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碩士論文

Master's Thesis

台灣 DRAM: 曾經高成長產業的族群面臨困難抉擇

Taiwan DRAM: Tough Choices in an Ex-growth Industry

Student: Marcos D. Torres

Advisor: Professor Jack Wu

中華民國一百年四月

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Abstract

Taiwan DRAM: Tough Choices in an Ex-growth Industry

By

Marcos D. Torres

This case is intended to be used in an Strategic Management or Strategic Alliances course to highlight the challenges faced by second tier industry players in a capital intensive industry with complex alliances and increasingly severe industry cycles.

The DRAM industry has become an ex-growth highly cyclical industry which requires high amounts of capital expenditure and scale to succeed. Taiwan DRAM companies have been facing unsustainable trends already for sometime as operating cash flows have failed to match capital expenditures even during the good times of the "Tech Bubble" of the late 1990s. The situation of DRAM companies deteriorated in the late 2000s as players over estimated Windows Vista related demand for DRAM and over invested. The situation worsened still further as the Great Recession caused a slump in world wide demand.

The situation of Taiwanese DRAM companies was very dire despite the exit of several companies from the industry during the Great Recession. The Taiwanese government attempted to lead a consolidation in the industry but failed as companies lost interest in its proposal due to several reasons and an upturn in the industry cycle. However, the DRAM cycle seemed to play out itself rather quickly as companies once again invested heavily to remain competitive. The investment and still fragile industry led to increased supply, lower prices, and the return of financial difficulties. All the while, the leading

players in the industry, mainly Koreans, keep gaining market share and increasing their technological gap versus industry peers. Finally Elpida of Japan apparently prepares another attempt at consolidating the industry.

The alliances in the industry constantly change, face challenges, and adapt to each twist and turn in the industry. Despite deepening alliances the fate of Taiwanese DRAM companies appear very bleak. Tough choices will have to be made in the near future as the market seems to head for another down turn while Elpida apparently prepares to make new consolidation/alliance offers. Should the Taiwanese DRAM companies attempt an industry exit such as the one executed by Winbond, should they further deepen their alliances, or just go it alone?

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Marcos D. Torres

“This is a horrible, terrible business that no one should be in, the way it’s organized currently. You get some incremental profits for a little while, then everybody moves in and there’s oversupply again.” Avion Cohen, managing partner at Avion Securities. 1.

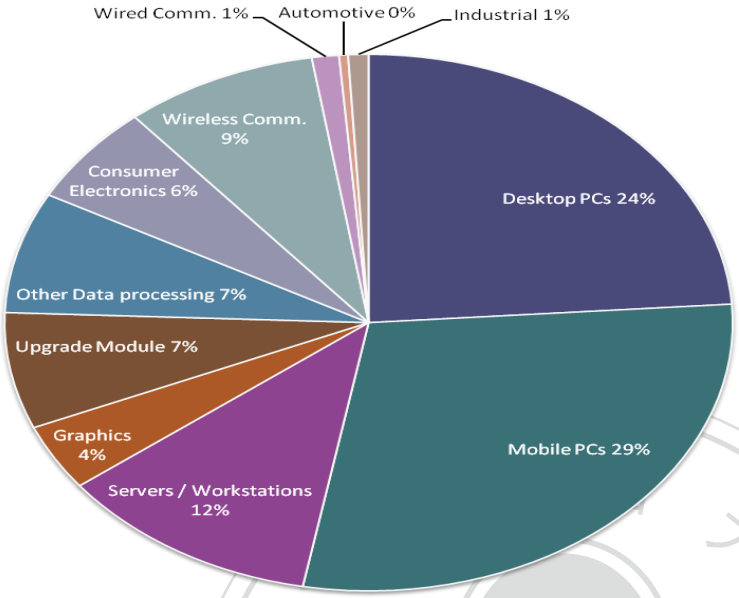
“The previous down cycle really killed the Taiwanese, they literally lost all the capability for future investment. That’s why if you look at the current technology, they’re so behind.” George Chang, an analyst at Yuanta Securities Co 2.

“It’s almost impossible for the Taiwanese to survive by themselves. Without doing something, it will be tough for us to survive, too. We don’t have the scale.” Elpida president Yukio Sakamoto. 2.

1.The DRAM Industry

Dynamic Random Access Memory (DRAM) is a type of memory semiconductor that temporarily saves data by storing it as an electronic charge in a capacitor. Because DRAMs outperform other memory semiconductors in combining higher memory density with faster speeds they are used today as the main memory in PCs, servers, mobile devices, digital consumer electronics and many other kinds of information-communication and electronic equipment. 3 In 2009 the PC and computing segment of hardware consumed about 90% of global DRAM production. 4.

