

Moore's Law: It's Death Has Been Greatly Over-Exaggerated

G. Dan Hutcheson



Photo: Great Salt Flats, UT Canon D60, 28-300mm zoom lens

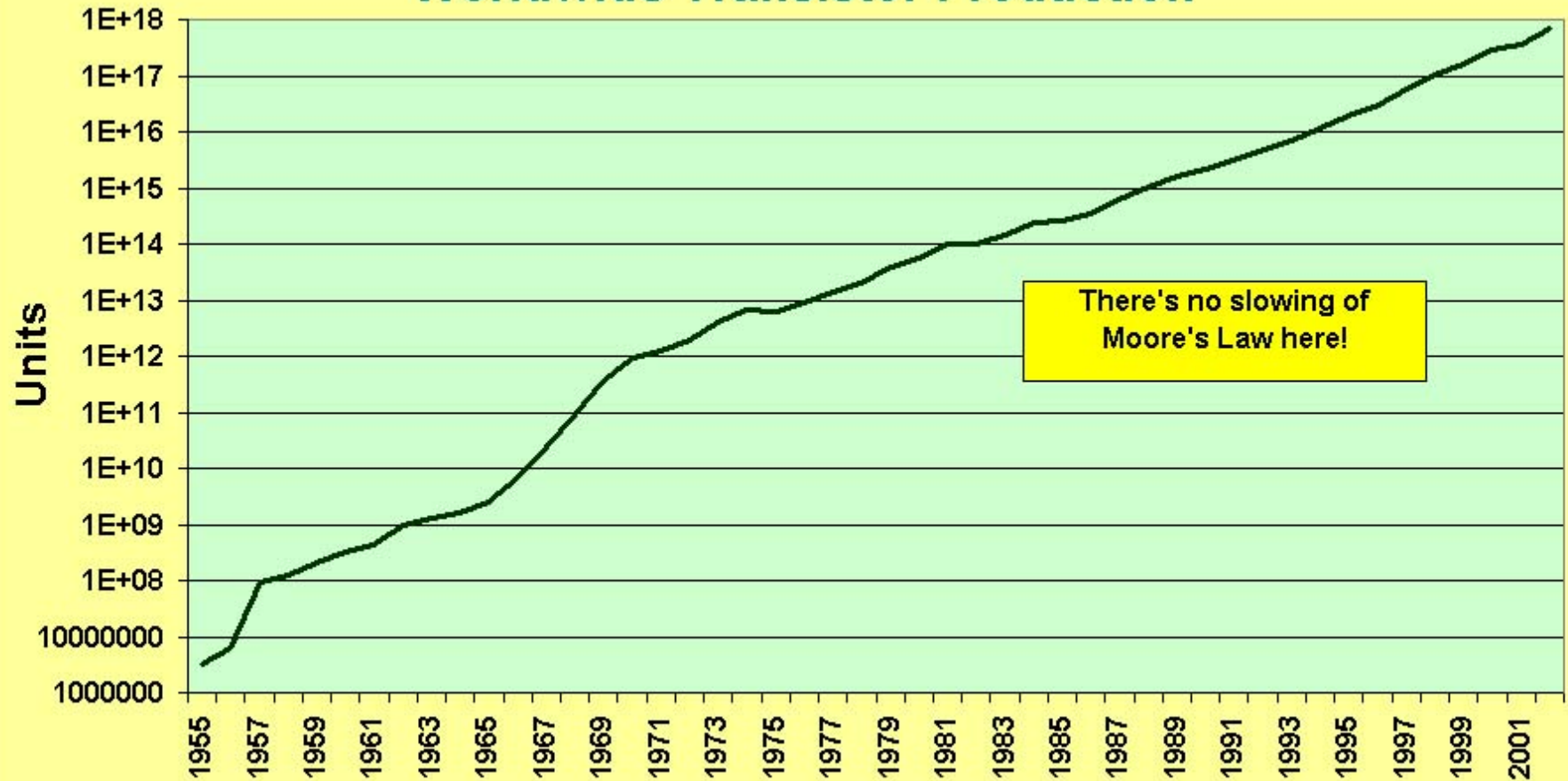
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- 1st:** 1996 - the Fed passes on controlling the stock market bubble.
- 2nd:** 1998 - AFC I causes the Fed to flood the economy with money.
- 3rd:** The Dotcon era of stratospheric stock prices and easy money.
- 4th:** Governments auction the communications revolution
- 5th:** Y2K - the infrastructure is upgraded at once.
- 6th:** The Fed reacts raising interest rates & bursting the bubble.
- 7th:** 2001- The cell phone business saturates.
- 8th:** 9/11 awakens the world to a new reality
and triggers a new collapse in the economy.
- 9th:** 2002 - The AFC II starts with Enron.
- 10th & 11th:** 2003- The war in Iraq and SARS.

