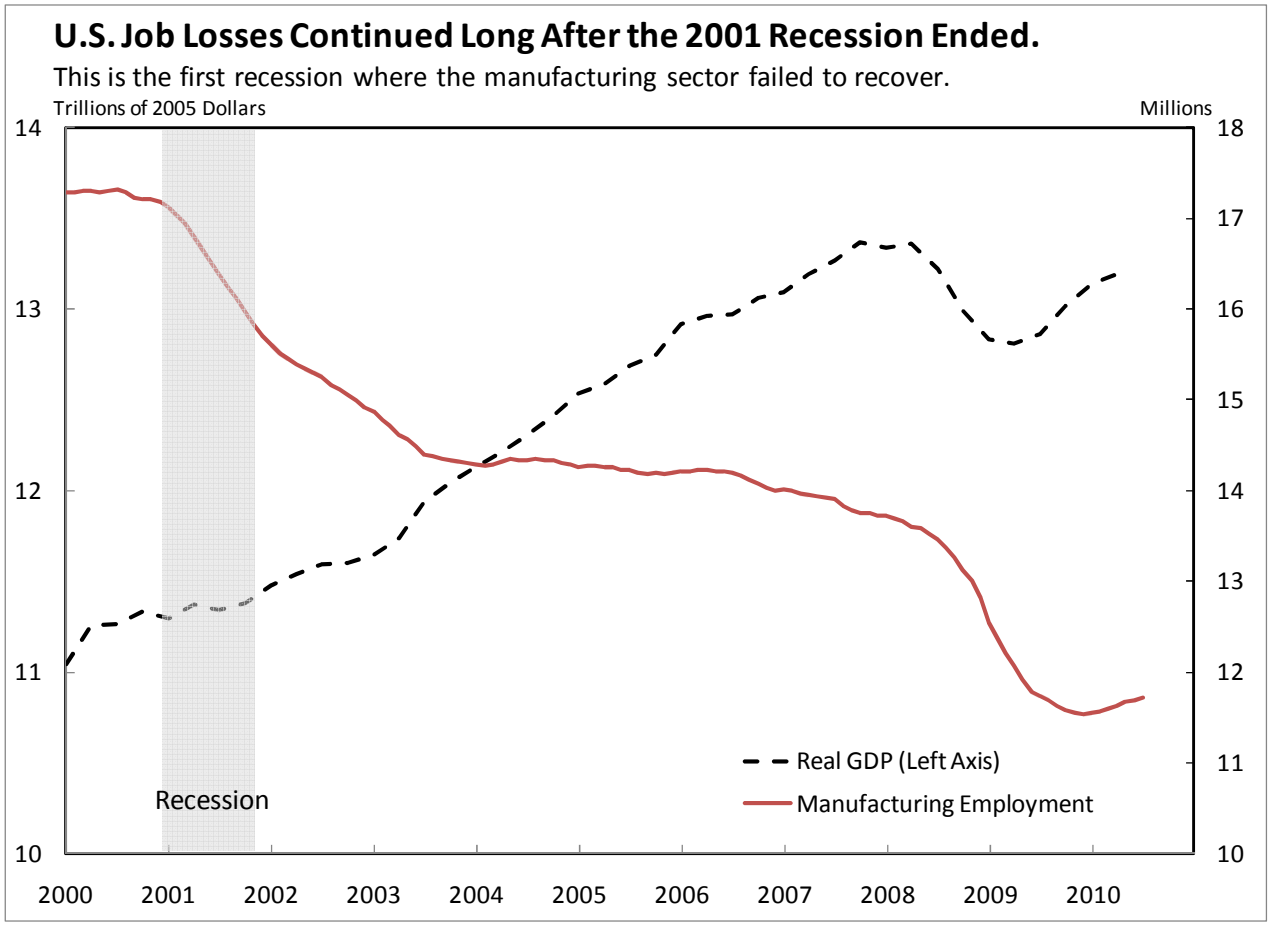
The views and opinions herein are the authors and the authors alone. The views do not necessarily reflect the views and opinions of the Federal Reserve Board, the Federal Reserve System or their respective staffs.

# Overview: We Address Two Questions

## 1) Why did Chinese Exports Boom?

# Overview: We Address Two Questions

2) Is there a relationship between China's export boom and the sharp fall in U.S. manufacturing employment?



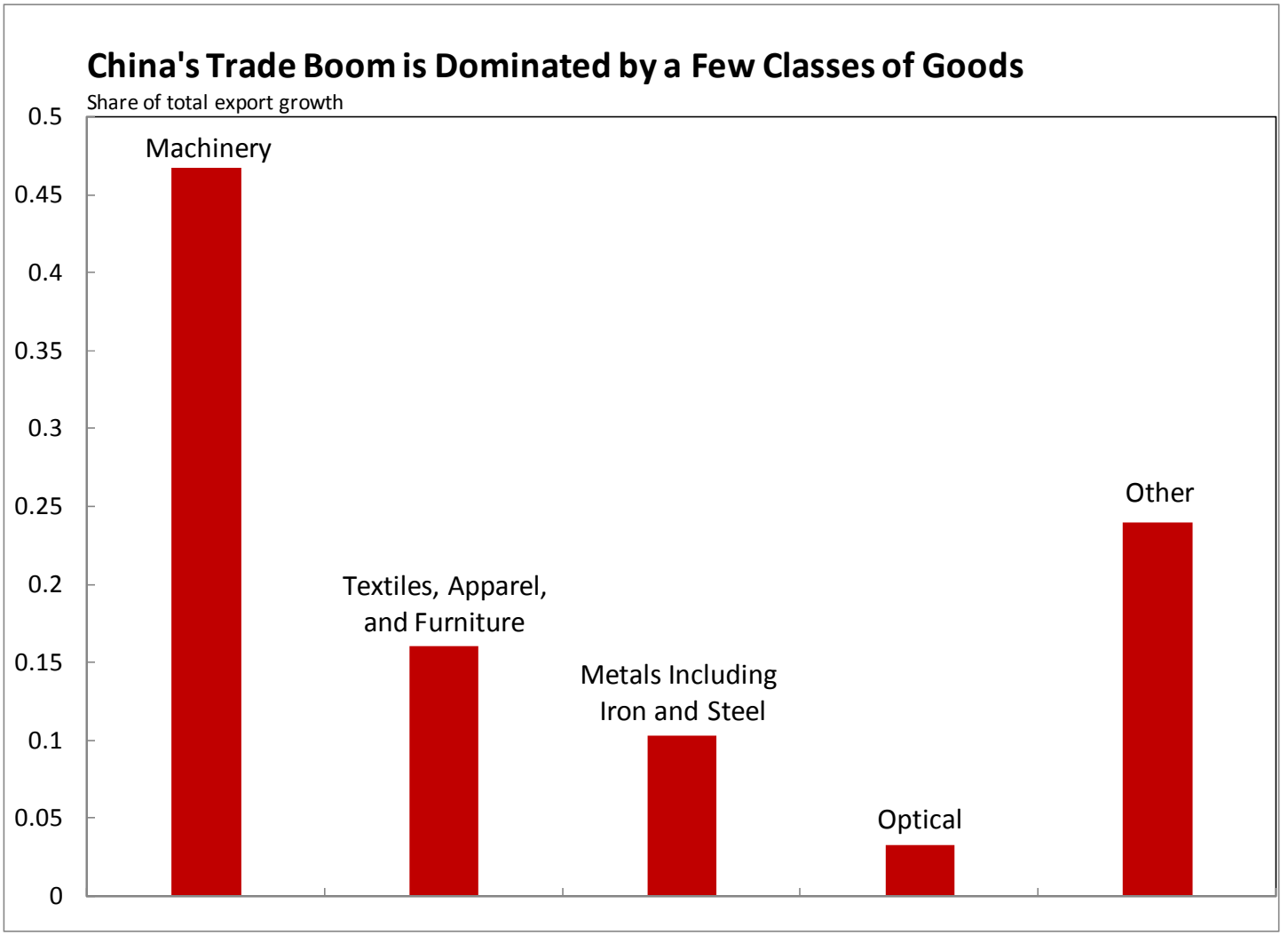
# Why Did Chinese Exports Boom?

- In theory
  - Classic comparative advantage
    - Natural advantage in labor and some natural resources
  - Krugman
    - Scale matters
    - Domestic market growth and economies of scale lead to export growth
  - Melitz
    - Trade costs and fixed entry costs matter
    - Reduction in trade and entry costs boost Chinese share

# Why Did Chinese Exports Boom?

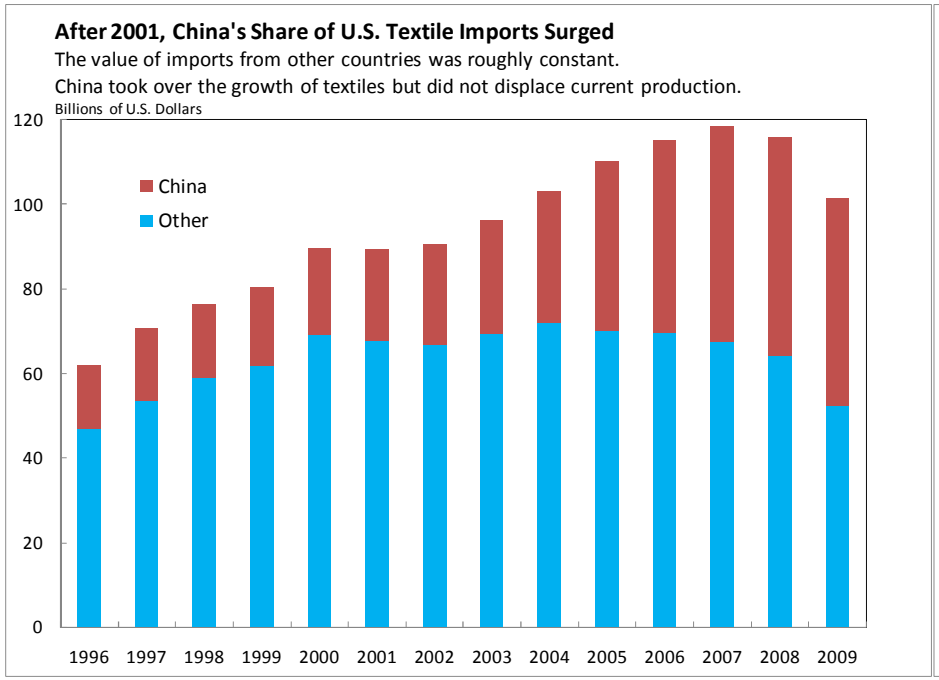
- In practice, a whole host of reasons
- But sector-specific stories are crucial.
- Reason include:
  - Natural comparative advantages
  - Industrial policy, such as subsidies and export promotion
  - Good luck (or fortunate timing) with the following coinciding:
    - Boom in global demand for new technology goods
    - The rise of China's middle class
    - Recovery from the Asian crisis
    - Surge in Chinese investment
    - Stagnant investment in U.S. following dot.com bubble
  - Exchange rate