Exhibit 1: 2009 Global DRAM Demand by Application (Revenue)



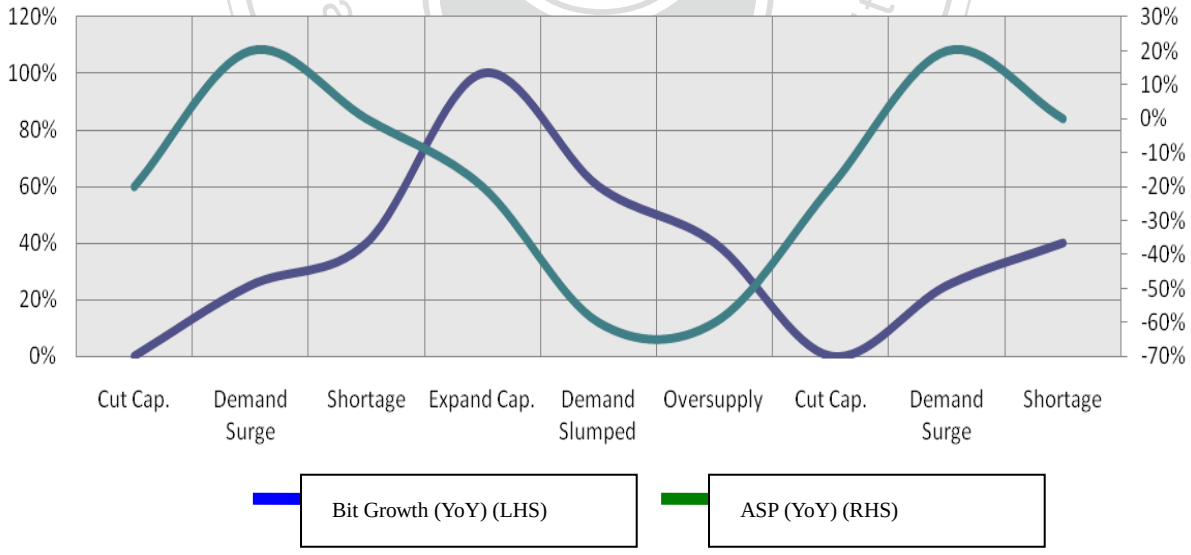
Source: (SinoPac Securities, 2010)

1.1 The Typical DRAM Industry Cycle

According to DRAM industry analyst Ryan Chen of SinoPac Securities the DRAM industry cycle can be divided into 6 general stages: capex cut, demand surge, shortage, capex expansion, demand slump, and oversupply. During the capex cut stage the industry players cut capex and UTRs (utilization rates) aggressively as losses mount due to lower ASPs (average selling prices) caused by a recession in the industry. Every recession is usually followed by a period of stability and stock rebuilding. The stock rebuilding is also often accompanied by an industry demand surge as the economy and industry recovers. During this time ASPs rise and companies react by raising UTRs as quickly as possible (it takes around 2 months to ramp up idle equipment in a DRAM fab). As the economy recovers the industry often encounters a shortage situation when companies in the industry have fully ramped up UTRs to 100% and cannot satisfy the market. The shortages cause ASPs to rise and

companies tend to respond by expanding capacity along with investments in more advanced manufacturing technologies which increases efficiency and production output. The investments in expansion and more efficient technologies lead to high bit growth which help to satisfy demand growth which in turn also stabilize ASPs. As new more efficient capacity comes online into the industry ASPs often begin to fall at a faster rate due to a combination of increased supply and lower demand from a petering out of the macro-economic cycle. The situation of increased supply, often accompanied by lower demand growth leads to the oversupply stage. Despite the increasing rate of ASP erosion at this stage companies in the industry will continue to run their fabs at 100% utilization as long as they make money in order to recoup the high depreciation of their capital investments. Eventually the industry starts to run into losses and the 6 stage cycle starts again as companies aggressively cut capex and UTRs. 5.

Exhibit 2. The DRAM Industry Cycle



Source: (SinoPac Securities. 2010)

1.2 The Windows Vista Cycle

The launch of Windows Vista in 2006 sparked an un-typical DRAM industry cycle which lasted until 2009. With the anticipated launch of Windows Vista, DRAM

producers rushed to double their production capacity on expectations that the new operating system would follow the previous memory growth patterns. However, it was later realized that the move to Windows Vista required no more memory growth than the normal trend for software upgrades. 4.

Exhibit 3. New OS release overview.

	Windows 95	Windows 98	Windows 2000	Windows XP	Windows Vista Home Basic	Windows Vista Home Prem
Release	Aug 1995	Jun 1998	Feb 2000	Oct 2001	Jan 2007	Jan 2007
Processor	80486 or above	66Mhz	133Mhz	300Mhz	1Ghz	1Ghz
Recommended DRAM specification	8MB	24MB	64MB	64MB~128MB	512MB	1GB/2GB
HDD	50MB	500MB	650MB	1.5GB	20GB	40GB
Actual average DRAM content (cost)	7MB ($185)	40MB ($61)	94MB ($100)	216MB ($27)	746MB ($70)	746MB ($70)
Actual contents relative to recommended specification when launching new OS	0.88	1.7	1.5	3.4~1.7	1.5	0.7~0.35

Source: Gartner. Woori I&S Research Center estimates

Source: (Woori Investment & Securities. 2009)

On the wake of Windows Vista's launch DRAM makers rushed to expand capacity in 2006. By 2007 capex spending in the DRAM industry equaled nearly 73% of the industry's total revenues, leading to a supply growth of 90% for that year. 4.

