Another year of strong growth
China’s Impact on the Semiconductor Industry
2012 Update
About this report

In 2004, PwC released its original report, *China’s impact on the semiconductor industry*, in response to our clients’ interest in the rapid growth of the semiconductor industry in China. Specifically, clients wanted to find out whether China’s production volumes would contribute to worldwide overcapacity and a subsequent downturn in the industry. For the past seven years, we have provided updates that included an analysis of both the semiconductor market (consumption) and industry (production). We also covered design, the value chain and possible production growth scenarios along with a number of other topics.

Because the report relies on a number of data sources, we have been unable to deliver it in full until the fourth quarter of the following year. This year, in an effort to get you this vital information in a more timely fashion, we have chosen to release the report in a tiered fashion. This is the sixth and final chapter in the series. Please note that figure and table numbering continue from the fifth chapter, thus the first figure in this chapter is numbered 27 rather than 1. Check back at www.pwc.com/chinasemicon in the coming weeks for the full report. In addition to the six individual chapters, it will provide an executive summary, recommended actions, acknowledgements and a brief description about Chinese semiconductor statistics.

Please visit www.pwc.com/chinasemicon to read online or download this year’s report.

Individual chapters are also available:

1. **Exceptional relative performance**
   Market and industry overview
2. **Strong but variable growth**
   China’s semiconductor industry
3. **Noticeable growth**
   Design in China
4. **Undergoing a structural shift**
   Greater China
5. **Growing capabilities**
   Manufacturing
6. **Supporting growth and measuring progress**
   Government and production growth scenarios
China’s 12th Five-Year Plan has a goal to more than double the size of the IC industry by 2015, with output exceeding 150 billion units, sales reaching RMB 330 billion (US$51bn), accounting for about 15% of the world IC market and satisfying nearly 30% of its domestic market demand and another goal to cultivate 5-10 key IC design firms with sales of over RMB 2 billion each (US$310m) with one firm ranking among the global top ten design firms.

China continued its dominance over the worldwide technology IPO market with the most technology IPOs—49 Chinese technology companies completed their IPOs in 2011 out of a worldwide total of 86.

For the past five years—from 2007 through 2011—5% to 6% of patents on semiconductor inventions have been first issued in China.

Nine Chinese companies represented more than 56% of the 16 semiconductor IPOs completed in 2011, raising 50% of the funding realized, almost all in China’s financial markets.

China’s 2011 IC production dollar revenues exceeded the moderate growth scenario by more than 3%, but with significant diversity among its three sectors.
Supporting growth and measuring progress

China’s 12th Five-Year Plan

During 2011 China entered its 12th Five-Year Plan (12th FYP) period which will run from 2011 through 2015. Our 2011 Update report included a meaningful discussion of China’s Five-Year plans and their broad implications for the semiconductor industry in China. We noted: “While China’s 12th FYP is more a message to the Party ranks and government hierarchies parameterizing “acceptable” behaviors than a roadmap for a new development path for China, it will result in new implementation policies affecting the semiconductor industry.”

The earlier 10th and 11th FYPs (2001–2010) had furthered policies pursuing stable economic growth with the objectives of doubling GDP between 2001 and 2010 and increasing the capacity for independent innovation, enabling firms to obtain key technologies by investing in R&D and raising their level of competitiveness with major international players. Those FYPs shared a focus on opening up markets, increasing the capacity for innovation and adjusting the industrial structure to achieve sustained economic growth, with the 10th FYP including phased targets to increase individual disposable income and the 11th FYP concentrated on building a market-led, private business-centered economy. That policy direction also became the main motivation for promoting the growth of China’s semiconductor industry. The semiconductor industry was listed as one of the key industries for state support and was therefore the beneficiary of a series of tax incentive policies and measures. China notably exceeded the overall economic targets set during the 10th and 11th FYP periods and China’s semiconductor industry revenues grew more than seven times from US$5bn (42 billion RMB) in 2001 to US$38bn (258 billion RMB) in 2010.

Chapter 6: Government and production growth scenarios

6.1 China’s 12th Five-Year Plan
6.7 Financial markets and IPO funding
6.9 Semiconductor patents
6.12 Production growth scenarios
6.14 Performance versus scenarios
The 12th FYP makes it clear that China, which became the world’s number two economy in 2010, has now turned its attention from the pursuit of national strength to increasing it people’s prosperity. The 12th FYP marks a shift away from output growth to R&D and overall industry competitiveness. It places far greater emphasis on internal markets and domestic demand than prior FYPs and includes industrial structures that emphasize added value.