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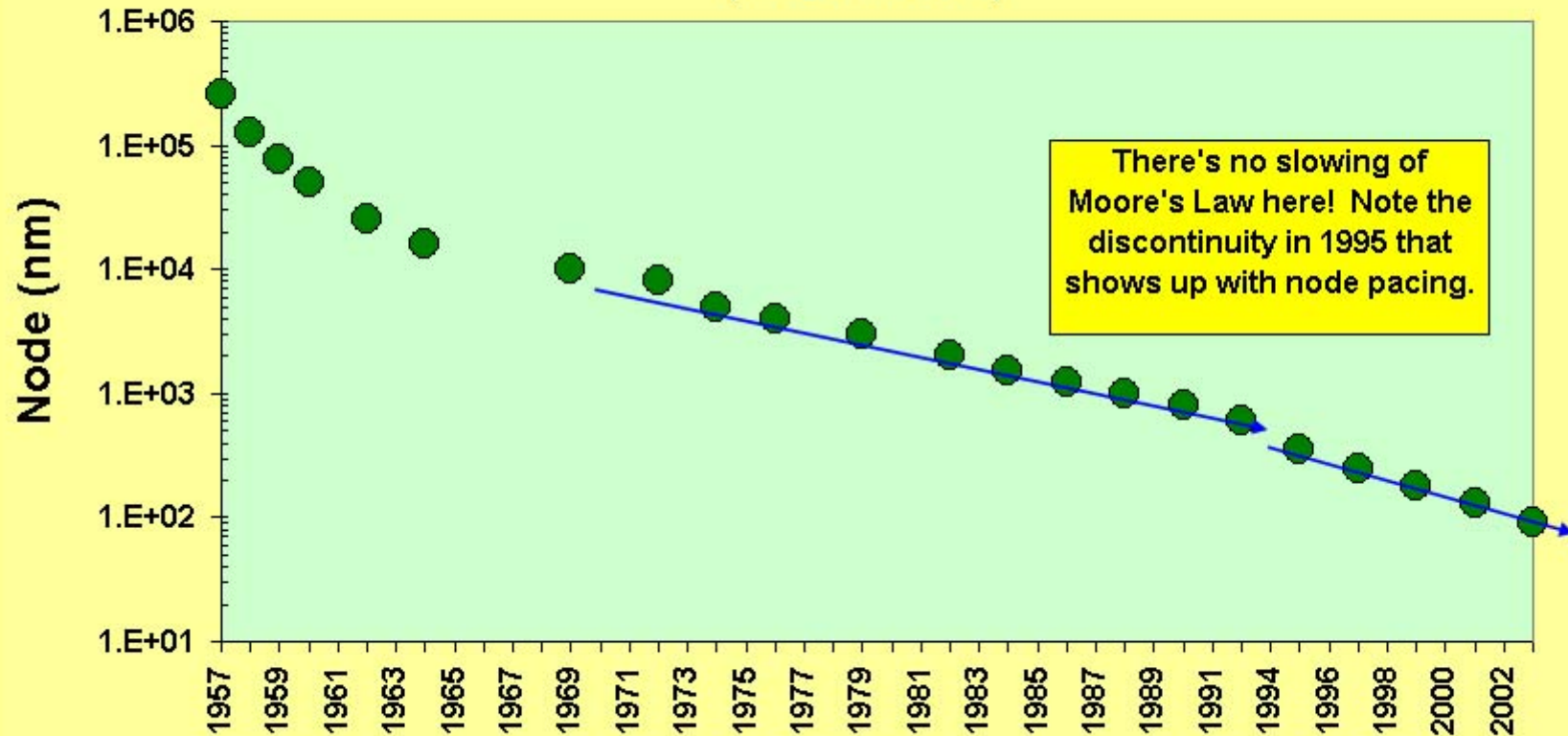
Where the Chip Making Industry Clicks to Find its Weather

Worldwide Transistor Production



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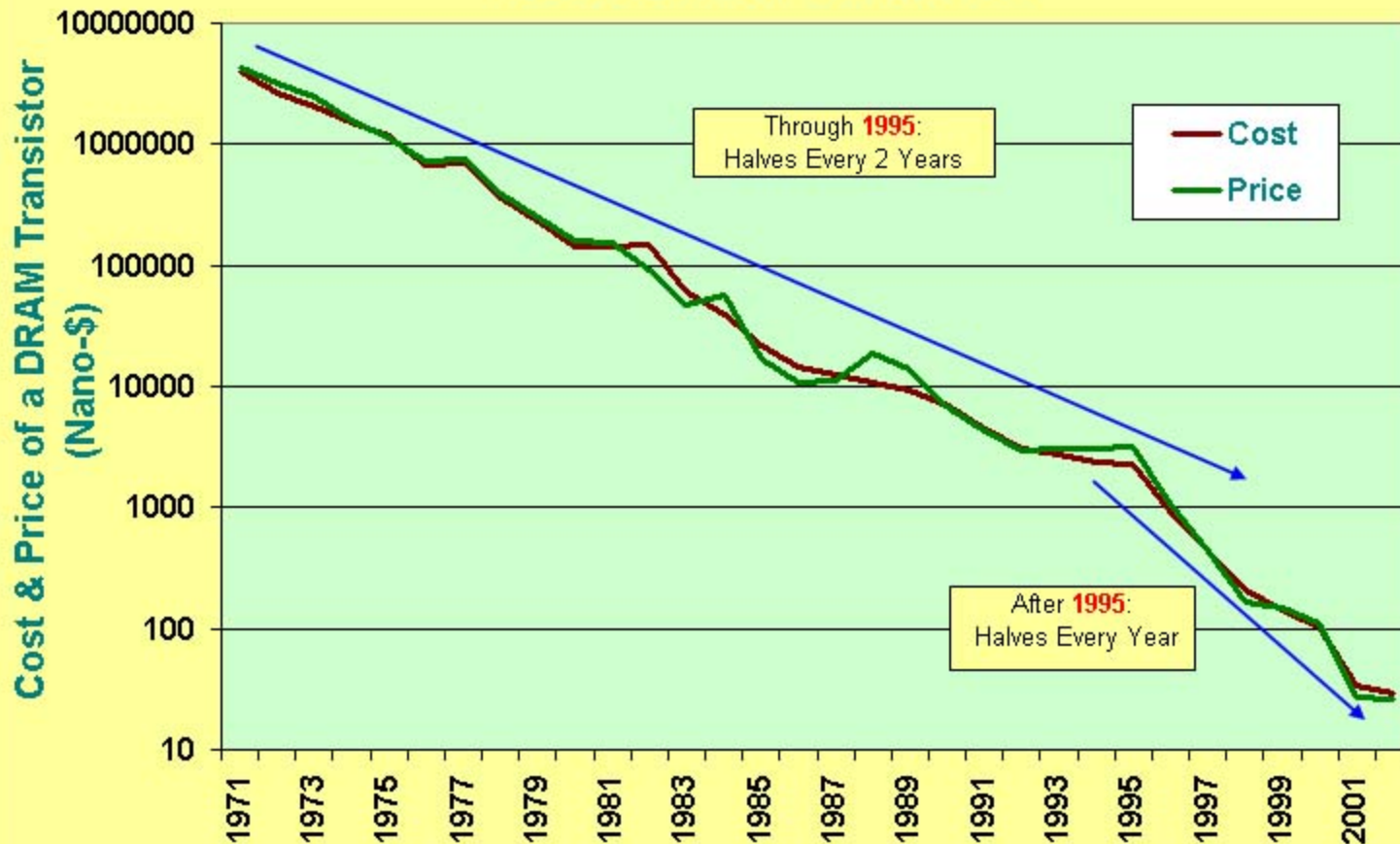
Forty years of Critical Dimension Shrinks (in nanometers)