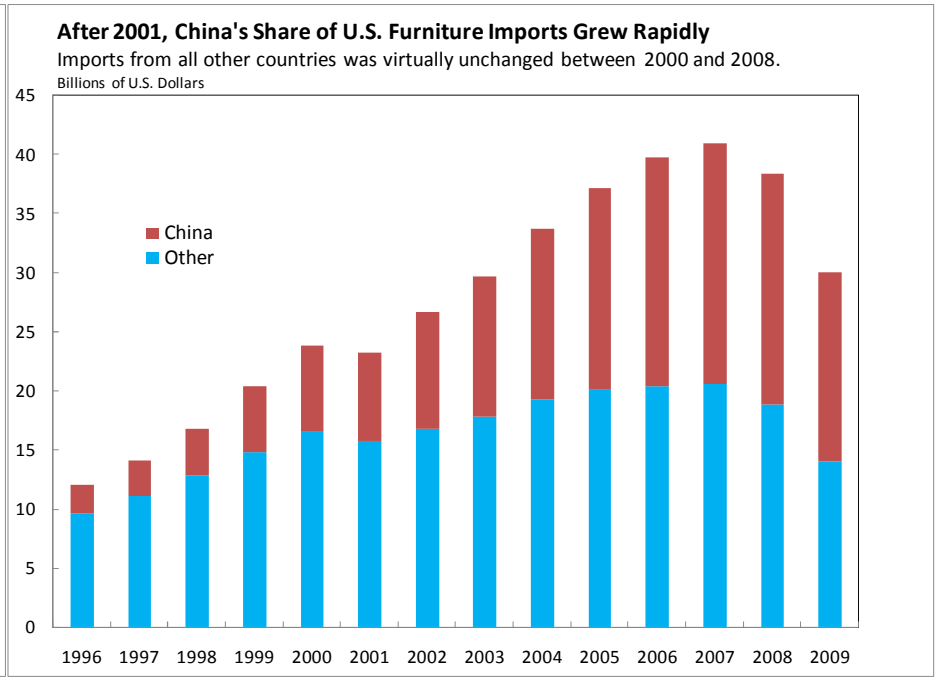
# Our Answers – Sector Specific Stories



# Our Answers – Labor-intensive sectors

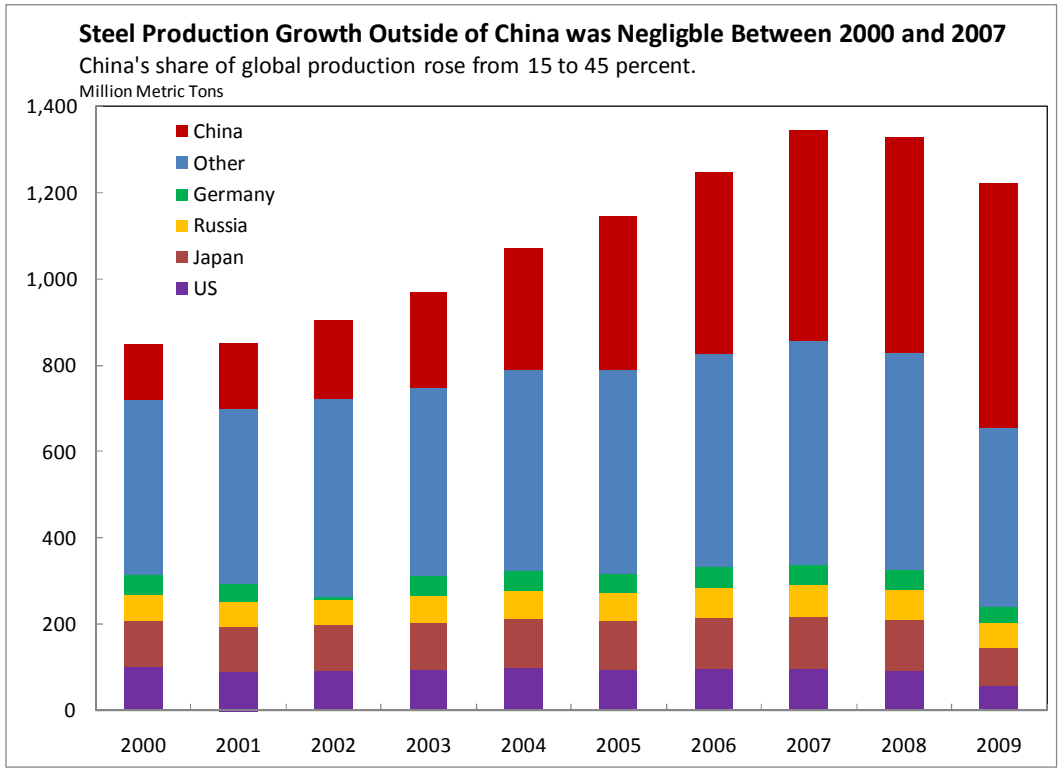
- Obvious natural advantages
  - Furniture
    - Entry into WTO in 2001 reduced tariffs on Chinese goods
  - Textiles and Apparel
    - And expiration of multilateral agreements (MFA, ATC) that had artificially held down Chinese exports



# Our Answers – Capital and Energy-Intensive Sectors

- Capital and energy subsidies for state-owned heavy industry (eg. metals)
- SOE reforms increased efficiency, led to rising profits and capacity
  - China's steel production quadrupled from 2000-2007
  - US and Japanese production flat (2nd and 3rd largest producers in 2000)



# Our Answers – Machinery Exports (HS 84 and 85)

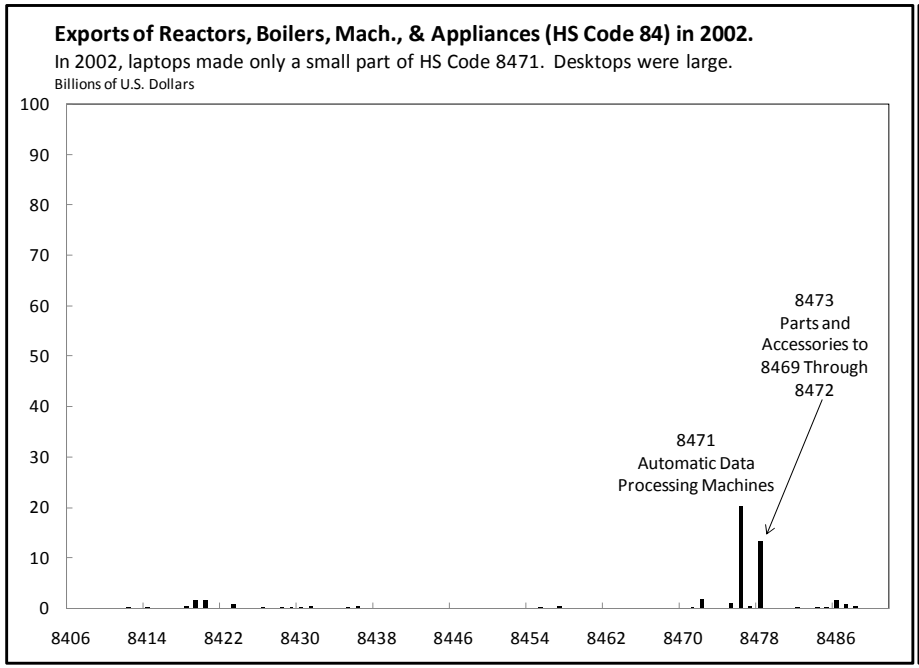
- Dominated export growth (45 percent of the total)
  - We use detailed Chinese trade data to shed some light on this category
  - Hand entry, official Chinese HS 8-digit data
- We find that 4 products account for more than a third of the growth
- Laptops
- Cellphones
- LCD Screens
- Integrated Electronic Circuits

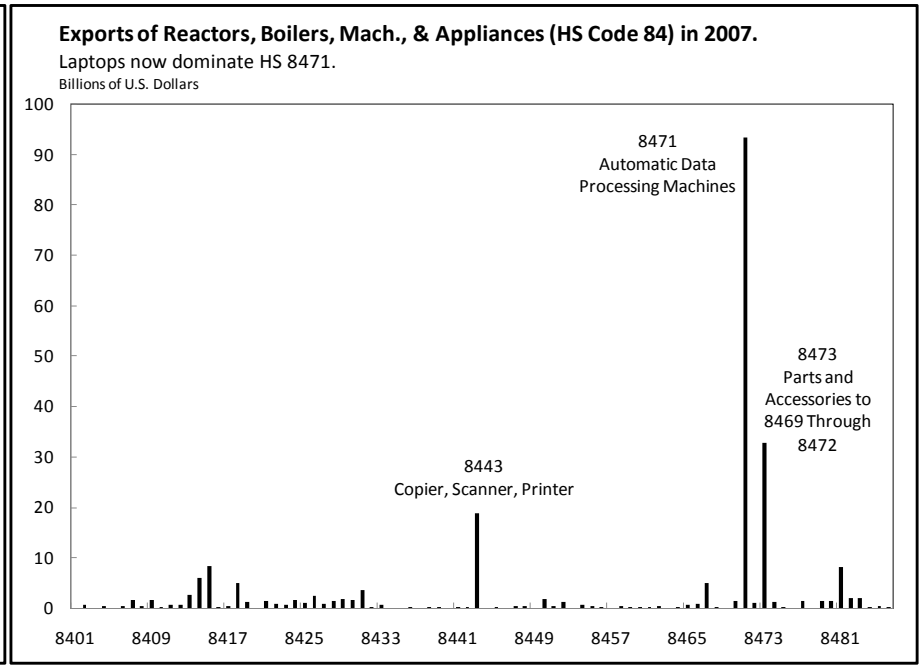
# How did China come to dominate these products?

- All of the factors discussed earlier contributed
  - Inexpensive labor contributed to the processing and assembly trade
  - Explosion in global demand for these products which came to dominate their broader categories (phones, computers, TVs)
    - China's own domestic market led global demand surge
  - "New" products: new technologies and production methods. Many require large capital investments
    - Eg. Semiconductor fabrication plants cost billions
    - These investments were subsidized with inexpensive capital and encouraged by the construction of science parks
  - US investment hampered, particularly in high-tech, following dot-com bust

# Nuclear Reactors; Boilers; …
# HS Code 84

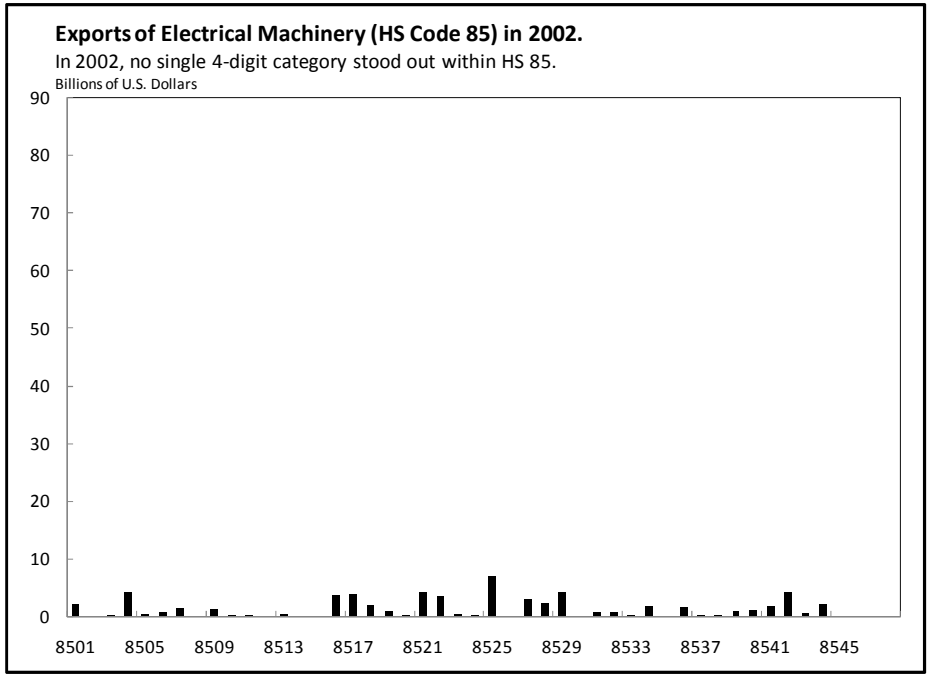
- HS 84 is dominated by exports of computers and their parts
- The growth of “other” categories may reflect exchange rate