China reoriented its semiconductor industry policy for the 12th FYP period, moving away from the pursuit of growth in capacity and output value in favor of pursuing advanced technology and advanced R&D capabilities. China’s policy objectives for the semiconductor industry during the 12th FYP period are to transform the industry into one of the world’s major development and manufacturing bases with sufficient capacity to satisfy the majority of China’s domestic demand, while achieving a certain level of exports, and to reduce the manufacturing process technology gap between China and the advanced nations. The focus is on fostering a group of globally competitive semiconductor firms that will develop into global leaders in terms of both technological standards and market share.

The 12th FYP continues to support the industry through methods including expanding domestic demand, promoting the seven new major strategic industries, funding and subsidies for major scientific and technological projects and intensifying reform of the financial markets. The semiconductor industry is included as one link in the infrastructure for next-generation IT, one of the seven strategic industries, and thereby relevant semiconductor businesses will be able to receive government support providing they meet the proper criteria. The policy goals set for the seven new strategic industries is to reach 8% of China’s GDP by 2015, increasing to 15% by 2020. To achieve these targets, the policy also calls for three government-supported measures in the form of tax incentives, strengthening government purchasing of relevant businesses and establishing specialized funds for the development of strategic new industries; and four measures aimed at private funding, specifically encouraging financial organizations to expand credit support for businesses, promoting the development of venture capital and equity investment funds, encouraging the development of capital markets, such as securities and bonds, and diversifying financing channels for businesses.

Earlier, the Executive Meeting of the State Council of January 12, 2011 determined that the software and semiconductor industries were new national strategic industries, as well as vital foundations for the creation of an information-based society in China, confirming that these two industries retain an important strategic role in China’s policy objectives for the semiconductor industry during the 12th FYP period are to transform the industry into one of the world’s major development and manufacturing bases with sufficient capacity to satisfy the majority of China’s domestic demand, while achieving a certain level of exports, and to reduce the manufacturing process technology gap between China and the advanced nations.
China’s national and economic development outside the framework of the seven new industries. The State Council has therefore set out six policies to further the development of the software and semiconductor industries:

- Strengthen investment and financing
- Expand support for research and development
- Implement tax incentives
- Improve measures to retain and attract talent
- Strictly enforce IP rights protection
- Strengthen regulations to maintain market order

State Council Rule 4 (2011) issued January 28, 2011, is the most important core government policy for the development of China’s semiconductor industry during the 12th FYP period.


Of all the policies set out in Rule 4 (2011), those relating to tax incentives will be the most critical to the development of China’s semiconductor industry and most likely to affect investment in the industry. Rule 4 rescinds VAT incentives for semiconductor firms in favor of business tax breaks; expands corporate income tax incentives and extends them to include semiconductor package, testing, specialist materials and equipment firms. More importantly, instituting tax incentives through corporate income tax means that only profit-making businesses are eligible to benefit from them.

The shift in tax incentives seen in Rule 4 reflect the 12th FYP policy objectives of improving R&D and technology to create companies with strong technical capabilities and large output, a change in direction from 10th and 11th FYPs, which were focused on expanding capacity and output when companies were subsidized through tax incentives whether they were profitable or not. Henceforth, semiconductor firms will receive the support of national tax incentives as long as they are capable of making a profit, while firms that are unable to do so will find that the resulting lack of government support will make it difficult to invest in advanced process R&D or capacity expansion. This change in tax incentive policy may increase the degree of concentration in China’s semiconductor industry and indirectly work to accelerate mergers between companies in the industry.

Besides tax incentives, Rule 4 (2011) also includes several investment fundraising-related measures as another focal point for the development of the semiconductor industry. There are three government investment and policy measures that provide for government subsidies for semiconductor firms on the basis of individual projects on the basis of individual projects.
As part of the 12th FYP cycle, China’s Ministry of Industry and Information Technology (MIIT) published the 12th Five-Year Plan for the Development of the Integrated Circuits Industry in December of 2011. The following is a synopsis of the most significant main tasks, priorities, policy measures and goals that were included in the MIIT plan.

### Main tasks
- Concentrate force, pool resources and make breakthroughs in R&D for a number of generic critical technologies and key products.
- Grow key enterprises to be strong and exemplary and boost enterprises’ core competitiveness.
- Build a large industrial chain for chips and end products.