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Moore's Law in Action



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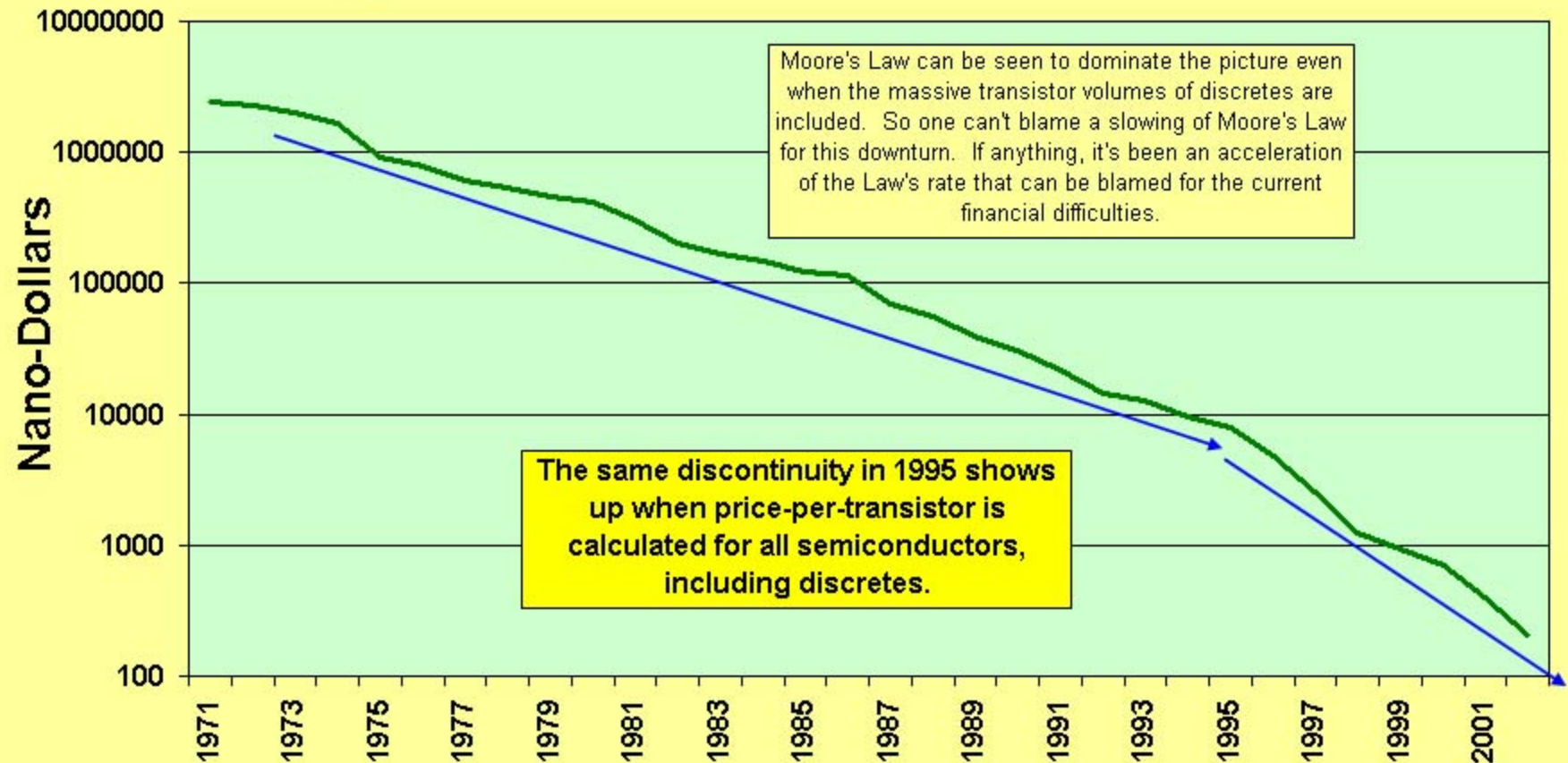
Despite all the pundits declaring the death of Moore's Law, it's still very much alive. One reason is that equipment costs have declined on a per transistor basis to make it possible (as shown in my Moore's 2nd Law article - TCI 030327).

If anything, Moore's Law has accelerated since 1995 as a price collapse forced manufacturers to speed up shrinks and cost reductions. DRAM's lifetime profit rate has been 7.8%, but -1.3% since 1995.