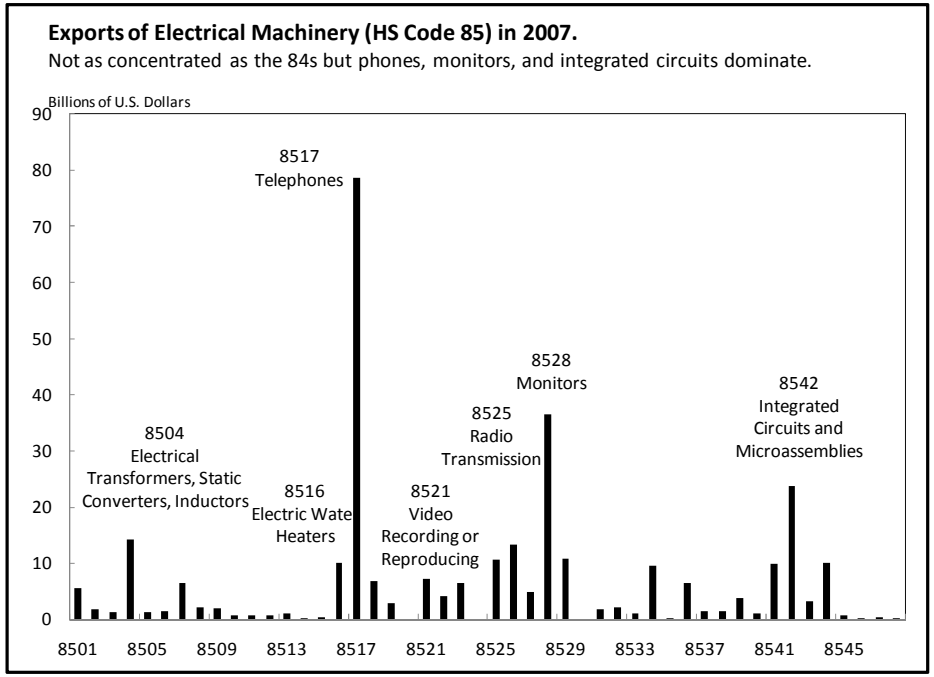


# Electrical Machinery
# HS 85

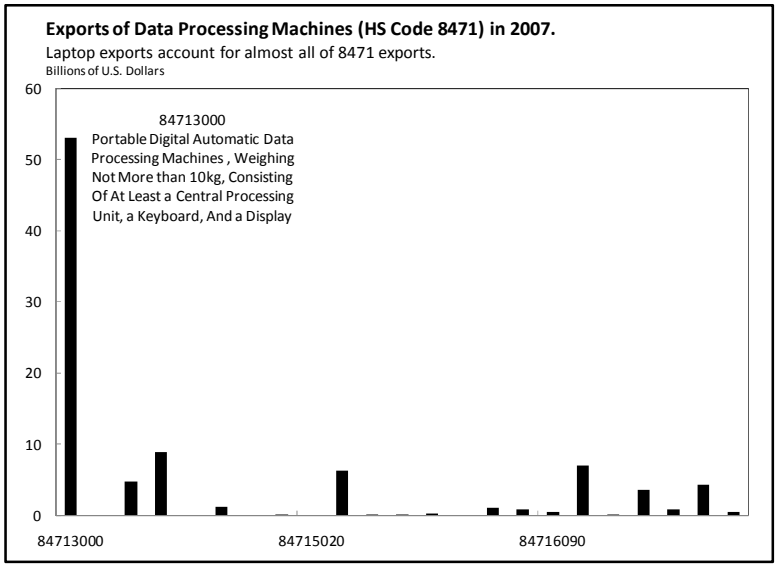
- HS 85 exports are more diverse than 84
- Still, about ½ of growth is in phones, monitors, and integrated circuits

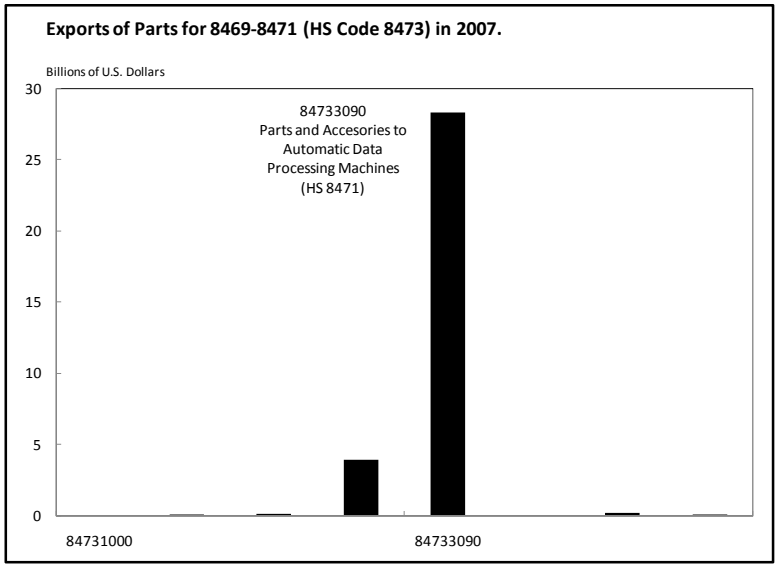


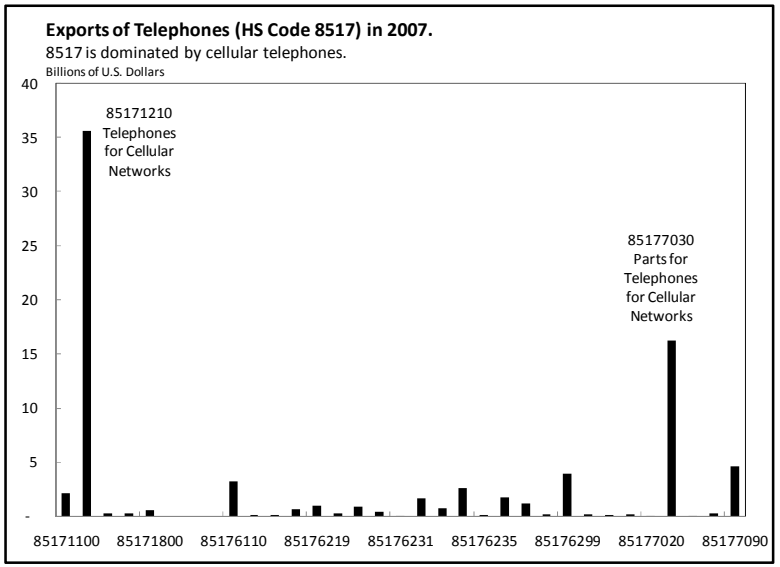



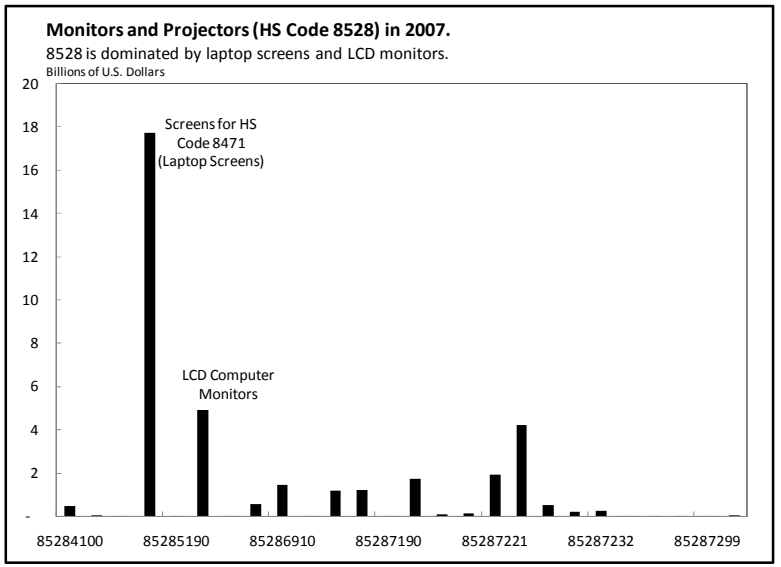
# 8-digit Categories

- 8-digit categories make clear that:
  computers = laptops, phones = cell phones, monitors = LCDs



