Semi. Cap. Equipment

Foundry Competition - Samsung 14nm vs. TSMC 16nm is Just the Beginning

Key Takeaway
Starting in 2H14 we continue to expect Samsung’s 14nm to disrupt TSMC’s 16/16+ by taking share of Qualcomm & Apple’s leading-edge foundry business. Starting in 2015, we expect foundry competition to intensify further with the introduction of Samsung’s 28nm FD-SOI, which would disrupt both TSMC’s 28nm and 20nm nodes. Finally, we believe Samsung is also likely to be ahead of TSMC at 10nm. Elevated foundry spending would be positive for AMAT, LRCX, MU, and SNDR.

14nm vs. 16nm is Just the Beginning. Consistent with TSMC’s comments on its 2Q14 earnings calls, our checks suggest Samsung has not only won 14nm production orders from Qualcomm, but also from Apple. While we do not know the exact magnitude of 14nm production orders, we expect a large portion of business to move from TSMC to Samsung. We expect Samsung and its 14nm partner Globalfoundries to satisfy customer demand through their S1 (Korea), S2 (Austin, TX), S3 (Korea), and Fab 8 (New York) fabs. Samsung’s presentations at DAC last month indicate a new 28nm FD-SOI node would begin ramping in 1H15, we think at S1 or S2. We continue to believe Samsung’s strategy is to disrupt TSMC in foundry at both the leading (“n”) and more mature (“n-1”, “n-2”) nodes, which have historically represented the majority of the foundry profit pool.

Expect Foundry Spending to Increase. We expect Samsung and Globalfoundries to expand their 14nm capacity to meet new customer requirements. As TSMC faces increased competition, we expect TSMC’s CapEx spending to remain elevated over the next 12-to-18 months to accelerate both its 16/16+ and 10nm efforts. Our checks suggest Samsung is ahead of TSMC at 10nm, in terms of process design kit (PDK) readiness. We believe Samsung is ahead of TSMC at both 14nm and 10nm, in part because Samsung is able to leverage process learning from DRAM and NAND; whereas TSMC is disadvantaged on this front, for not having DRAM and NAND manufacturing capabilities in house. KLA’s commentary on its 2Q14 earnings call indicates 14nm-related spending from Samsung and Globalfoundries has begun, consistent with our thesis.

Foundry Spending from Samsung is Good for DRAM/NAND. In addition to having superior technology, we believe Samsung is also likely to offer attractive pricing in foundry to attract and retain new customers. To provide the cash required for its foundry push, we believe Samsung is likely to maintain a high level of profitability in DRAM and NAND, in part by limiting capacity expansion. We continue to expect new DRAM capacity additions at Samsung to remain limited near term, and NAND capacity additions to be driven primarily by progress in 3D NAND.

Links to Related Reports.
Samsung: TSMC Falling Off the Leading Edge?
Samsung: Moore Stress at TSMC - Takeaways from DAC 2014
Samsung: 14nm FinFET Collaboration with GLOBALFOUNDRIES = TSMC Disruption
SemiCap: Moore Stress 2.0: Equipment Supplier Leverage - Initiating Coverage
The chart illustrates Samsung’s view of how different advanced process node variants compare on the basis of development complexity and associated power/performance benefits.

In addition to disrupting TSMC by taking customer share at 14nm, we believe Samsung is also in a good position to take customer share at 28 FD-SOI, and potentially at 14 FD-SOI.

Our checks suggest STMicro’s 28 FD-SOI process was developed using Samsung’s 28 LPP as the starting point. We believe Samsung already has some 28 FD-SOI capacity, and would build more with additional customer demand.

We expect Samsung to disrupt TSMC’s business model starting at the leading-edge (14nm) in 2H14.

Starting in 1H15 we expect Samsung to broaden its foundry offerings at the “n-1” and “n-2” nodes to increase its own profitability, and continue disrupting TSMC.