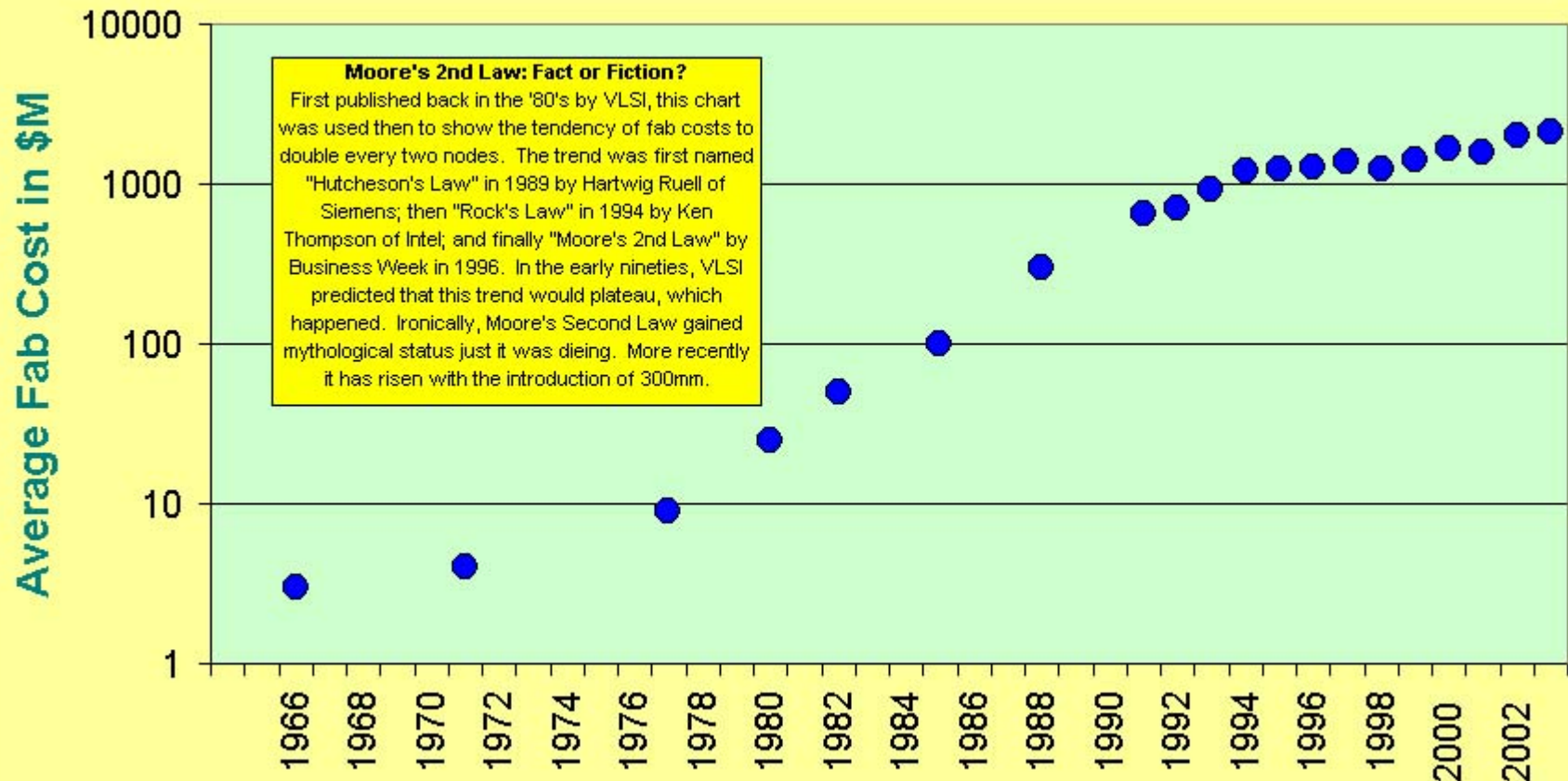
1995 may well have been the year that the industry matured.

