Opinion **Business Insight**

Why neither Asia nor the US has produced a rival to ASML

Dutch chipmaking equipment supplier dominates in a way that markets cannot correct

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An ASML plant in the Netherlands © ABACA via Reuters Connect

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ASML sells just over 40 of its most advanced chipmaking machines each year. For over a decade, investors questioned whether such limited volumes could ever add up to a viable business.

Those doubts have aged badly. After an 80 per cent rise in its share price over the past six months, ASML is now valued at more than $500bn.

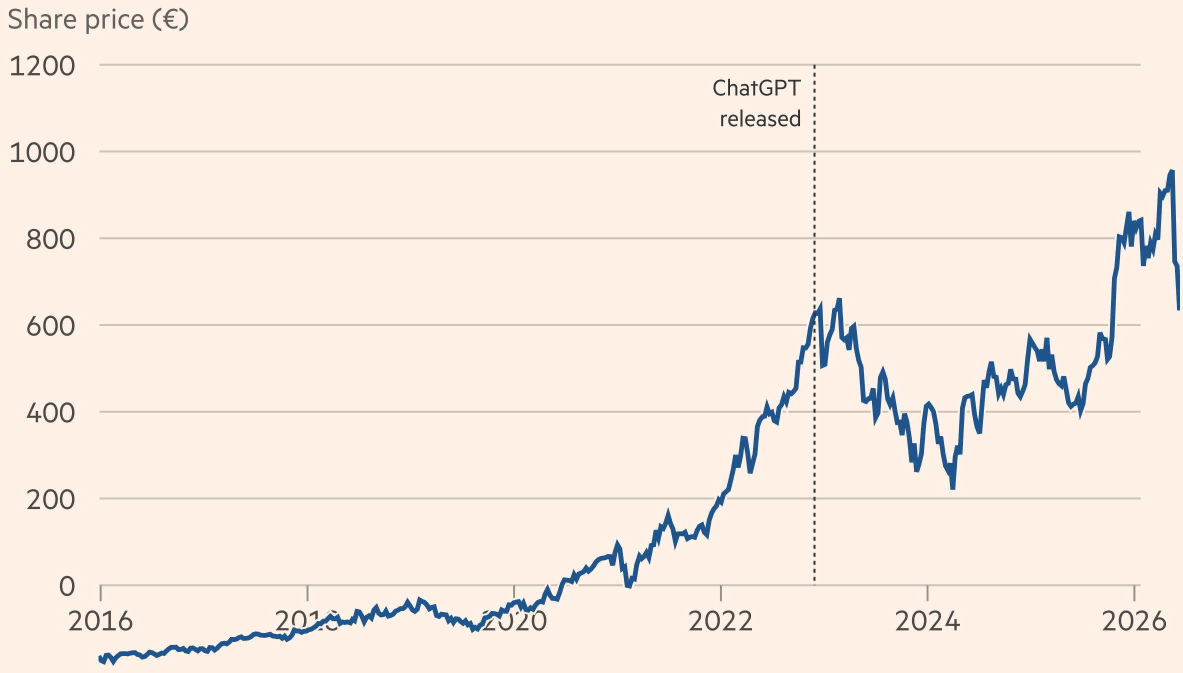
To understand why, it helps to look at where the real power sits in the AI supply chain. Chipmakers have become the industry's most visible winners of the AI boom. But even the most advanced makers, such as TSMC and Samsung, still compete the old school way: through running factories more efficiently, scaling production and improving yields. Their dominance is not guaranteed and customers can and do move.

ASML plays a different game. It is the only company that can make the extreme ultraviolet lithography machines required to produce those advanced chips. Each one has a starting price of $220mn and there is no commercially credible alternative supplier.

At first glance, this kind of dominance looks improbable. In most industries, a monopoly this profitable — ASML's gross profit margins were 52 per cent in the third quarter — would attract competition, especially from regions that already lead in related technologies. Asia runs the global chip industry. Taiwan makes the most advanced chips and Korea leads in memory. Japan is unrivalled in chipmaking materials while China is willing to spend heavily to close the technology gap. If any region could produce a credible second supplier of EUV lithography, it would likely be one of these.

Yet there is no number two. The usual explanations, including insufficient talent, funding or policy failure, do not address the core issue: in EUV, second place just does not work.

ASML's share price has surged



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Source: LSEG

The reason is that the technology behind EUV machines is a chain of almost impossible steps, all of which have to work at the same time. Modern chips are made by printing patterns, layer by layer, on to silicon using light.

To do this, engineers first need to create a form of light that does not occur naturally. Powerful lasers are fired at microscopic droplets of molten tin, turning them into plasma hotter than the surface of the Sun. That creates a pulse of extreme ultraviolet light, which is then reflected off a series of mirrors, each made with atomic-level precision and taking months to make, before the pattern is finally transferred to the silicon wafer.

The hardest part to replicate is the optics. EUV-grade mirrors are produced by a single supplier: Carl Zeiss SMT. They are the product of decades of tightly integrated development between Zeiss and ASML.

Lithography machine-maker ASML manages to maintain strong margins

Gross profit margin (%)

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Source: LSEG, company reports

Even if a peer could replicate that technology, the economics do not work. Any new entrant would sell too few machines each year to recover development costs, yet those machines would still be expected to deliver near-perfect reliability from day one. Chip fabrication plants operate continuously. At a company like TSMC, which makes more than $120bn in sales a year, a day of lost output across those fabs can cost hundreds of millions of dollars. A lithography tool that works almost as well as ASML's would be too much of a production risk, regardless of how much cheaper the sticker price looks.

As a result, chipmakers are unwilling to experiment with unproven EUV tools in volume production. That means a rival would never accumulate the field data required to improve. ASML shipped its first EUV machine in 2006 and its first production capable system in 2013. Because chip factories run around the clock, cumulative operating hours now run into the millions. That gap in real world operating data explains why Nikon and Canon, once ASML's peers in lithography, ultimately withdrew from pursuing EUV lithography systems over a decade before it became commercially viable, and why no successor has emerged since their exit.

Governments are often proposed as the solution. In theory, a determined state, backed by subsidies and guaranteed local buyers, could create a rival. China is one example. It has treated chipmaking as a national priority since export controls cut Huawei off from advanced chips in 2020. Efforts to make its own chipmaking machines are ongoing and heavily funded.

Yet China's experience has been the strongest test of the idea that money and policy can create a rival. ASML shows how, beyond a certain technological threshold, markets no longer correct monopolies.

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