Our analysis suggests TSMC is likely to face worsening profitability at the leading-edge, making it increasingly difficult to continue investing in R&D and CapEx at the leading-edge.
At its 2Q14 earnings call, Xilinx noted it was delaying its 16nm ramp schedule at TSMC. We would not be surprised to hear about further delays in production ramps on TSMC’s 16/16+ nodes.

At its 2Q14 earnings call, KLA-Tencor noted receiving a large $300m order related to 14nm foundry, and expects to benefit from stronger foundry competition in 2015.

KLA’s commentary suggests Samsung’s 14nm foundry node is not only getting ready to enter volume production, but that customer visibility at 14nm has also improved.

This is consistent with our checks that Samsung has won a substantial portion of both Qualcomm and Apple’s foundry business at 14nm.

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**Chart 3: Xilinx Foundry Comments from 2Q14 Earnings Call**

<table>
<thead>
<tr>
<th>Date</th>
<th>Quote</th>
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<tbody>
<tr>
<td>7/22/2014</td>
<td><strong>CFO on 20nm and 16nm development:</strong> “We remain committed to developing – to continue the 20-nanometer and 16-nanometer development programs. We will not be slowing those down and cutting those back.”</td>
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<td>7/22/2014</td>
<td><strong>CEO on TSMC FinFET:</strong> “We are delighted with the progress of TSMC. As best we can tell, they’re on schedule, and they have numerous other users of the technology who actually, in this case, will even be ahead of us. So there really is no issue, in our mind, on the availability of the FinFET from TSMC.”</td>
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<tr>
<td>7/22/2014</td>
<td><strong>CEO on timing of 20nm and 16nm:</strong> “So, the 20-nanometer, both families are now available. The initial tape out was of Kintex, and that is moving into production, and we’re sampling the Virtex product line and feedback that we have is that we have a minimum of a six-month lead based on any competitive product. On the 16-nanometer – this is FinFET – we’re on schedule to tape out in Q1 of calendar year 2015. And what has happened is that we have revised our roadmap to better align with customer requirements and specifications. So, originally, we had expected to tape out by the end of the year. We’re now expecting to tape out our first 16-nanometer device in the first quarter of 2015.”</td>
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Source: Xilinx, FactSet

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**Chart 4: KLA-Tencor Foundry Comments from 2Q14 Earnings Call**

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<tr>
<th>Date</th>
<th>Quote</th>
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<tr>
<td>7/24/2014</td>
<td><strong>CEO on Foundry Competition:</strong> “Foundry orders in Q4 featured nearly $300 million in system orders from one customer to largely support 14-nanometer activities. These orders are scheduled to begin shipping later in the current calendar year and revenue in calendar year 2015. I would note that these orders are not a pull-in and represent significant upside to original forecast for this customer. Clearly the competitive battleground for 3D foundry is taking shape, and as the market leader in process control, KLA-Tencor is well-positioned to benefit from what we expect to be strong broad-based foundry demand at the 16- and 14-nanometer nodes.”</td>
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<tr>
<td>7/24/2014</td>
<td><strong>CEO on 16nm and 14nm ramp:</strong> “The timing of those shipments combined with the uncertainty of our plans for sub-20 nanometer capacity additions among the other major foundries for the remainder of calendar 2014 continues to put pressure on the outlook for foundry spending in the year. However, we believe this also sets up a strong year for foundry in 2015 as we expect to see broader customer participation and a steady focus on ramping 16- and 14-nanometer technologies.”</td>
</tr>
<tr>
<td>7/24/2014</td>
<td><strong>CEO on whether the 14nm order is dependent on APPL/QCOM:</strong> “we’re heavily engaged with the management team and have had a lot of meetings about support, so I’m confident as well that there is, to Bren’s point, that these orders are very solid. I think one thing we have seen in the recent past as the customer has consolidated more, we do see I think we have pretty good visibility into people’s confidence in their plans. And usually they’ll let us know if it’s not going to happen, but once they place the order it’s a pretty good indication.”</td>
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Source: KLA-Tencor, FactSet
On its 2Q14 earnings call, TSMC indicated it would lose market share to Samsung’s 14nm node in 2015. TSMC also indicated it would accelerate development of its 10nm node.