-- Dan

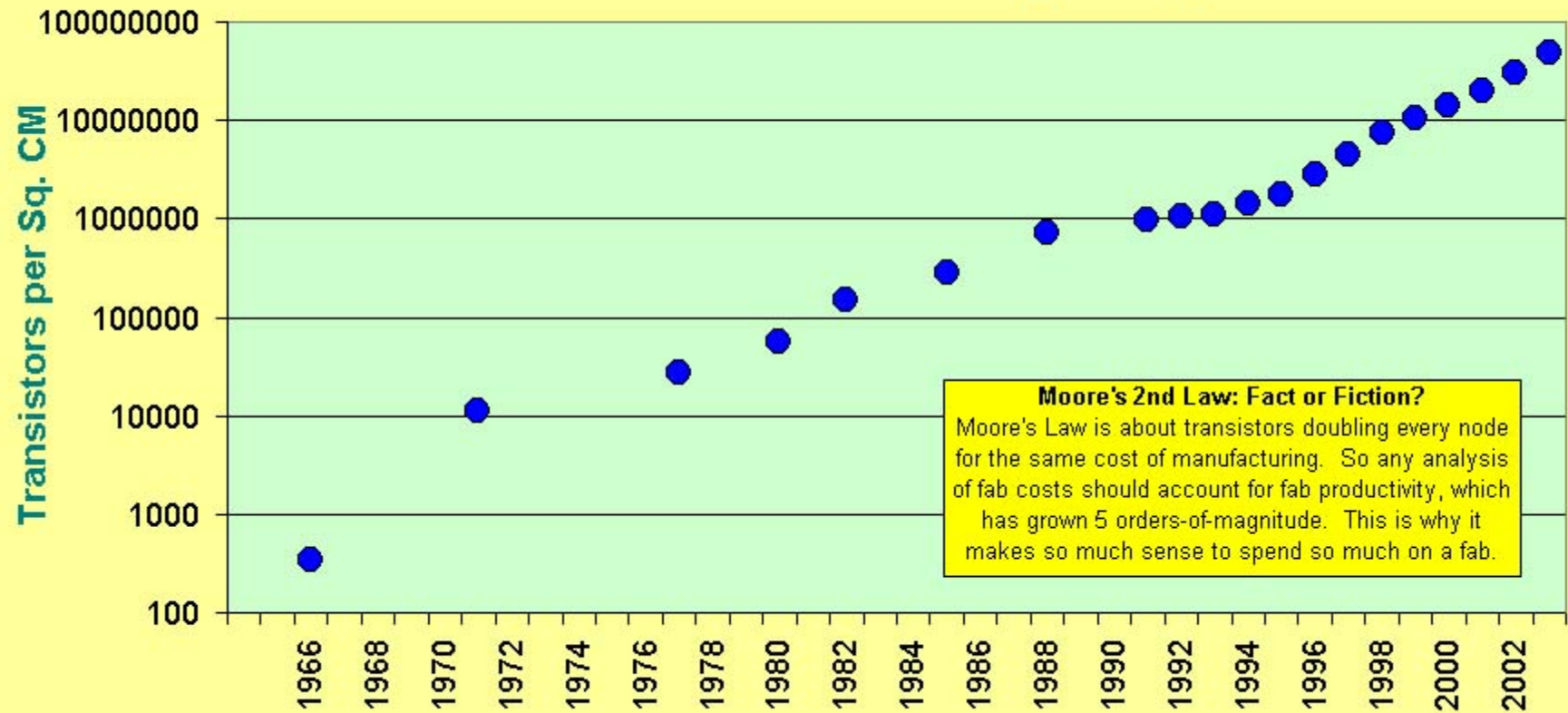
Average Price-Per-Transistor for all Semiconductors



History of Average Cost to Build & Equip a Wafer Fab



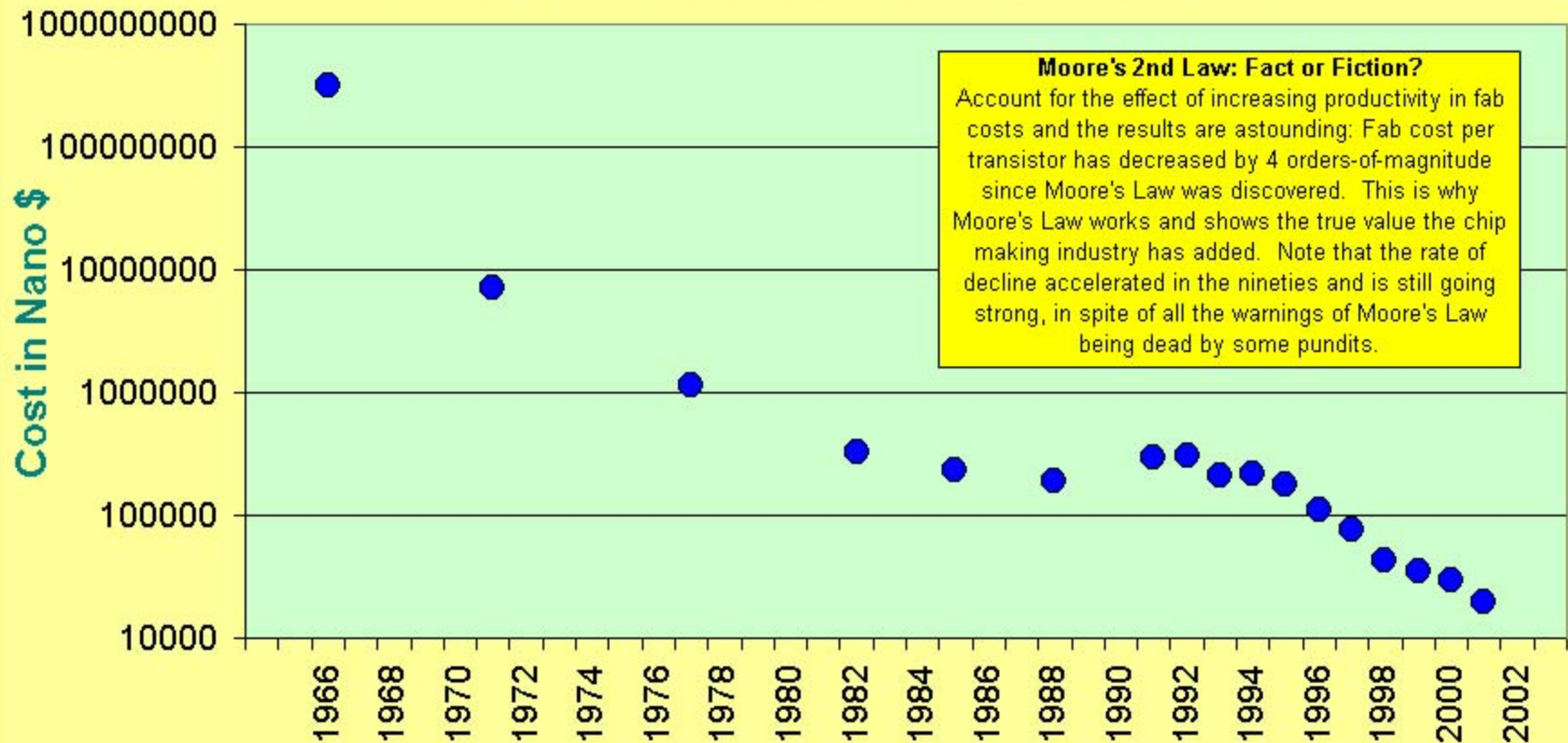
Wafer Fab Production Capability



Moore's 2nd Law: Fact or Fiction?