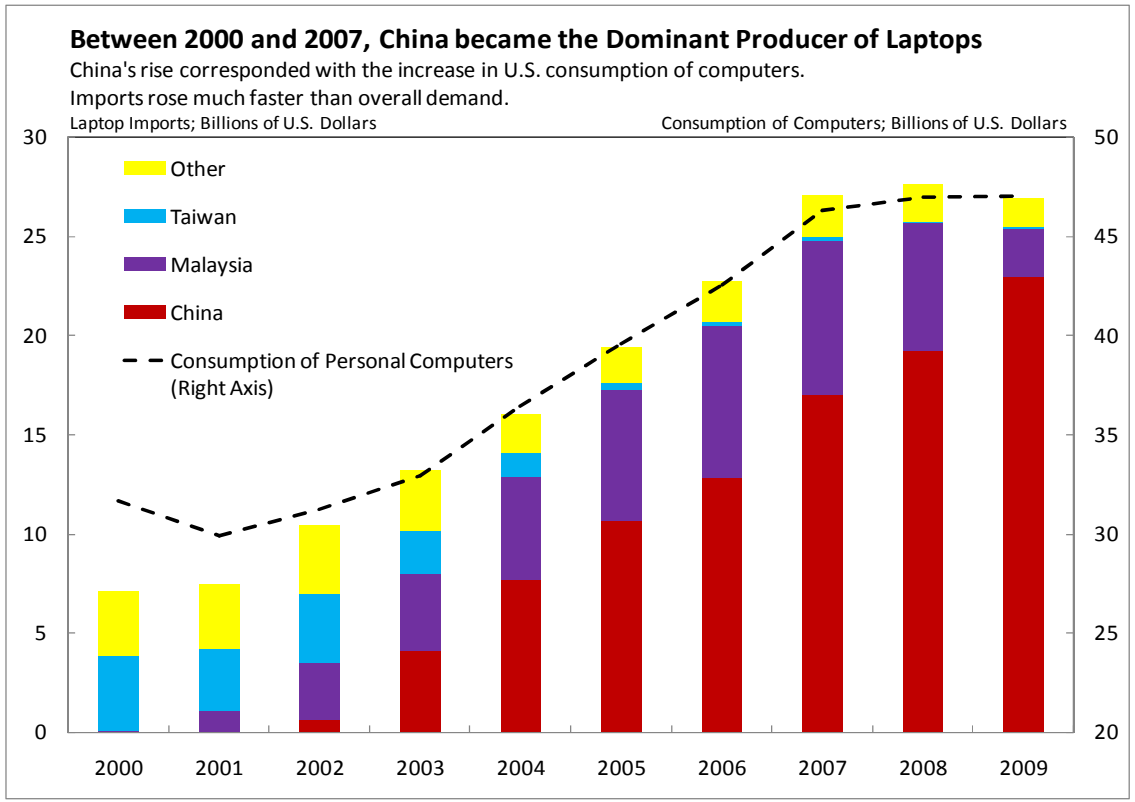



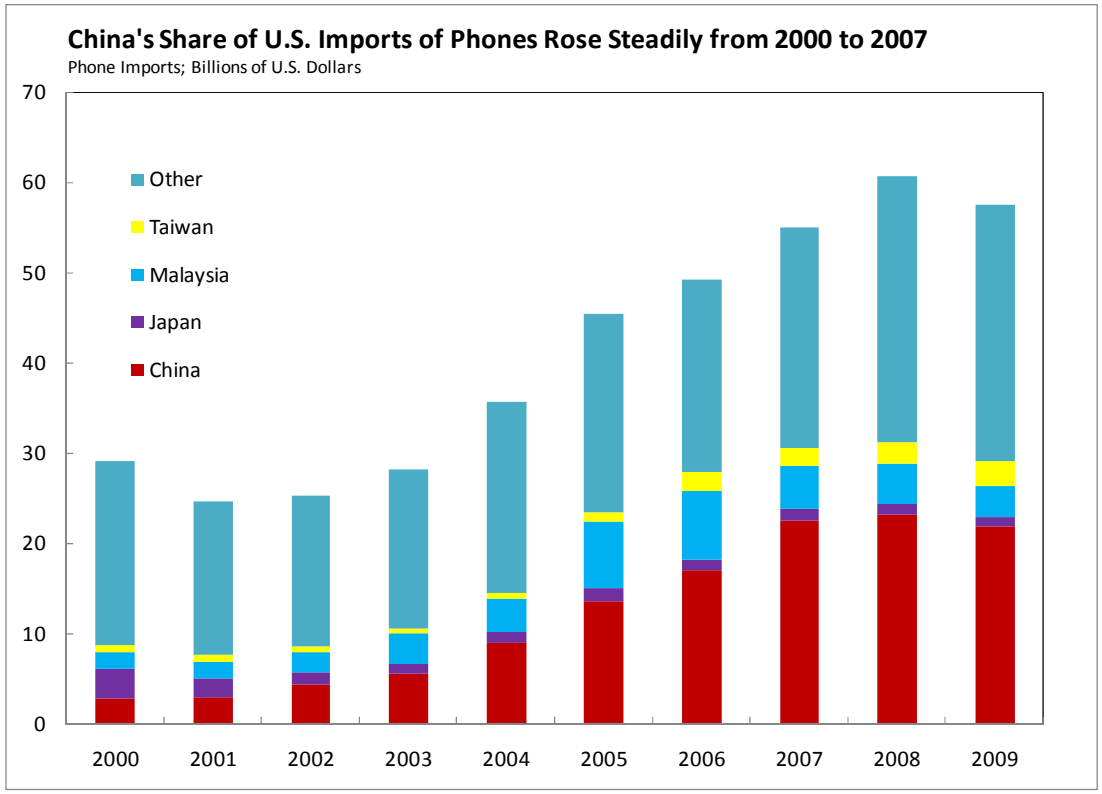
# Laptops

- China went from 0 to $23 Billion in exports to U.S. in 7 years.
- Dominates the market – owes in part to LCD technology.
- Captured more than all of the increase in **total personal computer** consumption in the United States.



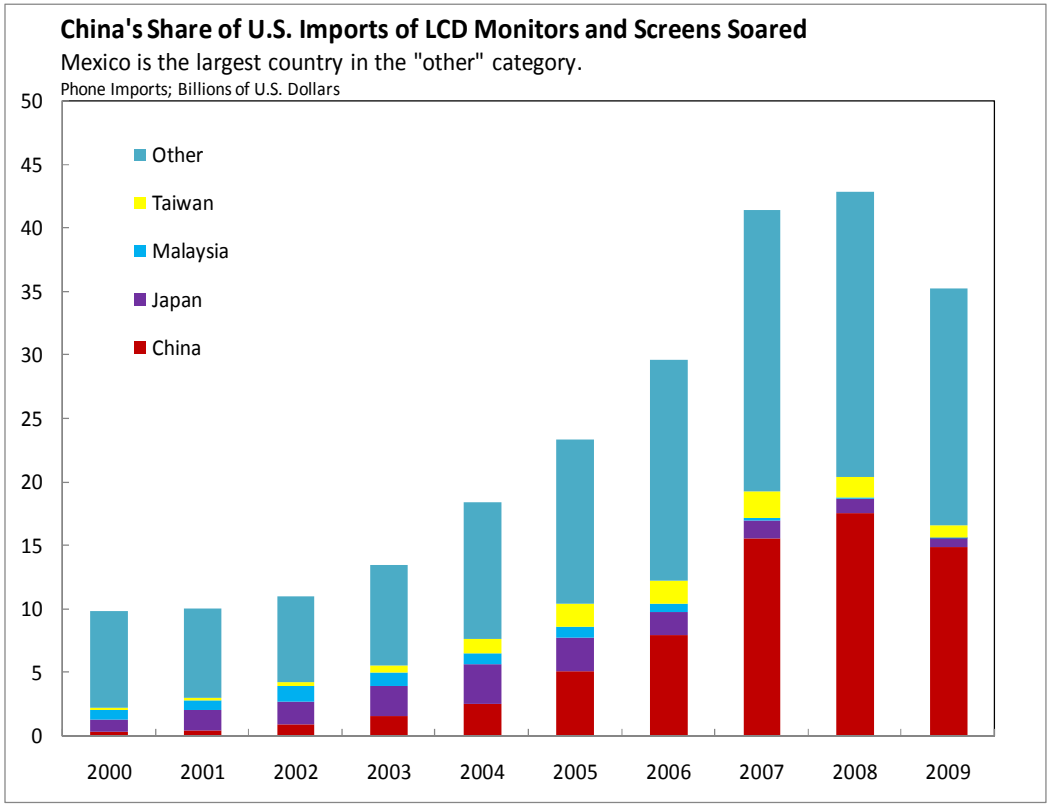
# Cell Phones

- Cell phone production also rose sharply but China has a mere third of the market for U.S. imports.



# LCD Monitors

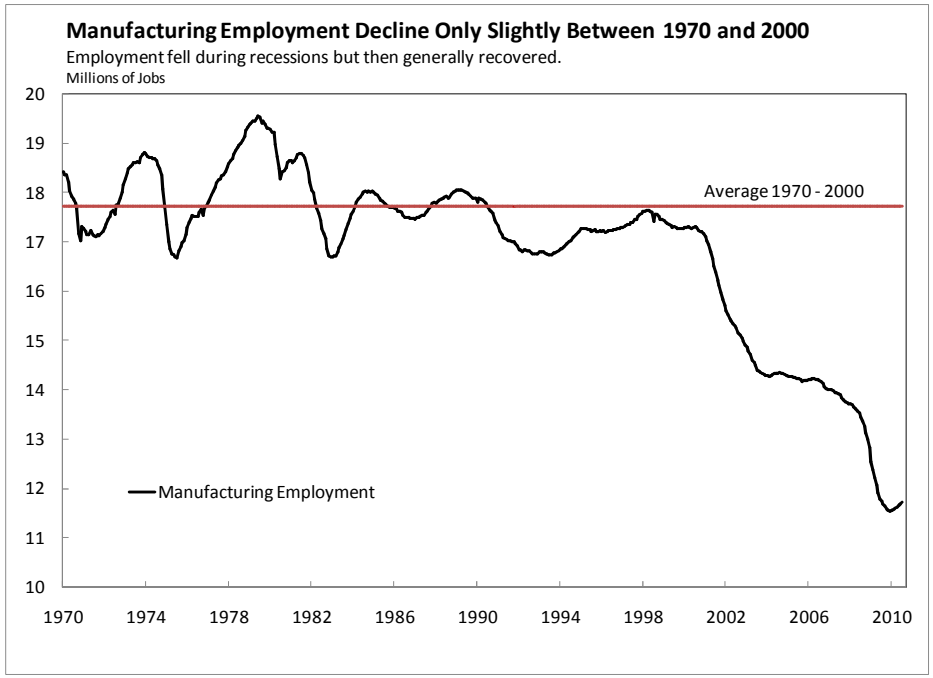
- China’s share of LCD screens is similar to the share of phone imports.

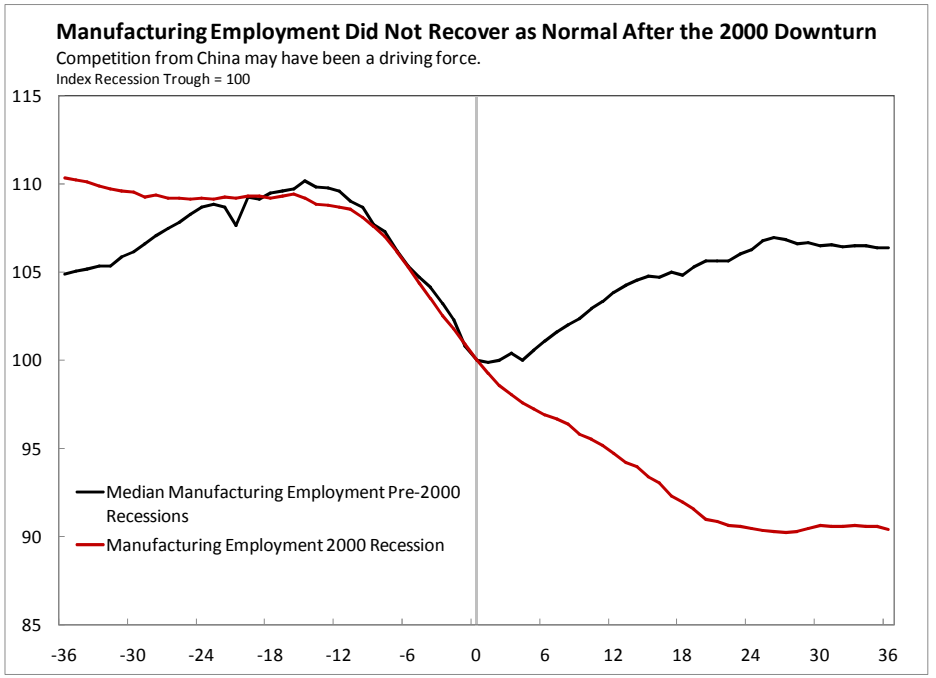


- Is there a relationship between China's export boom and the sharp fall in U.S. manufacturing employment?
  1. Was the fall in manufacturing normal?
  2. Were Chinese exports in areas where the U.S. lost jobs?

# U.S. Manufacturing

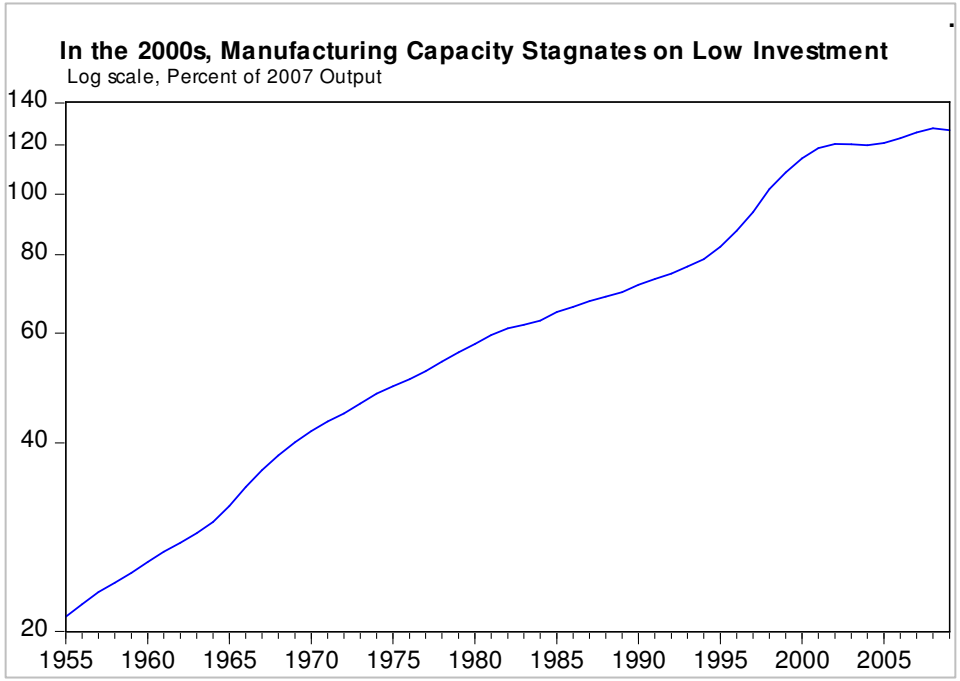
- The 2001 recession marked the beginning of the downturn in U.S. manufacturing employment.
  - Has been falling as a share of total employment for a long time, but the level had held fairly steady since the 1970s.
  - Continued decline and lack of recovery makes 2001 recession unusual.