### Priorities
- Concentrate efforts to develop the chip design sector and develop high-performance IC products.
- Expand the size of the chip manufacturing sector and enhance advanced and specialty process capabilities.
- Boost levels and capabilities of the packaging and testing sectors and develop advanced packaging and testing technologies and products.
- Make breakthroughs in R&D of critical special equipment, instruments and materials.

### Policy measures
- Improve the efficiency in use of financial funds and expand channels of investment and financing.
- Push forward integration of resources and foster large enterprises with international competitiveness.
- Continue to expand opening to the outside world and improve the benefit of utilizing foreign investments.
- Strengthen talent training efforts and introduce overseas talents vigorously.

### Goals
- By the end of the 12th FYP period, the size of the industry will more than double. IC output will exceed 150 billion units. Sales will reach RMB 330 billion (US$51bn). The industry will achieve an average 18% growth, accounting for about 15% of the world IC market, and satisfying nearly 30% of domestic market demand (infers China’s consumption market will be 50% of the worldwide market).
- Cultivate 5–10 key design firms posting sales of over RMB 2 billion each (US$310M), with one firm ranking among the global top ten design firms (infers sales =/> US$2.6bn).
- Cultivate 1–2 key chip manufacturers posting sales of over RMB 20 billion (US$3.1bn).
- Cultivate 2–3 packaging & testing firms posting sales of over RMB 7 billion (US$1.1bn) ranking among the global top ten in the packaging & testing sector.
- Advanced design capabilities will reach 22nm, with over 30% of IC products developed by Chinese enterprises independently used in domestic key end-product applications.
- Large-scale chip manufacturing production technology will improve to 12-inch, 32nm process, gradually introducing 29nm process and mastering such specialty process technology as advanced high voltage, MEMS and SiGe processes.
MOCVD systems are responsible for the chemical processes used to manufacture LED chips and these subsidies had led to a massive increase of MOCVD installations and resulting concerns about excess LED capacity, artificially low costs, unfair competition and less concentration on the efficiency of the LED produced.

This five-year plan for the LED industry was largely constructed to combat those concerns, while also facilitating continued growth for the LED industry. The following is a synopsis of the most significant goals that were included in the MOST plan.

### Research and development
- A number of specific goals related to improving the efficiency of LED light bulbs and the effectiveness of the production process.
- Increasing LED efficiency and luminosity to impact their effectiveness for use in general lighting.

### Economy
- Raise the value of the domestic LED industry to RMB 500 billion (US$77bn) by 2015.
- Place China among the world’s top three global LED producers.
- Create two million new jobs through increased LED production.
- Form 20 to 30 new LED enterprises in China in the next five years.

### Environment
- Grow LED lighting to account for over 30% of China’s lighting market by 2015.
- Thereby saving 100 bn kWh of energy, using 35 million less tons of coal and reducing harmful emissions by 100 million tons.

### Planning and implementation
- Subsidies, introducing talented workers, international cooperation, support for research and development.
- Focus subsidies on several of the bigger firms with the most potential for technological advances.
that will be selective in nature. Only firms that have advanced technology and R&D capabilities should expect to receive subsidies from the government. There are five measures aimed at fundraising on the financial market that provide for diversifying financing channels that will enable the government to reduce its share of investment in companies by increasing the proportion of funds coming from private financing. The long-term goal of these measures extends from the 11th FYP objective to “create a semiconductor industry centered on private companies and possessing independently developed advanced technologies”.

For the 12th FYP period, China has launched ambitious policy initiatives to develop large domestic markets for specific next-generation technologies including mobile Internet, information-based household appliances, 3C (computing, communications and consumer applications) convergence, Internet of Things, smart grid and cloud computing. The government is also increasingly emphasizing indigenous innovation in government procurement programs in order to reduce dependence on foreign technology.

Among others, the following tax incentives clearly reflect the Chinese government’s focus on encouraging technological developments:

1. Reduced Corporate Income Tax (CIT) of 15% for new/high technology enterprises (NHTEs)
2. Super deduction of R&D expenses for CIT purposes
3. CIT exemption or reduction on income derived from qualified technology transfer
4. Different CIT holidays for software and integrated circuit (IC) enterprises
5. Immediate Levy, Immediate Refund VAT policy for software and IC enterprises

The effects of the relevant policies of China’s 12th FYP are projected to move China’s IC manufacturing industry in two key directions: increasing and accelerating concentration within the sector and increasing the number of firms funded from security market listings. The following trends are expected to result from those effects:

- Increasing number of Chinese IC design firms
- Increasing concentration of China’s IC design industry
- Increasing IC design share of China’s semiconductor industry revenue
- Mobile communications becoming central to China’s semiconductor industry technology and development
- Advanced packaging becoming a key technology for next-generation IT within the 12th FYP’s seven new strategic industries
- Increasing concentration of China’s IC wafer foundry industry
- Increasing Chinese government stake in IC wafer foundry firms
- Decreasing IC wafer foundry share of China’s semiconductor industry revenue

For the 12th FYP period, China has launched ambitious policy initiatives to develop large domestic markets for specific next-generation technologies including mobile Internet, information-based household appliances, 3C convergence, Internet of Things, smart grid and cloud computing.
We have not found a similar 12th FYP published for China’s discrete semiconductor industry. We have been informed that “neither MIIT nor any other government department has published a 12th FYP for China’s Discrete semiconductor industry because officers and scholars consider this industry as ‘low tech’ and it “may be kind of included in the IC 12th 5YP”. This seems to reflect an unusual oversight or significant change in strategic priority. China’s discrete semiconductor industry (without LEDs) had 2011 revenues of more than US$13bn, accounting for 30% of China’s semiconductor industry, 58% of the worldwide discrete market, and has grown at a greater than 20% CAGR for the last 10 years. It accounted for 20% of China’s current wafer fab capacity, and for more than 40% of China’s semiconductor packaging, assembly and testing facilities and capacity. It also has greater indigenous Chinese participation than China’s IC industry. How can it be ignored?

Financial markets and IPO funding

As noted in our recent Updates, China has emerged as a significant source of new companies and financial funding for semiconductor start-ups. According to Thomson Financial, Chinese domiciled companies represented the second largest group of semiconductor IPOs (initial public offerings) completed between 2005 and 2011. During that period, there were a total of 355 semiconductor IPOs completed worldwide, including 54 by South Korean, 86 by Chinese and 100 by Taiwanese companies. The 86 Chinese IPOs represented 24% of the number of IPOs and 44% of the proceeds realized. Prior to 2009, less than half of the Chinese IPOs were completed in China’s financial markets. That trend changed very significantly in 2009 with the opening of the Shenzhen Stock Exchange Small and Medium Enterprise (SME) Board and ChiNext Board.

Figure 27: China versus worldwide semiconductor IPOs, 2005–2011

<table>
<thead>
<tr>
<th>Year</th>
<th>Worldwide semiconductor IPOs</th>
<th>Chinese semiconductor company IPOs</th>
<th>Chinese market semiconductor IPOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2006</td>
<td>45</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2007</td>
<td>60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2009</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2010</td>
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<tr>
<td>2011</td>
<td>5</td>
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</tr>
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</table>

to facilitate fund-raising of small and medium-sized enterprises and growing venture enterprises. The ChiNext was launched in 2009 and offered a new capital platform for Chinese enterprises engaged in innovation and other growing industries. Even while other worldwide capital markets were still suffering from the global recession and contracting economy, there was a significant rebound of IPO activities in the Greater China capital markets in the second half of 2009. As a result, nine Chinese companies represented 25% of the 36 semiconductor IPOs completed in 2009 and 77% of the funds raised. Seven of those nine IPOs were completed in China’s financial markets, accounting for 75% of all worldwide semiconductor IPO funding raised during 2009.

That momentum continued through 2010, with 30 Chinese companies completing more than 70% of the 42 semiconductor IPOs completed in 2010, 26 in China’s financial markets and raising 72% of the funding realized. During 2010, China overshadowed the US and the rest of the world with the most technology IPOs—67 Chinese companies completed their IPOs in 2010 as compared to 19 US companies. China’s Shenzhen exchange displaced NASDAQ as the leading exchange for technology IPOs, accounting for 49% (53) of total deals and 40% (US$7.2bn) of total funds raised. China’s strong showing in 2010 was largely a result of its focus on technology manufacturing and the semiconductor and alternative energy subsectors.