Moore's Law is about transistors doubling every node for the same cost of manufacturing. So any analysis of fab costs should account for fab productivity, which has grown 5 orders-of-magnitude. This is why it makes so much sense to spend so much on a fab.

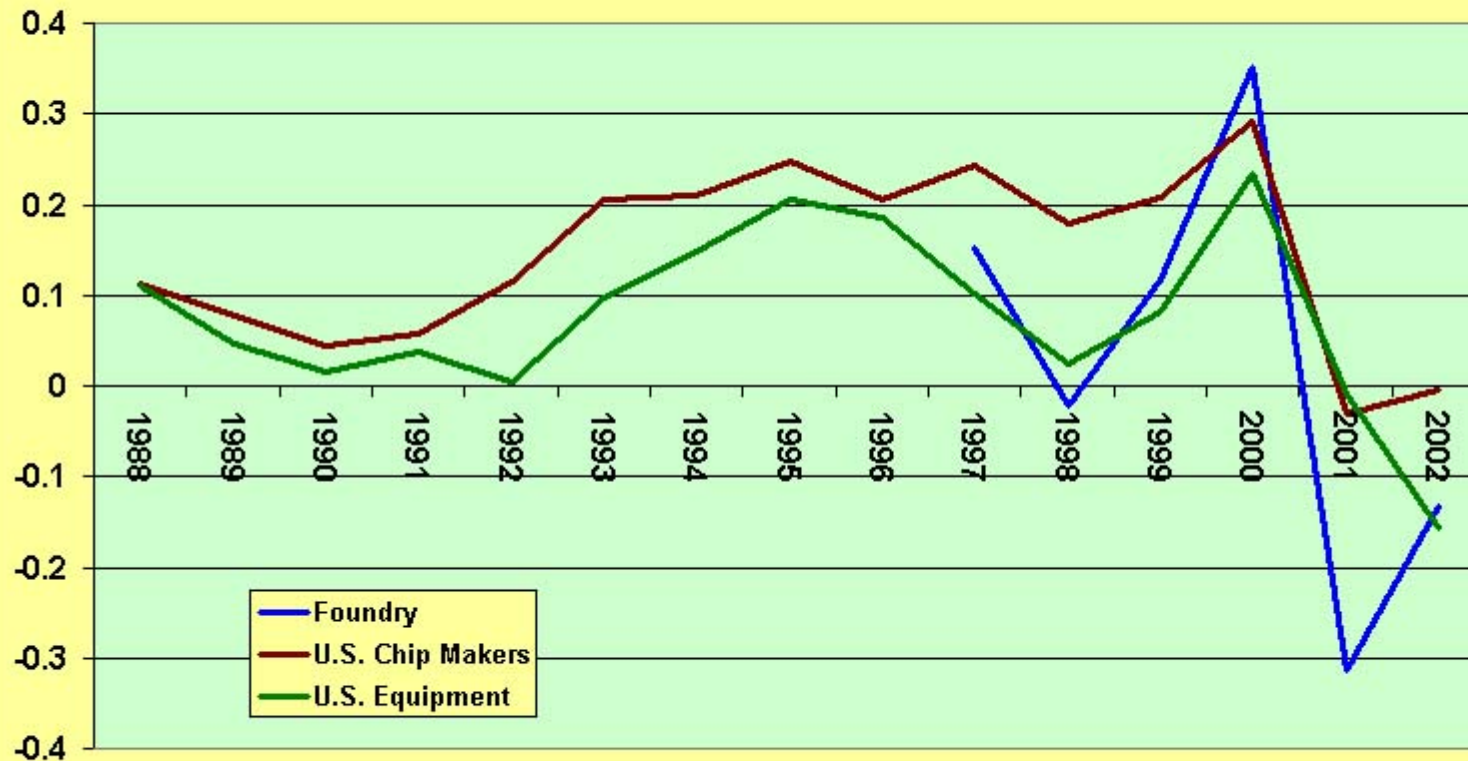
Wafer Fab Depreciation Cost per Transistor