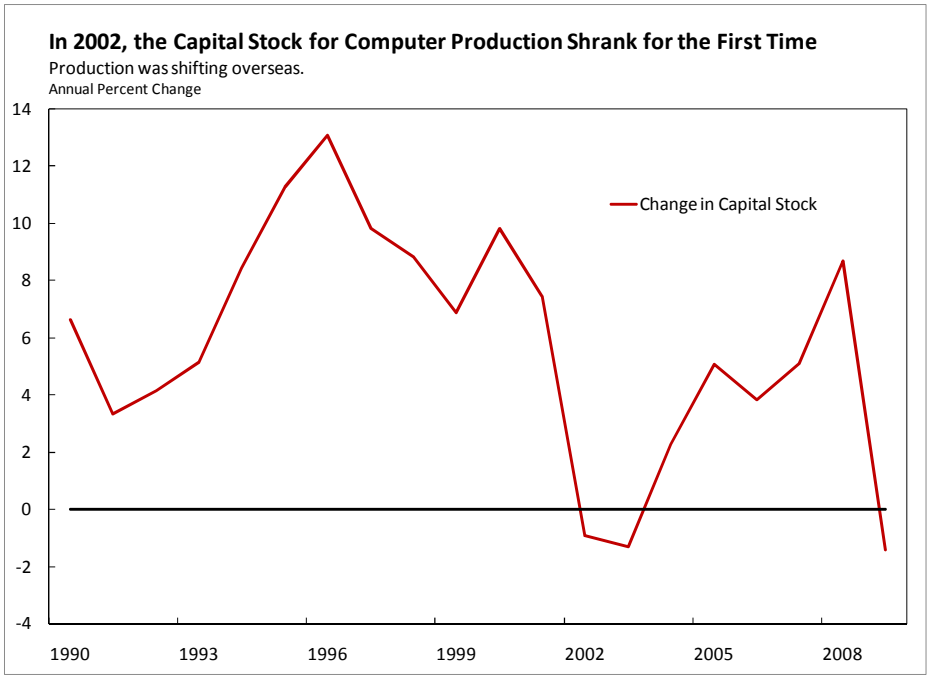


# U.S. Investment Never Recovered

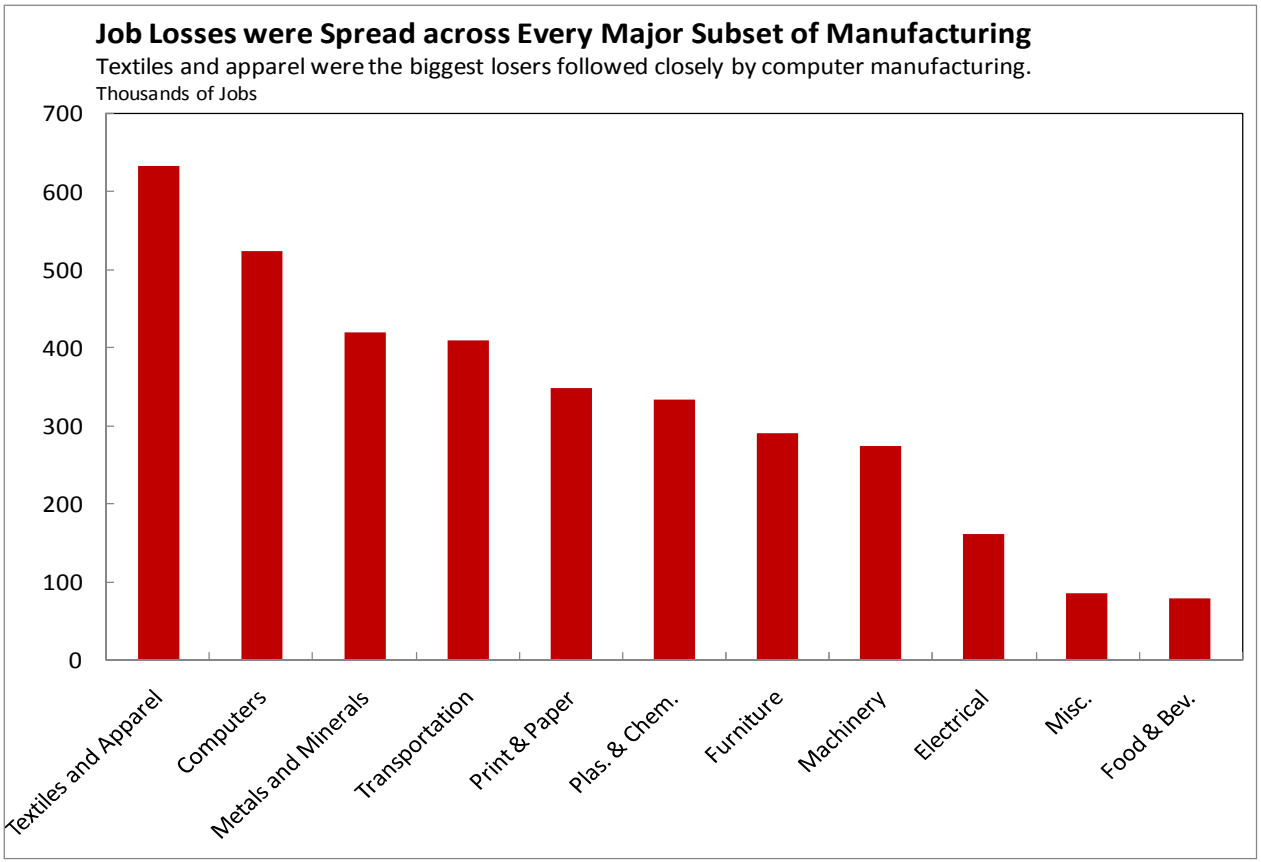
- The 2000s saw the slowest ten-year expansion of manufacturing capacity since 1955.
- It also saw the first decline in the capital stock for computer production since 1945.



# Job Losses by Industry

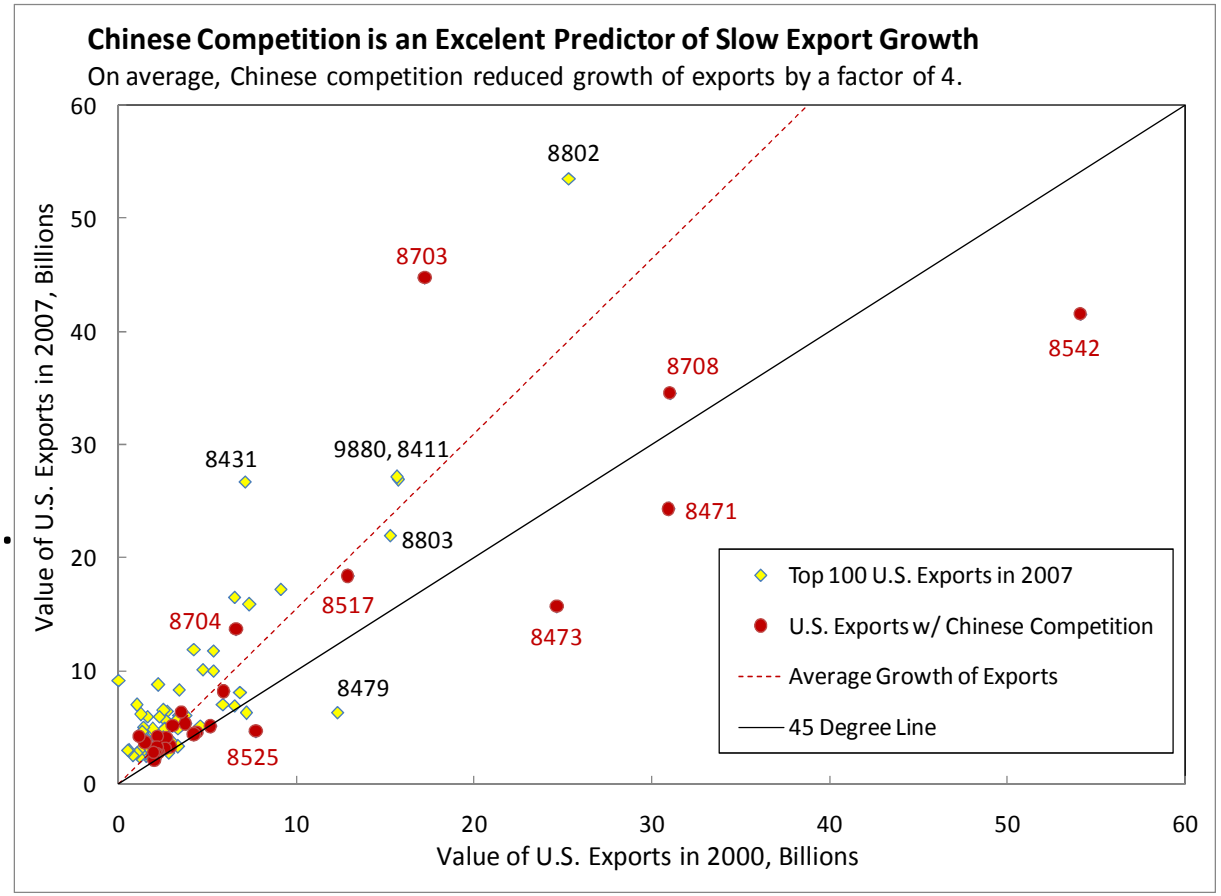
- Job losses in the United States matched up closely with industries where China's export growth was high.
  - ½ of losses were in industries with most Chinese export growth.



# Chinese Exports Do Compete with U.S. Exports

- Industries where China's exports grew rapidly are exactly those industries where U.S. export growth was stagnant or declining.

- Industries which were hurt most also had the lowest investment in the United States.



# Back of the Envelope

- We build a simple, regression-based, fundamentals model of U.S. manufacturing employment.
  - We estimate the regression from 1970 through 1999, quarterly.