While China’s predominance in technology IPOs continued through 2011, the global market for technology IPOs declined by 21% that year. The high volatility of capital markets during the summer of 2011—due primarily to the US debt and the Euro Zone

### Table 11: China versus worldwide semiconductor IPOs 2005–3Q 2012

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of IPOs</th>
<th>Proceeds (US$m)</th>
<th>% of worldwide</th>
<th>Proceeds (US$m)</th>
<th>% of worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>73</td>
<td>3,006.0</td>
<td>6.8%</td>
<td>407.9</td>
<td>13.6%</td>
</tr>
<tr>
<td>2006</td>
<td>91</td>
<td>3,663.8</td>
<td>18.7%</td>
<td>743.6</td>
<td>20.3%</td>
</tr>
<tr>
<td>2007</td>
<td>69</td>
<td>3,727.1</td>
<td>21.7%</td>
<td>1,109.5</td>
<td>29.8%</td>
</tr>
<tr>
<td>2008</td>
<td>28</td>
<td>1,693.6</td>
<td>3.6%</td>
<td>37.4</td>
<td>5.5%</td>
</tr>
<tr>
<td>2009</td>
<td>36</td>
<td>6,202.6</td>
<td>25.0%</td>
<td>1,308.9</td>
<td>77.3%</td>
</tr>
<tr>
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<td>4,493.6</td>
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<tr>
<td>1Q/12</td>
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<td>1,323.0</td>
<td>50.0%</td>
</tr>
<tr>
<td>2Q/12</td>
<td>10</td>
<td>372.0</td>
<td>7.4%</td>
<td>738.0</td>
<td>74.0%</td>
</tr>
<tr>
<td>3Q/12</td>
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<td>77.0</td>
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<td>282.0</td>
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</tr>
<tr>
<td>Total</td>
<td></td>
<td>21616.3</td>
<td>24.2%</td>
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<td>43.6%</td>
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</table>

**Chinese semiconductor company IPOs**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of IPOs</th>
<th>Proceeds (US$m)</th>
<th>% of worldwide</th>
<th>Proceeds (US$m)</th>
<th>% of worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>5</td>
<td>407.9</td>
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<td>13.6%</td>
</tr>
<tr>
<td>2006</td>
<td>17</td>
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</tr>
<tr>
<td>2007</td>
<td>15</td>
<td>1,109.5</td>
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<tr>
<td>2008</td>
<td>1</td>
<td>37.4</td>
<td>3.6%</td>
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<td>5.5%</td>
</tr>
<tr>
<td>2009</td>
<td>9</td>
<td>1,308.9</td>
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<td>1,308.9</td>
<td>77.3%</td>
</tr>
<tr>
<td>2010</td>
<td>30</td>
<td>4,493.6</td>
<td>51.4%</td>
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<td>72.4%</td>
</tr>
<tr>
<td>2011</td>
<td>9</td>
<td>1,323.0</td>
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<td>50.0%</td>
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<tr>
<td>1Q/12</td>
<td>7</td>
<td>738.0</td>
<td>7.4%</td>
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<td>74.0%</td>
</tr>
<tr>
<td>2Q/12</td>
<td>7</td>
<td>282.0</td>
<td>0.0%</td>
<td>282.0</td>
<td>75.8%</td>
</tr>
<tr>
<td>3Q/12</td>
<td>3</td>
<td>0.0</td>
<td>0.0%</td>
<td>0.0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>9423.9</td>
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<td>43.6%</td>
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**Chinese market semiconductor IPOs**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of IPOs</th>
<th>Proceeds (US$m)</th>
<th>% of worldwide</th>
<th>Proceeds (US$m)</th>
<th>% of worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
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<td>0.0</td>
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<tr>
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<tr>
<td>2007</td>
<td>7</td>
<td>37.4</td>
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</tr>
<tr>
<td>2008</td>
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<td>1,270.7</td>
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<tr>
<td>2009</td>
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</tr>
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<td>1Q/12</td>
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<td>282.0</td>
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</tr>
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<td>2Q/12</td>
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</tr>
<tr>
<td>Total</td>
<td></td>
<td>7227.7</td>
<td>15.5%</td>
<td></td>
<td>33.4%</td>
</tr>
</tbody>
</table>

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Chinese semiconductor company = domiciled in China

Source: Thomson Reuters 2010-2012
crises—significantly slowed the IPO market during the third quarter of 2011. China continued its dominance over the worldwide technology IPO market, with the most technology IPOs—49 Chinese technology companies completed their IPOs in 2011 out of a worldwide total of 86. However, the proceeds raised by Chinese technology companies declined by almost 30% in 2011 compared to 2010, while US companies posted healthy growth over quarter, reflecting decelerating economic growth. Similarly, worldwide semiconductor IPOs have dropped from ten in 1Q12 to four in 2Q12 and to only one in 3Q12. Although China had no semiconductor IPOs in 3Q12, they have had a total of ten semiconductor IPOs in 1Q and 2Q 2012, representing 67% of the worldwide total and 70% of the worldwide funding through 3Q12. At this point, it remains to be seen whether the technology IPO mar-