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Industry Profitability



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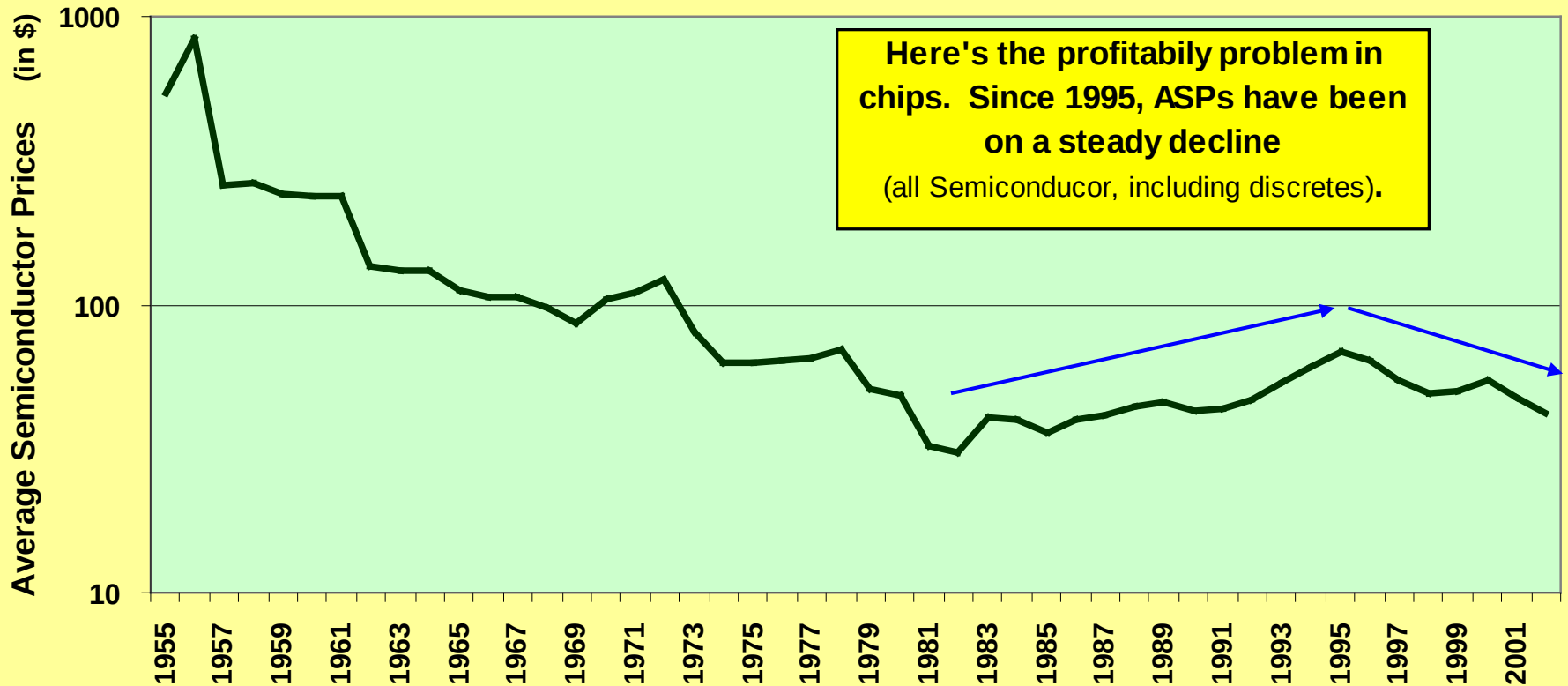
Profitability does not appear to have been affected by new trends after 1995.

However, the recent trend of negative profits in a downturn by U.S. makers is disturbing. This has been caused by the increased cyclicity. U.S. chipmakers incurred greater losses in 1985 (-9.6% - source: SIA) a year that also saw steep declines. But then was on a profit streak until 2001.

The break of a 15 year profitability streak is clearly another warning sign that the world has changed.