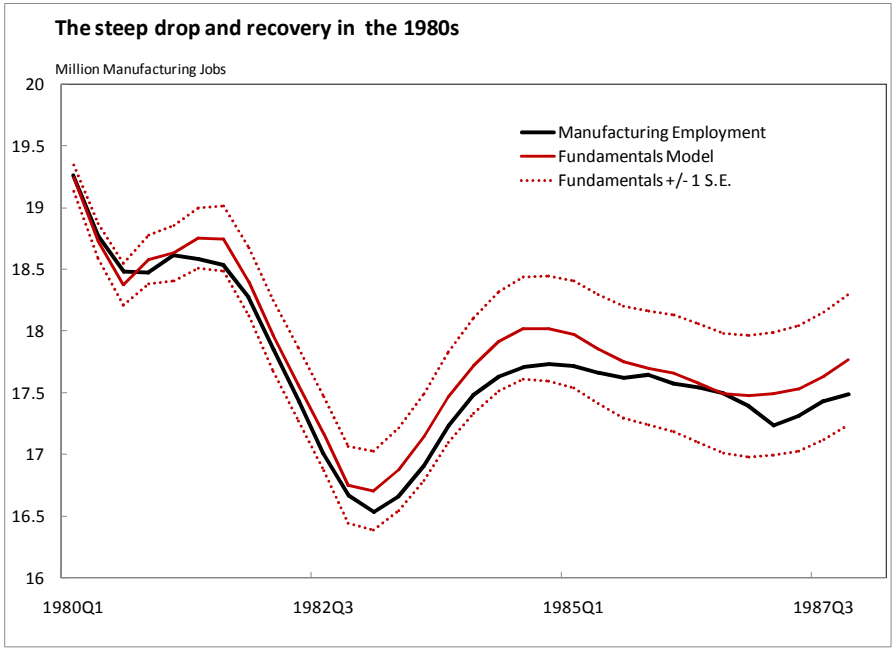
Dependent Variable: Log-difference Manufacturing Employment

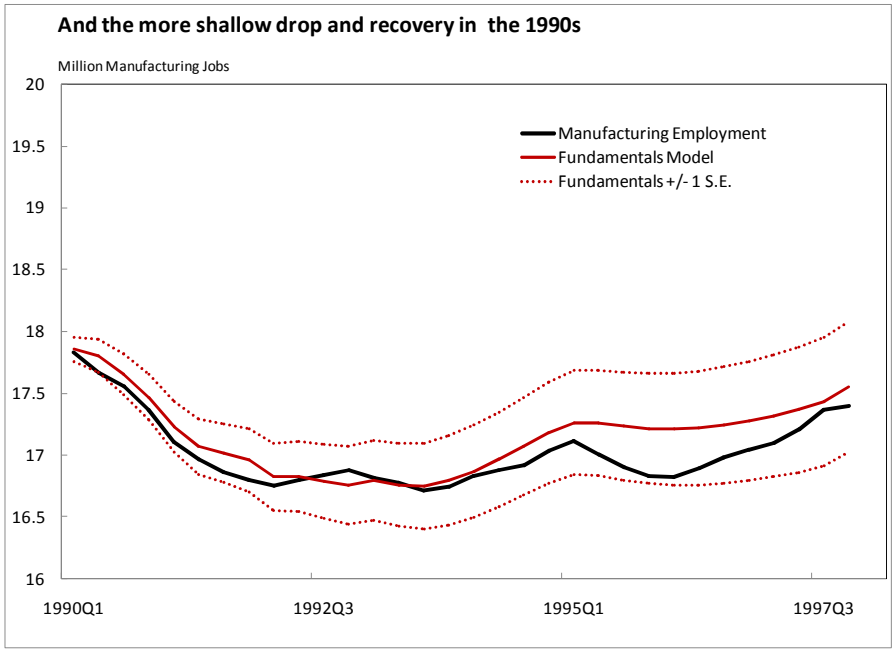
| Variable | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|
| C | -0.015 | 0.002 | -7.747 |
| US GDP | 0.604 | 0.277 | 2.182 |
| For GDP | 0.948 | 0.256 | 3.712 |
| E&S Inv. | 0.112 | 0.074 | 1.517 |
| AR(1) | 0.319 | 0.096 | 3.319 |
| | | | |
| $R^2$ | 0.816 | | |
| Adj. $R^2$ | 0.791 | | |

*Independent variables are log differences.

# Back of the Envelope

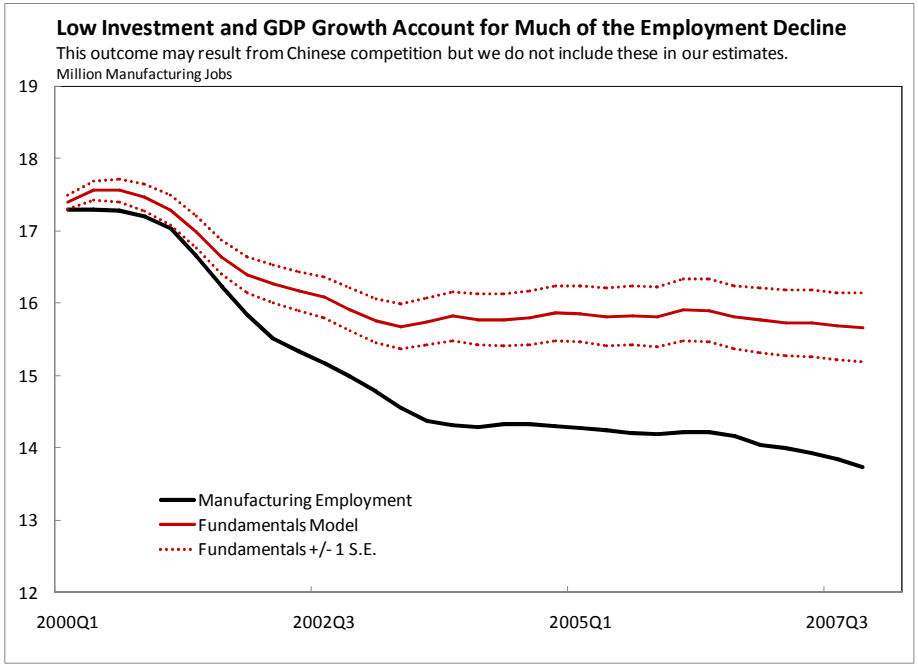
- In sample the model fits well through 1980s and 1990s, even though the recessions and recovery dynamics were quite different.



# 2001 Recession

- Out of sample, the fundamentals model attributes the lack of recovery in manufacturing employment to low U.S. GDP growth and E&S investment following the recession.




- But greatly underestimates the extent of the job lossses.

# Chinese Imports Improve the Fit

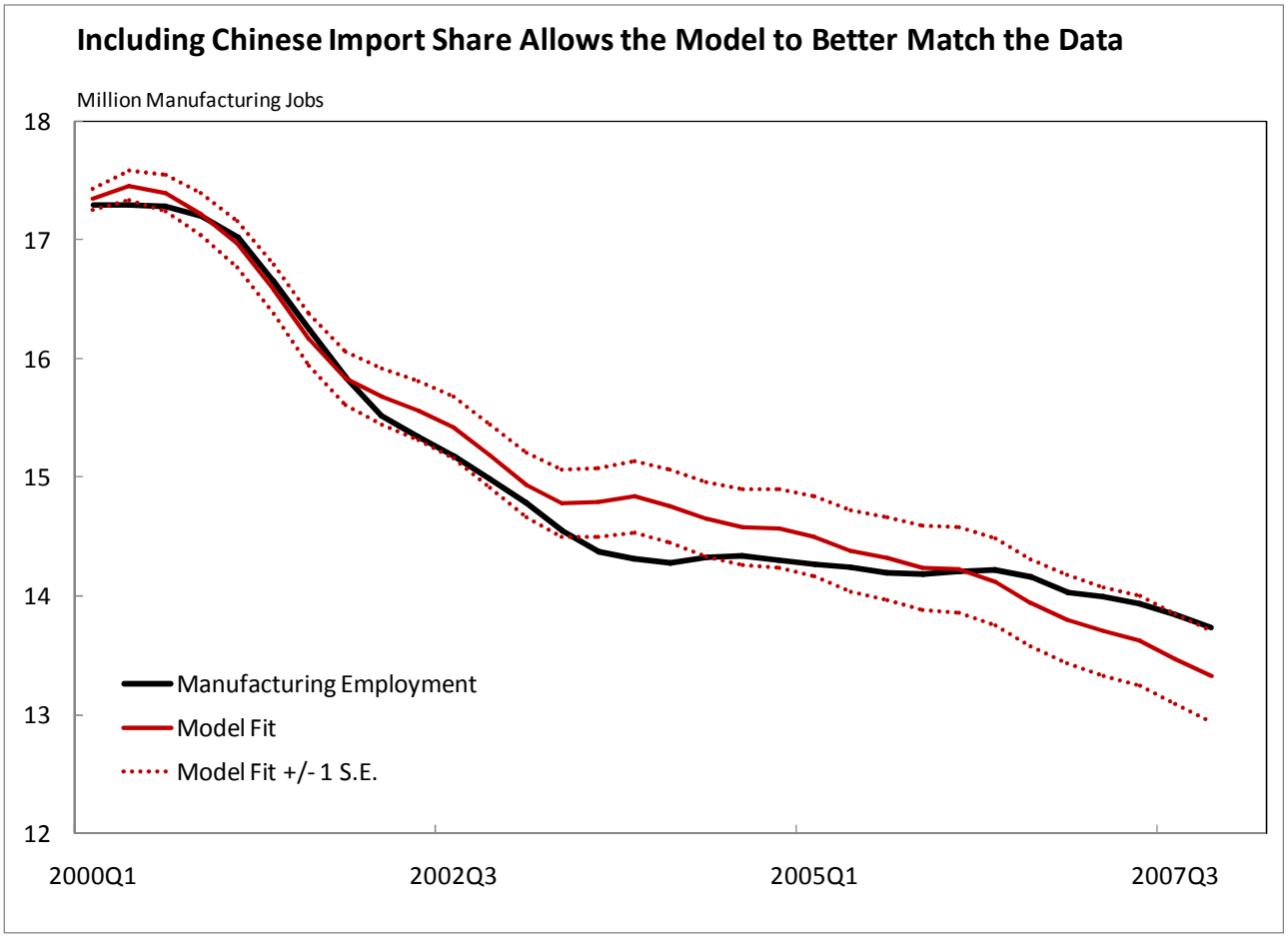
- We add China's import share as an additional explanatory variable
  - Still use 1970 to 1999 as our estimation sample
  - Notice, the negative sign and the modest improvement in $R^2$
  - The AR term is small but is included to improve time-series properties

Dependent Variable: Log-difference Manufacturing Employment

| Variable | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|
| C | -0.011 | 0.002 | -5.373 |
| US GDP | 0.341 | 0.254 | 1.341 |
| For GDP | 0.802 | 0.240 | 3.344 |
| E&S Inv. | 0.183 | 0.071 | 2.576 |
| Chin. Imp. Shr. | -0.062 | 0.030 | -2.088 |
| AR(1) | 0.209 | 0.093 | 2.254 |
| | | | |
| $R^2$ | 0.830 | | |
| Adj. $R^2$ | 0.795 | | |

