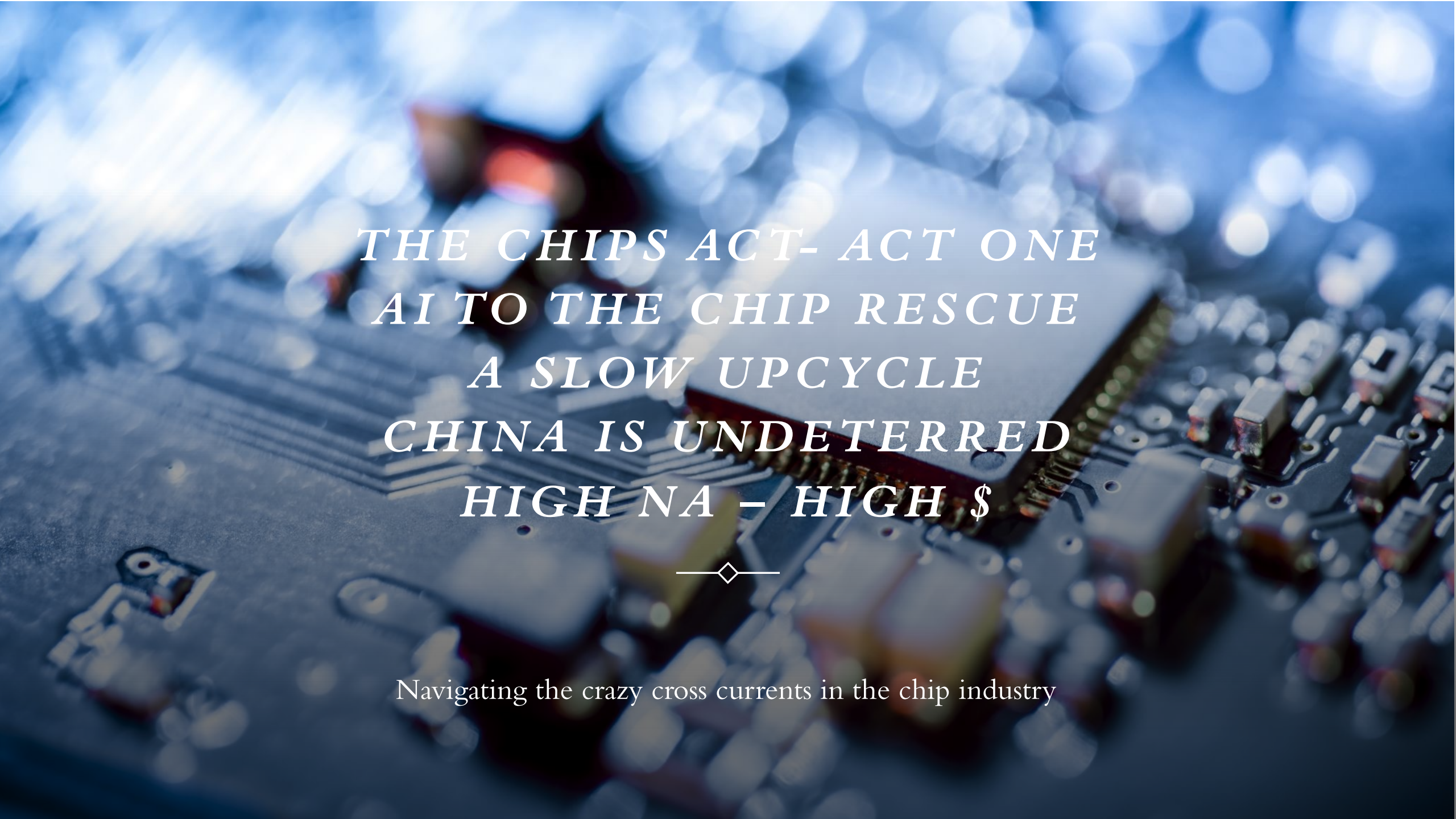


THE CHIPS ACT- ACT ONE
AI TO THE CHIP RESCUE
A SLOW UPCYCLE
CHINA IS UNDETERRED
HIGH NA – HIGH $

Navigating the crazy cross currents in the chip industry

The CHIPS Act- Act One
Writing big checks is the easiest part

- All we have heard is high level summary of total $- Headlines but few details
- Building fabs & buying equipment are the easy parts
- Biggest CHIPS Act challenge, hiring people, is still years away
- Problems at TSMC Arizona foreshadow HR issues
  - We need to more than double current fab employment
- How do we police how money is spent?
  - What restrictions on dividends, buybacks, foreign investing, moving jobs
- How does the CHIPS Act help us stay technically ahead?
  - We haven’t seen how the CHIPS Act fosters technology leadership

The CHIPS Act- Act Two

- Need stronger focus on HR needs- Not just creating jobs but high technology leading edge jobs
  - Being an operator in a fab is no more fun/desirable/value added than an auto worker
- It will take decades to reverse prior trend away from basic engineering
  - Colleges need to re-focus back to operational/productive technology
- Work ethics in US have slipped versus Taiwan & developing countries
  - American workers would never put in hours that are assumed in Taiwan
- US needs foreign workers in the interim decades to make up for US lack of engineers
  - Immigration rules need to be opened up and made easier for highly skilled engineering talent
- CHIPS Act needs to refocus on basic R&D and new start up small companies with new ideas
  - Not just funding Billionaire companies that do buy backs & dividends & build foreign plants
- CHIPS Act now needs to shift focus from production capacity to technology leadership