Over the longer term, it is still expected that China’s 12th FYP’s policies aimed at promoting different levels of market stock transfer mechanisms will help businesses to expand financial channels in phases as their operations grow in scale and provide more reasons to entice Chinese semiconductor companies to list themselves on the markets.

in 2011. Although China’s Shenzhen exchange remained as one of the top exchanges for technology IPOs, with a total of 35 IPOs (41%) in 2011, it declined in number of deals year over year by 30% and in proceeds raised by over 50% compared to 2010. China’s strong showing continued to be largely a result of its focus on both the internet software & services and the semiconductor and alternative energy subsectors. Correspondingly, nine Chinese companies represented more than 56% of the 16 semiconductor IPOs completed in 2011, seven in China’s financial markets, raising 50% of the funding realized.

After demonstrating healthy growth in 1Q12, with 30 IPOs, the worldwide technology IPO market declined sharply to 20 IPOs in 2Q12 and 11 IPOs in 3Q12, reflecting a lack of liquidity in the market and dampening investor confidence due to ongoing global economic uncertainty. China’s Shenzhen exchange, which had led the IPO market with the highest number of technology IPOs in each of the last several quarters, dropped to second place with only four IPOs in 3Q12 yielding proceeds that declined 77% quarter ket will pick up steam in 4Q12 or wait until the beginning of 2013, at which time uncertainties in global leadership will be settled.

Over the longer term, it is still expected that China’s 12th FYP’s policies aimed at promoting different levels of market stock transfer mechanisms will help businesses to expand financial channels in phases as their operations grow in scale and provide more reasons to entice Chinese semiconductor companies to list themselves on the markets.

Semiconductor patents

Intellectual property and intellectual property protection is an area of specific focus of China’s 12th FYP. One of the policy objectives of the 12th FYP for the semiconductor industry is to foster a group of semiconductor firms that will develop into global leaders in terms of both technology standards and market share. Rule 4 (2011) aims to create globally competitive Chinese semiconductor firms through seven policy areas that include one for IP protection policy. Further, Rule 4 (2011) reinforces the focus of the Chinese government to promote and support
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In addition to continuing existing tax incentives, including the reduced corporate income tax (CIT) rate of 15% for new/high technology enterprises (NHTEs), Rule 4 (2011) covers many new incentives including providing intellectual property protection.

One of the criteria for qualification for NHTE status is core proprietary intellectual property (IP) rights. Since 2005, China’s share of worldwide semiconductor technology-focused patents published by year has increased from 13.4% in 2005 to a peak of 21.6% in 2009 before declining to 17.7% and 18.2% in 2010 and 2011 according to data from the Derwent Worldwide Patent Database. China’s share declined further during the first three quarters of 2012, and is forecast to be about 14% for all of 2012. Perhaps more important is the gradual growth of China’s share in the first instance of a semiconductor patents publication, referred to as the patent basic statistic. China, which had no semiconductor patents basic issued in 2005 or 2006, started to grow its share of worldwide semiconductor patents basic issued from 1.3% in 2007 to 9.1% in 2011. China is forecast to account for about 5% of semiconductor patents basic issued during 2012. This means that for the past five years, from 2007 through 2011, 5% to 6% of patents on semiconductor inventions have been first issued in China.

Figure 28: China versus worldwide semiconductor patents 2005–2012

![Graph showing the number of published semiconductor technology patents and semiconductor basic (initial claim) patents for China and USA, along with their percent of worldwide, from 2005 to 2012.](source: Derwent 2012)
Further research with the Derwent patent data base reveals that most of these Chinese semiconductor patents are being issued to companies registered outside of China. The top 10 assignees, accounting for 20% of the 1,244 semiconductor technology patents issued in China in 2011, were the following multinational companies:

<table>
<thead>
<tr>
<th>Company</th>
<th># of patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSMC (Taiwan Semiconductor Manufacturing Co., Ltd.)</td>
<td>42</td>
</tr>
<tr>
<td>SEME (Semiconductor Energy Laboratory Co., Ltd.)</td>
<td>38</td>
</tr>
<tr>
<td>SMSU (Samsung Electronics Co., Ltd.)</td>
<td>30</td>
</tr>
<tr>
<td>IBM (IBM Corp.)</td>
<td>21</td>
</tr>
<tr>
<td>SHAF (Sharp KK)</td>
<td>21</td>
</tr>
<tr>
<td>DUPO (Du Pont De Nemours &amp; Co.)</td>
<td>18</td>
</tr>
<tr>
<td>PHILG (Konink Philips Electronics NV)</td>
<td>18</td>
</tr>
<tr>
<td>SONY (Sony Corp.)</td>
<td>16</td>
</tr>
<tr>
<td>SUMO (Sumitomo Chemical Co., Ltd.)</td>
<td>16</td>
</tr>
<tr>
<td>GLDS (LG Innotek Co., Ltd.)</td>
<td>15</td>
</tr>
</tbody>
</table>