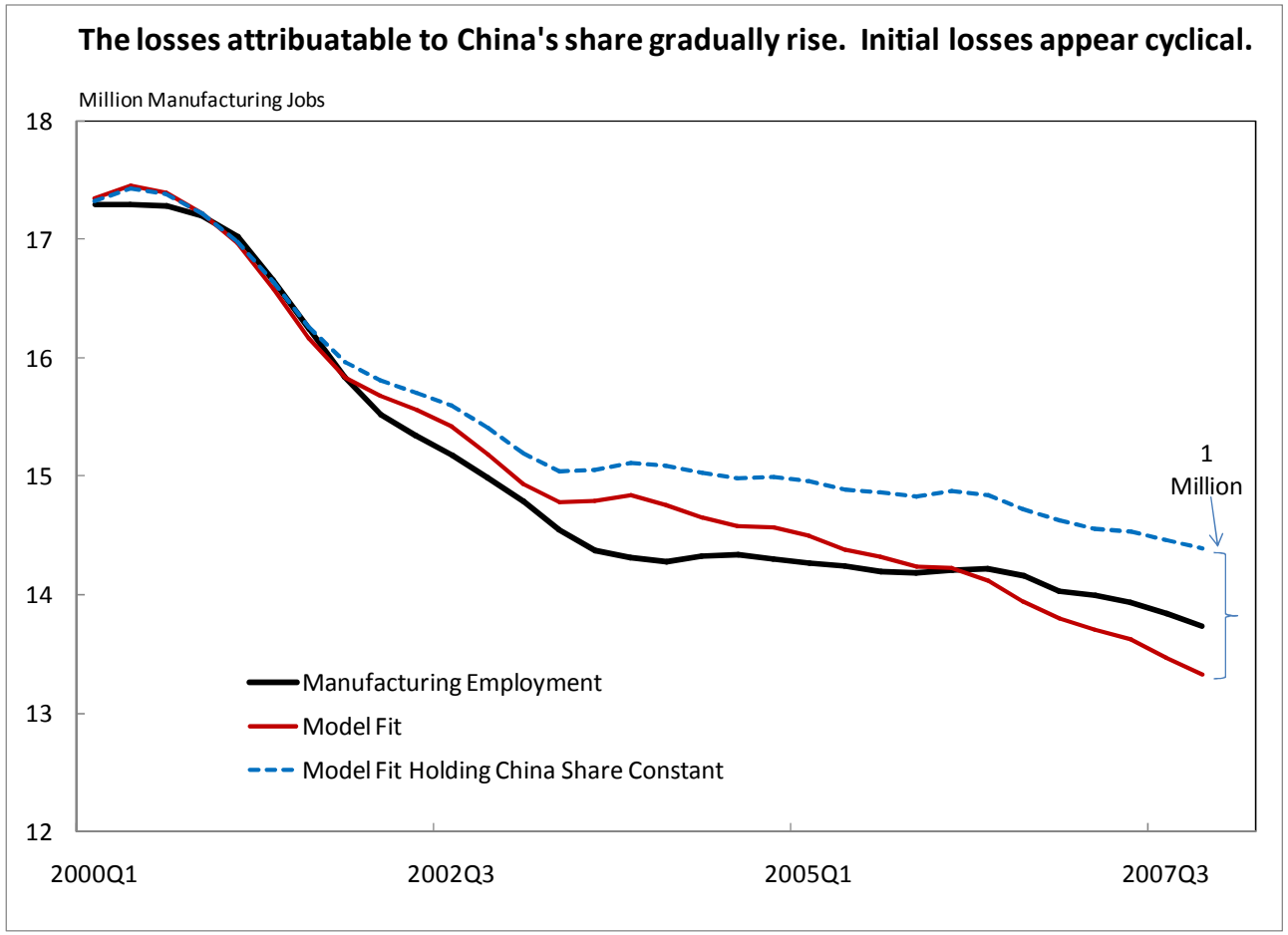
# Chinese Imports Matter, A Lot

- Out of sample, the addition of Chinese imports substantially improves the model's ability to match employment data



# Counterfactual

- We hold the import share constant at its 1999 level
- We find this would boost employment by 1 million



# Industry by Industry (2001-2007)

- We find similar results.

| | | Cummulative Impact of Import Penetration on Jobs* | | | | | |
|---|---|---|---|---|---|---|---|
| | | Chinese Jobs Impact | World Jobs Impact | Chinese Imports | T-Stat | World Imports ex China | T-Stat |
| **Panel Estimate** | | **-788** | **464** | **-2.89** | -2.6 | **8.39** | 4.3 |
| **Industry Estimates** | | | | | | | |
| 311 | Food | 12 | -26 | 1.14 | 0.2 | -7.03 | -0.9 |
| 312 | Bev. and Tobacco | 0 | -6 | **4.15** | 1.7 | -8.99 | -0.6 |
| 313 | Textiles | 8 | 4 | 3.45 | 0.7 | 7.82 | 0.5 |
| 314 | Txtl. Mill Products | -46 | 9 | **-34.85** | -2.6 | 15.37 | 1.0 |
| 315 | Apparel | -25 | 1 | **-8.30** | -1.3 | 0.70 | 0.1 |
| 316 | Leather | -13 | 4 | **-50.31** | -1.7 | 19.90 | 0.7 |
| 321 | Wood | 32 | 6 | **10.85** | 1.4 | **19.54** | 7.6 |
| 322 | Paper | -29 | 3 | **-8.07** | -1.4 | 5.34 | 0.7 |
| 323 | Printed Matter | -8 | 0 | -2.14 | -0.3 | 0.02 | 0.0 |
| 324 | Petroleum | 0 | 0 | 0.22 | 0.2 | -2.08 | -0.4 |
| 325 | Chemicals | -8 | 8 | -1.66 | -0.9 | 4.62 | 0.9 |
| 326 | Plastics | 38 | -13 | 8.84 | 0.6 | -7.03 | -0.3 |
| 327 | NonMetal Mineral | -16 | 19 | **-13.60** | -1.8 | **42.87** | 6.7 |
| 331 | Primary Metal | -1 | 18 | -0.28 | -0.1 | 8.28 | 1.3 |
| 332 | Fabricated Metal | -242 | 155 | **-29.04** | -3.5 | **41.98** | 3.9 |
| 333 | Machinery | -123 | 71 | **-16.16** | -2.5 | **30.02** | 3.6 |
| 334 | Computers | -149 | 39 | -13.41 | -0.5 | 16.83 | 0.8 |
| 335 | Electrical Equip. | -26 | 47 | -11.25 | -0.6 | **30.06** | 1.5 |
| 336 | Transportation | 24 | 16 | 2.28 | 1.0 | **17.17** | 1.5 |
| 337 | Furniture | -6 | 13 | -2.24 | -0.2 | 17.73 | 1.0 |
| 339 | Misc. | -18 | 19 | **-9.23** | -2.9 | **9.83** | 2.0 |

* Percent change in employment to a percent change in import penetration

# Welfare

- Did China's emergence hurt the U.S. on net?
  - Much more difficult question – We don't know.
  - Job losses likely needed to benefit from trade gains
- Little question that Chinese competition led to large employment losses in the manufacturing sector.
  - Offset to some extent by increased productivity in U.S. manufacturing firms
  - More important offset through non-manufacturing sector.
- Some job losses were in industries that had been previously protected by trade barriers – textiles, apparel, and furniture.
- China's emergence lowered prices on a broad range of goods
  - Do you own a flat screen television? Did you in 2000?

# Can China Repeat?

- Once again Western investment is in a slump; Chinese investment is soaring
- The IMF projects China's trade surplus to more than double over the next 5 years
- The source of export growth is not clear
  - China already has a large market share in the markets where they experienced their previous rapid growth
    - Steel, textiles, laptops, and LCDs
  - China needs a "new" industry
    - Solar panels, high-speed trains, …
    - Hard to see the breakthrough global product on horizon
    - It's spending $ billions so the odds are not negligible– but it's no slam dunk either

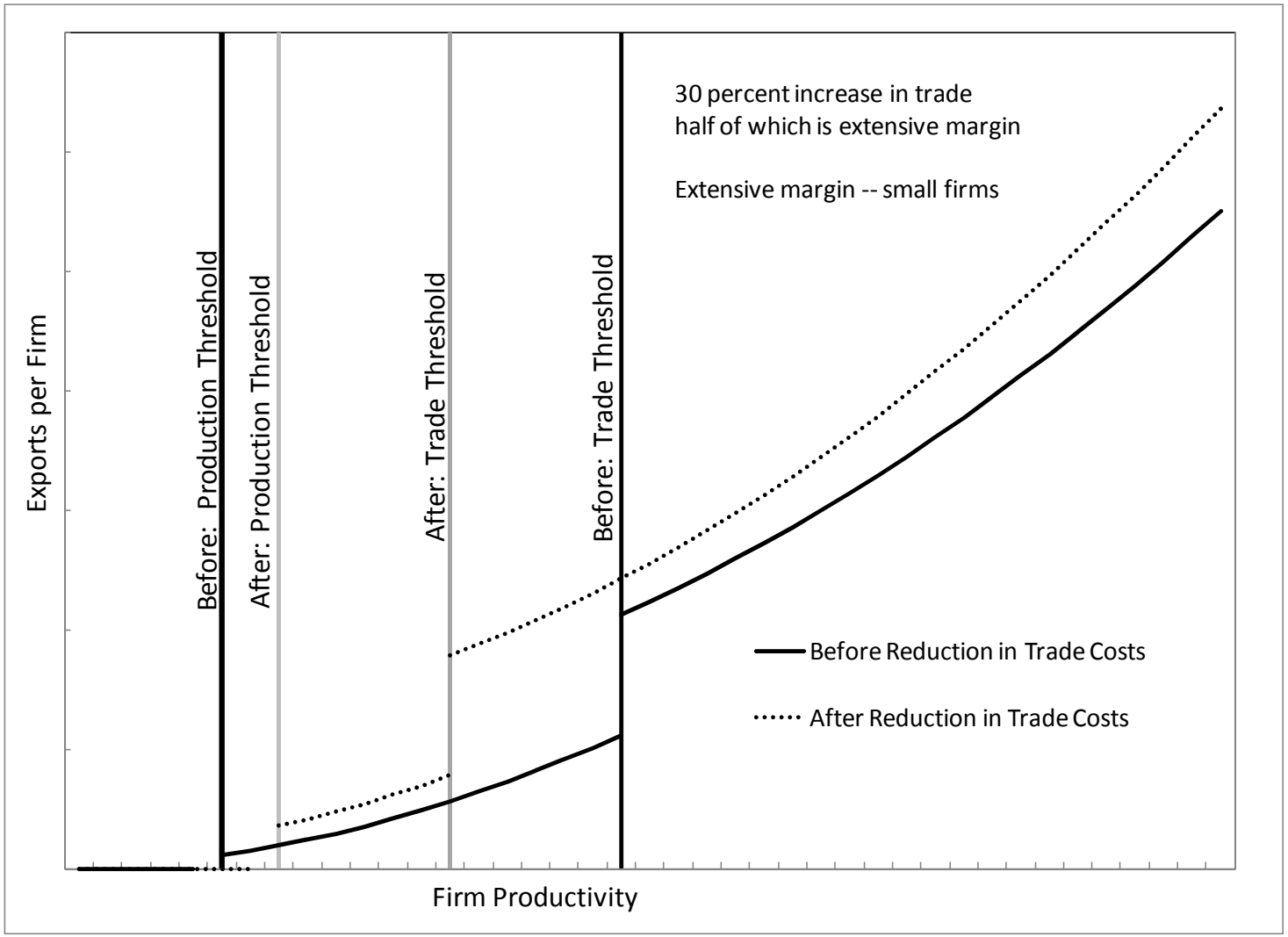
# Conclusion

- Chinese export growth was concentrated in a few sectors, driven primarily by sector-specific stories
- Machinery export growth, which dominates total growth, was concentrated in just a few specific products
- All of the factors driving China's export growth contributed to China dominating these products
  - labor comparative advantage
  - subsidies
  - huge domestic market
  - exchange rate
  - strong Chinese investment at a time of diminished U.S. investment

# Conclusion

- U.S. manufacturing declined most (output and employment) in areas where Chinese exports grew fastest
- We estimate that, but for China's emergence and holding other factors constant, U.S. manufacturing employment would have been about 1 million higher
- Soft investment and low U.S. GDP growth likely account for the remainder of lost jobs

# Appendix-Melitz Model



# Appendix-different specifications

•equation chin1999.ls dlog(manemp) c pdl(dlog(usgdp),4,3) pdl(dlog(forgdpwx),4,3) pdl(dlog(esinv),4,3) pdl(chimpshr,4,3) ar(1)