<table>
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<th>Date</th>
<th>Quote</th>
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| 7/15/2014  | CEO on 16nm: “Volume production of 16-nanometer is expected to begin in late 2015 and will be fast ramped up in 2016. The ecosystem for 16-nanometer designs is current and ready. A few years ago, in order to take advantage of special market opportunities, we chose to develop 20-SoC first and then quickly follow with 16-nanometer. We chose this sequence to maximize our market share in the 2016 nanometer generation.

As the 2016 foundry competition unfolds, we believe our decision to have been correct. Number one, in 20-SoC, we believe we’ll enjoy overwhelmingly large share in 2014, 2015 and onwards. Number two, in 16-nanometer, TSMC will have a smaller market share than a major competitor in 2015, but will regain leading share in 2016, 2017 and onwards.” |
| 7/15/2014  | CEO on 10nm: “Now, a few words about 10-nanometer. The 10-nanometer department is progressing well. The 10-nanometer speed is 25% faster than the 16-nanometer. The power consumption is 45% less than 16-nanometer. And the gate density is 2.2x that of the 16-nanometer. Power is 25% faster. Did I say speed or power? I mean speed. Speed is 25% faster, power is 45% less, gate density 2.2 times more, all compared with 16-nanometer.

We work closely with our key customers to co-optimize our 10-nanometer process and design. We expect to have customer tape-outs in the second half of 2015.” |
| 7/15/2014  | CEO on TSMC 16nm vs Samsung/Intel 14nm: “Actually, I intended to repeat what I said in the general – Annual General Meeting just now. Really if you combine the three; speed, density and power, we feel that we’re more than competitor.

Now, you asked me how bigger leap we have et cetera, et cetera. Well, I think that will be a very difficult to – a very difficult question to answer, because our competitors on the 16-nanometer are the two companies that I in the past referred to as, the two big gorillas of the industry. And each has its strengths.

So the two are not the same at all. And each has the strength, and each has its weaknesses. And a competitor may be technologically strong, but if he turns out to be a competitor of his potential customers, then that's a weakness. And if a competitor is already used to being both a competitor and a supplier, but he has got technology weaknesses, well that's a problem too for him. Well, I don’t think I can really answer your question in very simple way. I can only answer it by just repeating what I said earlier combining performance, density and speed – or speed, density and power, we believe we are more than competitive. And in terms of the ability to get business, we believe we are more than competitor.” |

Source: TSMC, FactSet
This chart captures the progression in TSMC’s commentary about the timing of its 16/16+ nodes.

We would not be surprised if the timing of TSMC’s 16/16+ nodes was delayed further.