The CHIPS Act Can't & Didn't stop/slow China

- China has been outspending the US in semiconductor production tools >6/1
- China has done 7NM and will be able to do 5NM- using double patterning
  - They can now manufacture world class mobile phone chips and good enough AI
- The government wimped out/failed to slow/stop the flow of equipment from US
  - Equipment companies still selling 45% of tools to China versus 6% to US
  - Selling China the rope to hang us with – Lenin regarding capitalists
- China will attack low end of market – GloFo & UMC etc.
  - SMIC has already past both UMC & GloFo in revenues & technology- now #2
- A matter of time before they attack leading edge or Taiwan
  - US will not be self sufficient by the time that happens
- Bottom line is that US will still be vulnerable to China/Taiwan for long time

The long & slow road to a recovery

- The recovery will be slower than past upcycles- not hitting on all cylinders
  - AI is fantastic- it's the PC, mobile phone, internet …all over again..yet bigger
  - Memory is finally starting to recover with HBM (AI driven –leading the way)
  - Trailing edge is slow and could get crushed by China before it ever recovers
- HBM is only 5% of memory- even if it doubles its still small
- All the equipment being sold to China isn't going to sit idle
  - The coming China "Chipocalypse" could kill all but leading edge
- Technology is big key to AI success- more transistors wins
- CHIPS Act is drop in the bucket- fabs need to be profitably making advanced chips
- The US isn't the only country "re-shoring"- lots of new capacity & competition
  - We have to worry about Japan, Korea & Europe and maybe India too

Technology has gotten expensive- High NA=High $

- The price of Moore's law has gone up exponentially- we worry about sustainability
  - A High NA scanner is closing in on $400M for one tool! TSMC says too costly!
  - Like the nuclear arms race, chip technology race is all about economics
  - Only Intel in the US is competitive with a lot of help – Apollo/Ireland?
- Multi-chip & packaging helps but is itself costly
  - No significant packaging OSATs in US
  - Where is CHIPS Act in packaging
  - Even if the US can produce wafers do we still send them off shore for packaging?
- China is pouring a lot of money into basic R&D & science programs- We aren't
- Basic economics may need to be temporarily suspended -
  - Near term goal of self sufficiency versus longer term goal of profitability- Like China

AI will be the driver of the current long semiconductor "wave"
Prior waves were: PC, mobile phones, the internet

- AI is driving both high transistor count, bleeding edge, large die size silicon as well as HBM
  - Huge, almost infinite demand, as demonstrated by Nvidia
- Its more than one company; Nvidia, Google, AMD, Microsoft, IBM, Apple, Amazon, Intel, Meta, Samsung
  - Demand for bleeding edge foundry services are huge-Everyone wants their own chip-not like PCs
- Like prior "waves" AI is likely a multi decade long wave that will continue Moore's law
  - Moore's Law remains the primary driver measured in transistors per square inch of silicon
- AI will be more critical for defense, espionage, war fighting & global dominance than prior waves
  - AI could be an inflection point for Chinese dominance
- High Bandwidth Memory will command premium pricing until it becomes commoditized like other types
  - AL is all about LLM and massive data so memory makers will clearly benefit

New York State's Role in Semiconductors

- Focus on "Technology Creation" not just "Job Creation"
  - Technology will create new jobs- Jobs will not necessarily create technology
- Emulate the success of Silicon Valley- Focus on new start ups that are innovative & fast moving
  - Working with big, old slow companies is safe, easy & low risk but start ups create more …
- Be a technology leader not a follower
  - Buying the 25th High NA tool years after the industry is in production is NOT leading R&D
  - Appliance operator jobs making memory from R&D pioneered in Boise is not leading its following
- The US needs more than one leading edge company, Intel
  - Could GloFo's EUV be restarted? Why keep building outdated technology?
  - Could IBM be part of a Rapidus in New York?
- Get more Semiconductor equipment companies doing "real" R&D & product development in NY
  - TEL is good but AMAT, LAM, ASML & KLA don't do real research here

Conclusions

- CHIPS Act took almost 2 years for the easy part- Most difficult parts, HR & technology still ahead
- The semiconductor industry is in an up cycle albeit a slow one – in part due to macro economics
- The Chinese existential threat to semiconductors hasn't changed – clearly has worsened
- HR may be the biggest issue facing re-shoring in the chip industry- Difficult to solve- long term
- Moore's Law costs rise exponentially- Nearing the breaking point with $400M scanners
- AI is the new, " long term wave" driving chips for the next several decades
- US needs to focus on technology leadership, creativity, new start ups, core science- more value added
- After long downcycle things are improving but we are not out of the woods, still huge opportunities

"No physical quantity can continue to change exponentially forever. Your job is delaying forever"

Gordon Moore