Likewise, the top 10 assignees accounting for 24% of the 238 semiconductor patents basic (initial claim) issued in China in 2011 were the following mix of multinational and Chinese companies and institutions:

<table>
<thead>
<tr>
<th>Company</th>
<th># of patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Au Optoelectronics Corp. (Taiwan)</td>
<td>9</td>
</tr>
<tr>
<td>SMIC (Semiconductor Mfg. International Corp.)</td>
<td>9</td>
</tr>
<tr>
<td>Enraytek Optoelectronics Co. Ltd.</td>
<td>6</td>
</tr>
<tr>
<td>Suzhou Institute Nano-Tech &amp; Nano-Bionics</td>
<td>6</td>
</tr>
<tr>
<td>ITRI (Ind. Technology Res. Inst. Taiwan)</td>
<td>5</td>
</tr>
<tr>
<td>University Fudan</td>
<td>5</td>
</tr>
<tr>
<td>University Peking</td>
<td>5</td>
</tr>
<tr>
<td>University Qinghua</td>
<td>5</td>
</tr>
<tr>
<td>Chinese Acad Sci Changchun Inst. Appl. Che.</td>
<td>4</td>
</tr>
<tr>
<td>University Nankai</td>
<td>4</td>
</tr>
</tbody>
</table>
PricewaterhouseCoopers’ original 2004 report examined the effects that different levels of growth in the Chinese integrated circuit (IC) semiconductor industry would have on the greater industry. We used scenarios that spanned the time period of 2003 through 2010, and we also analyzed the developments, investments and milestones that would need to occur for China to achieve each level of growth during the forecast period. Finally, we predicted the likelihood that China would achieve each level of growth—conservative, moderate or aggressive—based upon then-current market conditions.

Figure 29: China’s integrated circuit production and consumption—12th FYP scenarios compared with actual

Source: CSIA CCID, World Fab Watch, PricewaterhouseCoopers
Since then, China has progressed through the last of its 10th and all of its 11th Five-Year Plan periods and the semiconductor industry progressed through more than one complete business cycle. Therefore, based upon those experiences and in conjunction with the start of China’s 12th Five-Year Plan, PwC revised the basic assumptions and business models used for our further scenario analysis of China’s IC industry.

The following is a concise summary of our analysis of new conservative, moderate and aggressive growth scenarios developed last year for China’s IC industry over the period from 2010 through 2015. The conservative and moderate scenarios reflect China’s capabilities, while the aggressive scenario reflects its stated intentions.

The conservative scenario is based upon an assumption that China completes and fully equips all current and the two committed IC wafer fab facilities that were under construction at the end of 2010 to 70% of their nominal capacity, ramps them into full production and operates them at a utilization and effectiveness that averages 90% of their 70% WFW nominal capacity. We estimate that 70% of nominal capacity is slightly more than the highest level equipped in China to date. That level was first achieved in 2009 and again in 2011 after declining to about 61% in 2010. This scenario further assumes that all of the resulting wafer fab output is packaged and tested in China in addition to the 2010 volume of imported wafer devices packaged and tested in China, and that China’s IC design sector grows at a 10% CAGR, slightly higher than China’s forecast GDP growth. This scenario would result in China’s IC industry growing at a CAGR slightly less than 5%, to reach revenue of US$27bn by 2015. It would require an additional investment of about US$4bn. The results of this scenario are almost the same as would result if China’s IC manufacturing sector grew at the same rate as the worldwide GDP, while China’s IC design sector grew at the same rate as China’s GDP. We believe this to be a less likely scenario, with about a 20% probability.