### Chart 6: TSMC 16nmFF Ramp Timing Progression

<table>
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<tr>
<th>Date, TSMC Executive</th>
<th>Quote</th>
<th>Implied 16nmFF ramp</th>
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<tr>
<td>Oct-17-2013, CEO</td>
<td>On 16 FinFET, technological development is progressing well. Risk production is on schedule by the end of this year. More than 25 customer product tape-outs are planned in 2014 including mobile computing, CPU, GPU, PLD and networking applications. <strong>We are on track to begin volume production within one year of 20-nanometers.</strong></td>
<td>1Q15</td>
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<td>Jan-16-2014, Co-CEO</td>
<td>Therefore, we leverage the volume experience in volume production this year to be able to immediately go down to 16-nanometer volume production next year, within one year of 20nm.</td>
<td>1Q15</td>
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<td>Apr-16-2014, Co-CEO</td>
<td><strong>Volume production is planned in 2015.</strong> Since 95% tool of 16-nanometer and 20-nanometer are common, we will ramp then in the same GIGAFABs in TSMC. 16-FinFET yield learning curve is very steep today and has already caught up with 20-SoC...And we are working with the customer closely, and we expect to ramp up 2015.</td>
<td>&quot;2015&quot;</td>
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<tr>
<td>Apr-16-2014, Co-CEO</td>
<td>From 2015, first of all, the volume of 16-FinFET Plus will happen in 2015. Let me drive that. Even for some of the customer, initially, their product sits on 16-FinFET. They also would like to migrate their second if market opens the opportunity to upgrade their product. So, we’ll see the majority, I really mean massive majority will be 16-FinFET Plus. Yeah.</td>
<td>&quot;2015&quot;</td>
</tr>
<tr>
<td>Jul-16-2014, CEO</td>
<td><strong>Volume production of 16-nanometer is expected to begin in late 2015 and will be fast ramped up in 2016.</strong> The ecosystem for 16-nanometer designs is current and ready. A few years ago, in order to take advantage of special market opportunities, we chose to develop 20-nanometer SoC first and then quickly follow with 16-nanometer. We chose this sequence to maximize our market share in the 20-nanometer, 16-nanometer generation.</td>
<td>3Q15</td>
</tr>
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</table>

Source: TSMC, FactSet

In the next chart (Chart 7), we plot semiconductor manufacturer revenues over time, and how they compared to the cost of building a leading edge semiconductor manufacturing facility (blue line with diamond markers). We also put on the graph what we label as the “Drop-Out Zone,” highlighted by the two upwardly sloping red lines. We define the “Drop-Out Zone” as 0.8x-to-2.0x the cost to build a leading edge factory, and is typically the revenue range at which semiconductor manufacturers can no longer support building a leading edge factory.
We continue to believe that:

1) Samsung Semiconductor and Intel are the only two companies well above the “Drop-Out Zone.” We expect these two companies to have the critical mass of revenues required to support the building of leading edge factories for at least the next several manufacturing process nodes.

2) TSMC is close to the upper end of the “Drop-Out Zone.” With the expected loss of a significant portion of revenues from its large customers, TSMC is likely to struggle to stay on the leading-edge.
Equipment Supplier Leverage

Industry device scaling cost reductions have decelerated, as device characteristics have started approaching limits posed by physics, and next-generation lithography technology (EUV) is delayed – we refer to this dynamic as **Moore Stress**. The resulting industry shift toward alternative approaches to device scaling, including alternative materials, and manufacturing process enhancements, has put a higher burden of R&D on Semiconductor Equipment suppliers, and is driving **industry consolidation**, in order to better address demand from a concentrated customer base.

Chart 9 summarizes the secular industry dynamics at play. **We expect AMAT’s merger with TEL to close in 2H14, and shift the balance of power toward equipment vendors, from their customers.** In the areas of Deposition (20% of WFE CapEx) and Etch (24%, including Clean and Planarization), we expect to see the biggest inflections in supplier industry concentrations. Our case study of HDD and DRAM consolidation using the Herfindahl-Hirshman Index (HHI) suggests that HHI inflections in Dep/Etch would drive higher profitability and stock outperformance for AMAT and LRCX. In Process Control (14% of WFE) we expect positive fundamentals to continue, and the industry’s dominant player KLAC to do well.

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**Chart 8: Moore Stress 2.0 - Big Picture Structural Dynamics**

- **Multi-Patterning**
- **DRAM and NAND Capacity Discipline**
  
  - **Multi-Patterning**
  - **3D NAND**
  - **TSV**
  - **FinFET**
  - **Stable growth in profits & investments**

1. **Industry Consolidation**
   - AMAT + TEL
   - ASML + CYMR
   - LRCX + NVLS

2. **Moore Stress**
   - Investments from Intel, Samsung,

3. **Intense Foundry Competition**
   - Samsung + GLOBALFOUNDRIES
   - TSMC vs. Intel

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- PMC-Sierra, Inc. (PMCS: $6.98, HOLD)
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