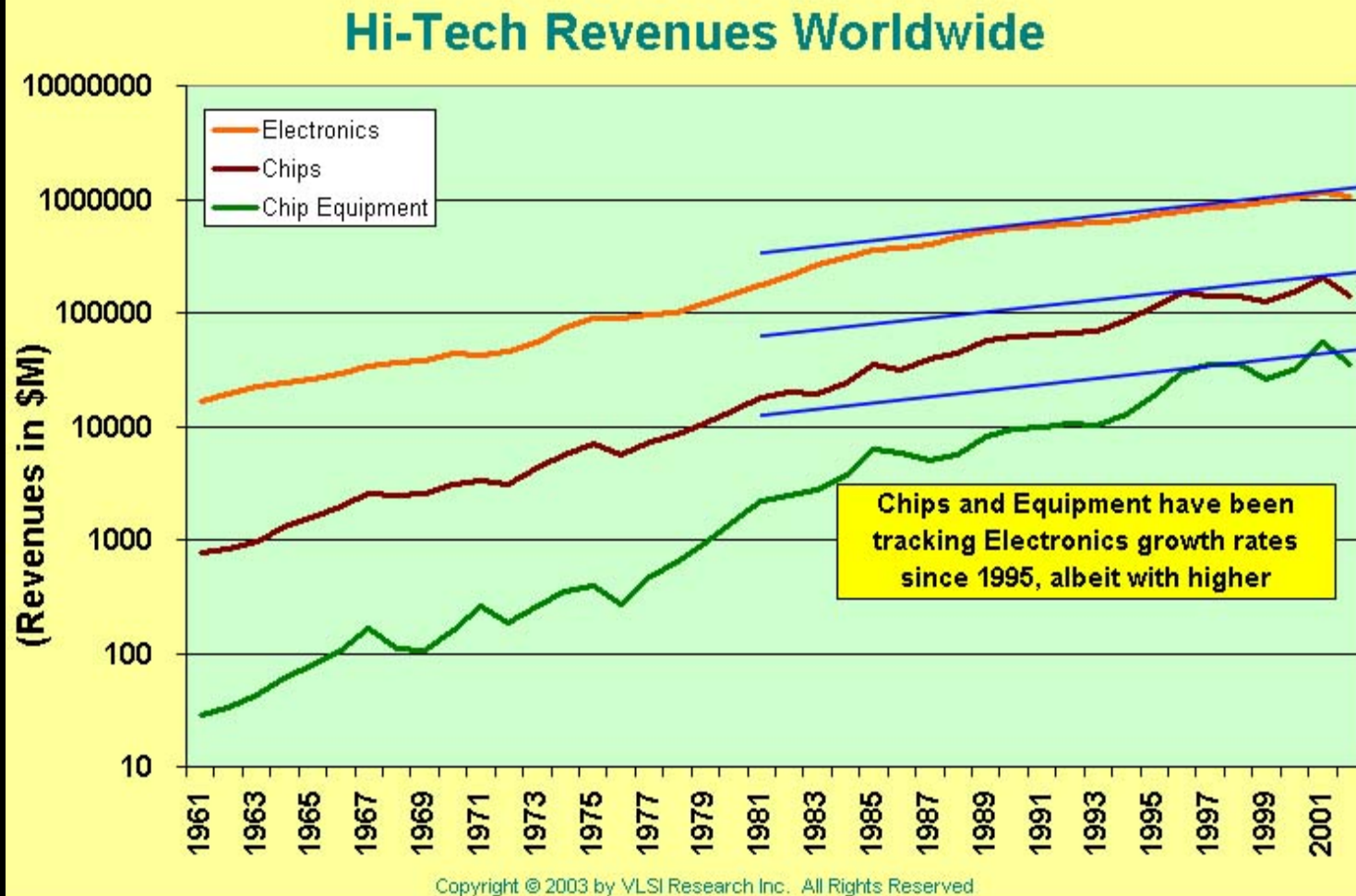
-- Dan

Average Price-per-Chip



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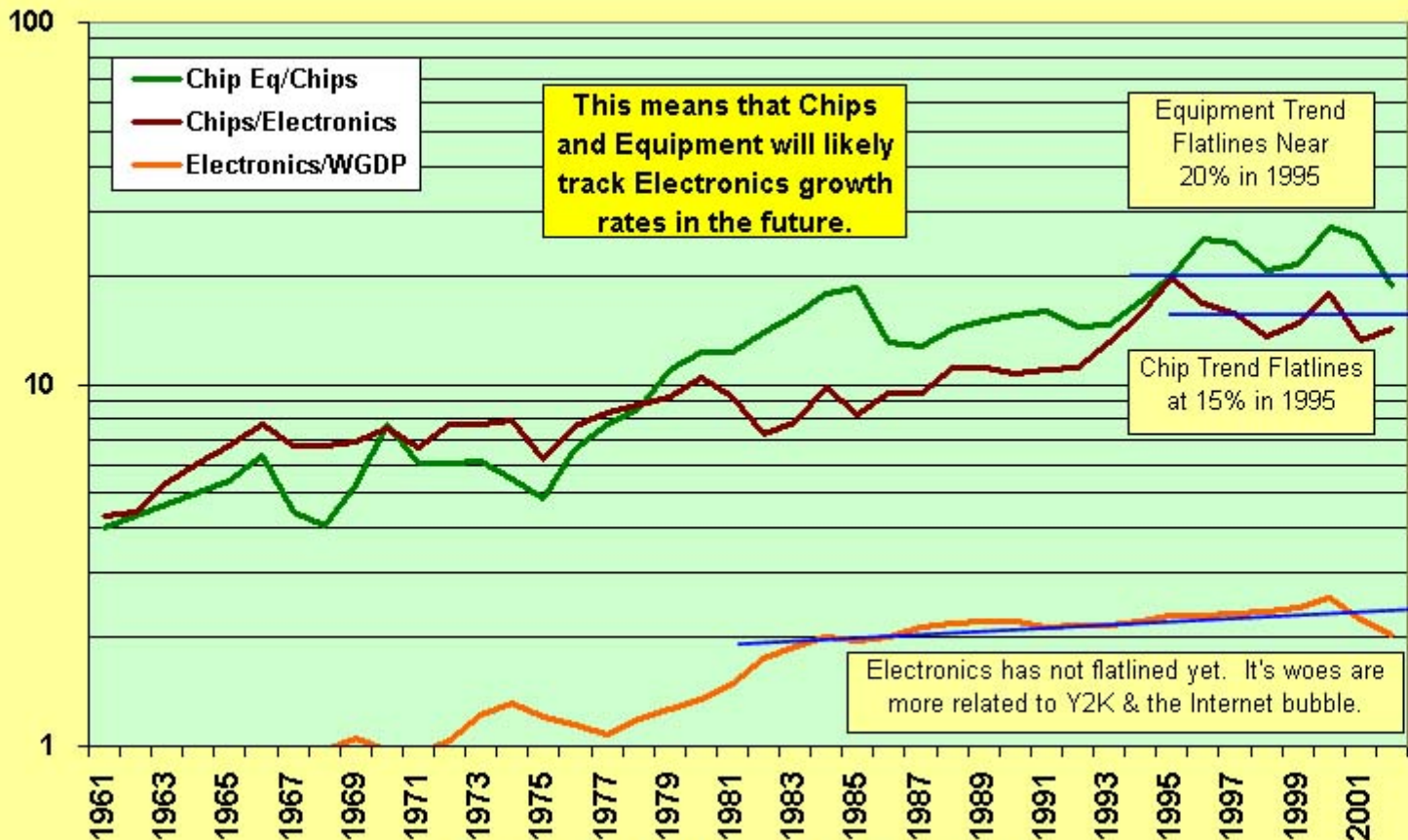
Here, the blue line that matches long-term electronics growth has been copied and overlaid on the Chips and Equipment Revenue lines. Note how they appear to have reached saturation. After 8 years of tracking electronics, it is safe to say that a new and slower growth trend has emerged for Chips and Equipment.

So far, the trend in volatility has been to grow. The reason is that companies have been running a strategy of market share rather than profits. -- Dan

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Technology Diffusion Rates



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Changes in trend lines take some time before it's clear that it's a new trend and not just noise. It's been 8 years since the industry started acting strange in the mid-'90s. There were unexplainable sharp rises in content rates and then a steep drop. Now there've been two such cycles in which there is an imperceptible ceiling.

VLSI Research has always held that the limit for equipment spending was around 20%. IBM economists figured the chip limit was 15% back in the '70s. So, the run-up in the mid-'90s appears to have been the last gasp of a maturing industry. -- Dan