The moderate scenario is based upon an assumption that China completes and fully equips all the current and the two committed IC wafer fab facilities that were under construction at the end of 2010, ramps them into full production and operates them at a utilization and effectiveness that averages 90% of their WFW nominal capacity and earns an average of US$600 per 8-inch equivalent wafer. It further assumes that all of the resulting wafer fab output is packaged and tested in China in addition to the 2010 volume of imported wafer devices packaged and tested in China, and that China’s IC design sector grows at a moderately higher CAGR than the IC manufacturing sector to meet the MIIT’s 12th FYP objectives. This scenario would result in China’s IC industry growing at a slightly greater than 10% rate for the five years to reach revenue of US$34.5bn by 2015. It would require an additional investment of about US$13bn. We believe this to be the most likely scenario, with about a 65% probability. If, under this scenario, the IC design sector were to grow at CCID’s current forecasted 22.4% CAGR, China’s IC industry revenue would have increased at more than a 14% CAGR to reach US$42bn by 2015 for about the same capital investment.

The aggressive scenario is based upon an assumption that China completes and equips all current and the two committed IC wafer fab facilities that were under construction at the end of 2010 to 70% of their nominal capacity, ramps them into full production and operates them at a utilization and effectiveness that averages 90% of their 70% WFW nominal capacity. We estimate that 70% of nominal capacity is slightly more than the highest level equipped in China to date. That level was first achieved in 2009 and again in 2011 after declining to about 61% in 2010. This scenario further assumes that all of the resulting wafer fab output is packaged and tested in China in addition to the 2010 volume of imported wafer devices packaged and tested in China, and that China’s IC design sector grows at a 20% CAGR, slightly higher than China’s forecast GDP growth. This scenario would result in China’s IC industry growing at a CAGR slightly less than 5%, to reach revenue of US$27bn by 2015. It would require an additional investment of about US$4bn. The results of this scenario are almost the same as would result if China’s IC manufacturing sector grew at the same rate as the worldwide GDP, while China’s IC design sector grew at the same rate as China’s GDP. We believe this to be a less likely scenario, with about a 20% probability.
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The aggressive scenario assumes that China’s IC industry and IC design sector achieves the goals established by MIIT as part of China’s 12th FYP. Those goals were for China’s IC industry to achieve revenue of 330 billion RMB and China’s IC design sector to have revenues of 70 billion RMB by 2015. Based upon the same fully equipped, 90% utilization and effectiveness, and US$600 per wafer assumptions as used for the moderate scenario, these goals would require the addition of more than 10 large wafer fab facilities—as large as the Intel Fab 68 in Dalian—and an additional investment of US$21bn beyond the US$13bn required for the moderate scenario, for a total investment of almost US$34bn. Achievement of the MIIT 12th FYP goals will require China’s IC industry to achieve an 18% CAGR for the five-year period through 2015. We believe this to be the least likely scenario, with a 15% probability.

The IC consumption scenario is based upon China MIIT’s 12th Five-Year Plan expectations for 2015 coordinated with the CSIA forecast for the earlier years.

**Performance versus scenarios**

China’s 2011 IC consumption market grew much faster than the worldwide market, but, when measured in local RMB currency, missed the CSIA forecast by almost 3%. However that miss was more than offset by a 5% gain in the RBM exchange rate, so that when measured in US dollars, China’s actual 2011 IC consumption market grew almost 2% faster than the CSIA/MIIT scenario forecast.

China’s 2011 IC production dollar revenues exceeded the moderate scenario by more than 3%, but with significant diversity among its three sectors. IC design, which grew at 36%, far exceeded even the aggressive scenario, while IC manufacturing, which grew at 14%, exceeded the moderate but not the aggressive scenario and IC packaging and testing, which grew by less than 2%, missed even the conservative scenario as well as the moderate and aggressive scenarios.

During 2011, almost US$8bn of additional fixed-asset investments were made in China’s semiconductor industry. Of that amount, almost US$5bn was invested in the integrated circuit (IC) industry, which will clearly support the moderate scenario, but could be short of the aggressive scenario requirements.

At this point, we continue to believe that the moderate scenario remains the most likely, with at least a 65% probability of realization. There could be a upside if the new Samsung NAND wafer fab is completed and ramped into full and integrated production faster than projected as it could positively affect both production volume and technology-driven wafer average selling price.
If your company is facing challenges doing business in China, or you just want to have a deeper discussion about what’s happening in the market and how we can help, please reach out to one of the technology industry leaders listed below.

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The Technology Institute is PwC’s global research network that studies the business of technology and the technology of business with the purpose of creating thought leadership that offers both fact-based analysis and experience-based perspectives. Technology Institute insights and viewpoints originate from active collaboration between our professionals across the globe and their first-hand experiences working in and with the technology industry. For more information please contact Raman Chitkara, Global Technology Industry Leader.

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