Dependent Variable: DLOG(MANEMP)
Method: Least Squares
Date: 12/21/10 Time: 09:18
Sample (adjusted): 1975Q2 1999Q4
Included observations: 99 after adjustments
Convergence achieved after 10 iterations

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.011108 | 0.002067 | -5.372723 | 0.0000 |

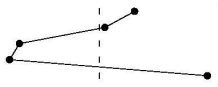
| | | | |
|---|---|---|---|
| R-squared | 0.830249 | Mean dependent var | 0.000124 |
| Adjusted R-squared | 0.794622 | S.D. dependent var | 0.009228 |
| S.E. of regression | 0.004182 | Akaike info criterion | -7.953095 |
| Sum squared resid | 0.001417 | Schwarz criterion | -7.481255 |
| Log likelihood | 411.6782 | Hannan-Quinn criter. | -7.762188 |
| F-statistic | 23.30404 | Durbin-Watson stat | 1.879578 |
| Prob(F-statistic) | 0.000000 | | |

Inverted AR Roots .21

| Lag Distribution of DLOG(USG | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
|  | 0 | 0.28061 | 0.07060 | 3.97458 |
| | 1 | 0.09081 | 0.07561 | 1.20103 |
| | 2 | 0.03570 | 0.06908 | 0.51683 |
| | 3 | 0.01307 | 0.07369 | 0.17736 |
| | 4 | -0.07929 | 0.07403 | -1.07112 |
| Sum of Lags | | 0.34089 | 0.25420 | 1.34103 |

| Lag Distribution of DLOG(FOR | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
|  | 0 | 0.52599 | 0.12943 | 4.06400 |
| | 1 | 0.23650 | 0.11661 | 2.02807 |
| | 2 | 0.02215 | 0.08941 | 0.24769 |
| | 3 | -0.05386 | 0.11593 | -0.46460 |
| | 4 | 0.07168 | 0.13019 | 0.55059 |
| Sum of Lags | | 0.80246 | 0.23996 | 3.34418 |

| Lag Distribution of DLOG(ESIN | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
|  | 0 | 0.10679 | 0.02502 | 4.26809 |
| | 1 | 0.08510 | 0.02649 | 3.21311 |
| | 2 | 0.03519 | 0.02196 | 1.60248 |
| | 3 | -0.01322 | 0.02389 | -0.55346 |
| | 4 | -0.03037 | 0.02197 | -1.38227 |
| Sum of Lags | | 0.18349 | 0.07123 | 2.57601 |

| Lag Distribution of CHIMPSHR | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
|  | 0 | 0.09205 | 0.32525 | 0.28300 |
| | 1 | 0.01387 | 0.33155 | 0.04183 |
| | 2 | -0.21138 | 0.22095 | -0.95668 |
| | 3 | -0.23763 | 0.33078 | -0.71839 |
| | 4 | 0.28119 | 0.33296 | 0.84451 |
| Sum of Lags | | -0.06191 | 0.02965 | -2.08833 |

# Appendix-different specifications

- equation chin1999dlog.ls dlog(manemp) c pdl(dlog(usgdp),4,3) pdl(dlog(forgdpwx),4,3) pdl(dlog(esinv),4,3) pdl(dlog(usimpchnsa_sa/usgdp),4,3) ar(1)

Dependent Variable: DLOG(MANEMP)
Method: Least Squares
Date: 12/21/10 Time: 09:18
Sample (adjusted): 1975Q3 1999Q4
Included observations: 98 after adjustments
Convergence achieved after 11 iterations

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.013161 | 0.002165 | -6.080307 | 0.0000 |
| AR(1) | 0.351528 | 0.110580 | 3.178960 | 0.0021 |

| | | | |
|---|---|---|---|
| R-squared | 0.818445 | Mean dependent var | 0.000327 |
| Adjusted R-squared | 0.779865 | S.D. dependent var | 0.009049 |
| S.E. of regression | 0.004246 | Akaike info criterion | -7.921373 |
| Sum squared resid | 0.001442 | Schwarz criterion | -7.446583 |
| Log likelihood | 406.1473 | Hannan-Quinn criter. | -7.729331 |
| F-statistic | 21.21402 | Durbin-Watson stat | 1.986693 |
| Prob(F-statistic) | 0.000000 | | |

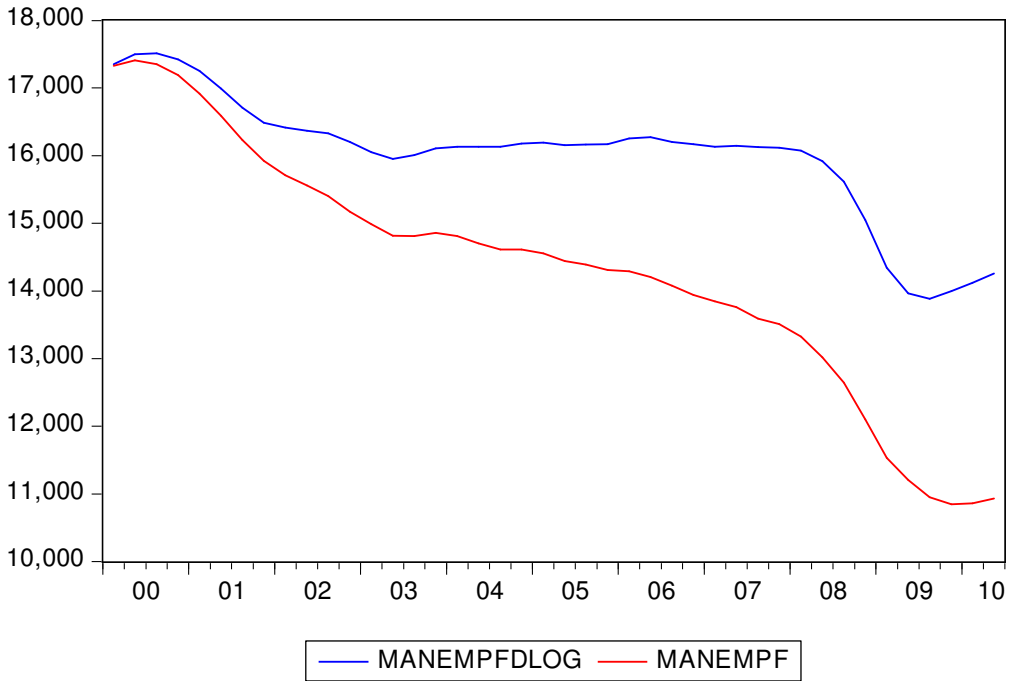
Inverted AR Roots .35

| Lag Distribution of DLOG(USG | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
| | 0 | 0.31836 | 0.07287 | 4.36867 |
| | 1 | 0.14755 | 0.08001 | 1.84421 |
| | 2 | 0.09788 | 0.07479 | 1.30875 |
| | 3 | 0.05701 | 0.07774 | 0.73336 |
| | 4 | -0.08739 | 0.07693 | -1.13599 |
| Sum of Lags | | 0.53341 | 0.27288 | 1.95478 |

| Lag Distribution of DLOG(FOR | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
| | 0 | 0.47216 | 0.13420 | 3.51841 |
| | 1 | 0.21430 | 0.12526 | 1.71090 |
| | 2 | 0.06001 | 0.10288 | 0.58333 |
| | 3 | 0.02577 | 0.12335 | 0.20891 |
| | 4 | 0.12804 | 0.13378 | 0.95706 |
| Sum of Lags | | 0.90028 | 0.29264 | 3.07643 |

| Lag Distribution of DLOG(ESIN | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
| | 0 | 0.08114 | 0.02490 | 3.25917 |
| | 1 | 0.05654 | 0.02694 | 2.09872 |
| | 2 | 0.01256 | 0.02163 | 0.58044 |
| | 3 | -0.02640 | 0.02376 | -1.11104 |
| | 4 | -0.03593 | 0.02196 | -1.63615 |
| Sum of Lags | | 0.08791 | 0.06960 | 1.26299 |

| Lag Distribution of DLOG(USIM | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
| | 0 | 0.00511 | 0.00402 | 1.27301 |
| | 1 | -0.00165 | 0.00469 | -0.35068 |
| | 2 | -0.00434 | 0.00457 | -0.94843 |
| | 3 | -0.00455 | 0.00464 | -0.97976 |
| | 4 | -0.00386 | 0.00378 | -1.02058 |
| Sum of Lags | | -0.00928 | 0.01574 | -0.58969 |



# Appendix-different specifications

- dlog(manemp) c pdl(dlog(usgdp),4,3) pdl(dlog(forgdpwx),4,3) pdl(dlog(esinv),4,3) pdl(usimpchnsa_sa/usgdp,4,3) ar(1)

Dependent Variable: DLOG(MANEMP)
Method: Least Squares
Date: 12/21/10 Time: 10:19
Sample (adjusted): 1975Q2 1999Q4
Included observations: 99 after adjustments
Convergence achieved after 10 iterations

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.011509 | 0.001967 | -5.850286 | 0.0000 |
| AR(1) | 0.198604 | 0.093544 | 2.123114 | 0.0368 |

| | | | |
|---|---|---|---|
| R-squared | 0.829352 | Mean dependent var | 0.000124 |
| Adjusted R-squared | 0.793537 | S.D. dependent var | 0.009228 |
| S.E. of regression | 0.004193 | Akaike info criterion | -7.947826 |
| Sum squared resid | 0.001424 | Schwarz criterion | -7.475986 |
| Log likelihood | 411.4174 | Hannan-Quinn criter. | -7.756919 |
| F-statistic | 23.15653 | Durbin-Watson stat | 1.862288 |
| Prob(F-statistic) | 0.000000 | | |

Inverted AR Roots .20

| Lag Distribution of DLOG(USG | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
| | 0 | 0.28520 | 0.07134 | 3.99758 |
| | 1 | 0.10015 | 0.07519 | 1.33191 |
| | 2 | 0.04118 | 0.06883 | 0.59837 |
| | 3 | 0.01200 | 0.07381 | 0.16264 |
| | 4 | -0.08369 | 0.07424 | -1.12729 |
| Sum of Lags | | 0.35485 | 0.25385 | 1.39791 |

| Lag Distribution of DLOG(FOR | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
| | 0 | 0.52114 | 0.12890 | 4.04305 |
| | 1 | 0.22587 | 0.11601 | 1.94701 |
| | 2 | 0.01951 | 0.09060 | 0.21535 |
| | 3 | -0.05018 | 0.11607 | -0.43235 |
| | 4 | 0.06455 | 0.12921 | 0.49962 |
| Sum of Lags | | 0.78089 | 0.24730 | 3.15770 |

| Lag Distribution of DLOG(ESIN | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
| | 0 | 0.10500 | 0.02521 | 4.16556 |
| | 1 | 0.08648 | 0.02626 | 3.29296 |
| | 2 | 0.03743 | 0.02162 | 1.73086 |
| | 3 | -0.01154 | 0.02379 | -0.48520 |
| | 4 | -0.02982 | 0.02207 | -1.35089 |
| Sum of Lags | | 0.18754 | 0.06989 | 2.68334 |

| Lag Distribution of USIMPCHNSi | i | Coefficient | Std. Error | t-Statistic |
|---|---|---|---|---|
| | 0 | -0.00176 | 0.01894 | -0.09306 |
| | 1 | 0.00874 | 0.01951 | 0.44796 |
| | 2 | 0.00244 | 0.01195 | 0.20379 |
| | 3 | -0.00705 | 0.01962 | -0.35932 |
| | 4 | -0.00608 | 0.01904 | -0.31945 |
| Sum of Lags | | -0.00372 | 0.00174 | -2.13374 |