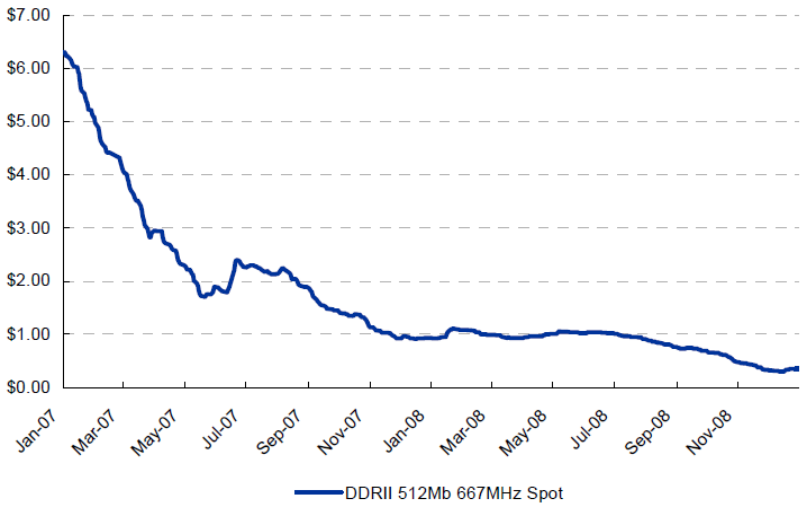
Exhibit 4. Worldwide Wafer Starts

Source: (SinoPac Securities. 2010)

Jim Handy, director of Objective Analysis, a chip industry research firm noted that it takes two years from the actual spending before the new capacity reaches full volume production. Thus the onset of the Windows Vista overcapacity started in early 2008, two years after the 2006 spending spree commenced."1.

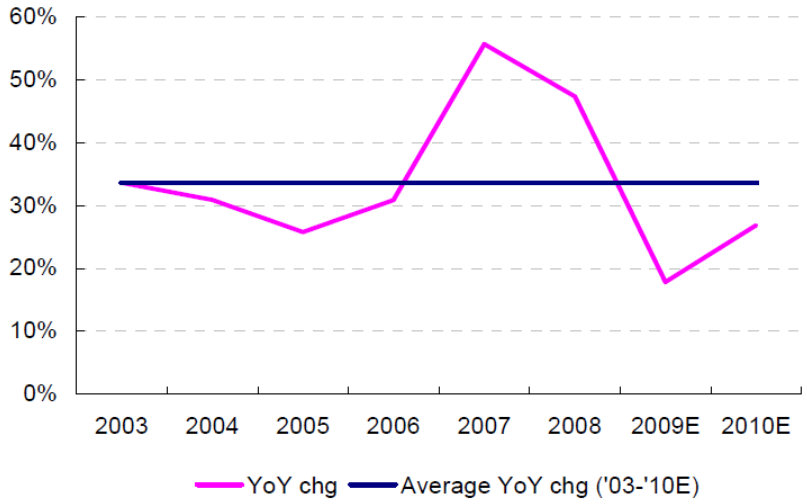
Disappointment of Windows Vista followed after additional capacity was built as sharp DRAM price declines followed. The computer industry absorbed the extra capacity in 2008 and 2009 as PC makers were spurred to offer higher amounts of DRAM with their products. Despite this, DRAM makers' margins and balance sheets collapsed on the lower prices. The ensuing global economic recession drove the DRAM downturn deeper as demand for DRAM weakened even more. (Exhibit 5)

Exhibit 5. DRAM Prices – Virtually Given Away (2007-08)



Source: (Morgan Stanley. 2009)

Exhibit 6. DRAM Content per PC



Source: (Morgan Stanley. 2009)

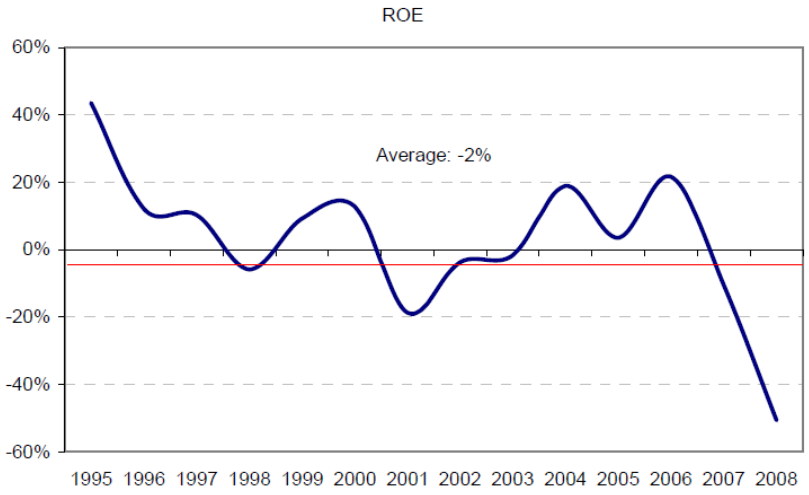
2. Taiwan DRAM and Past Unsustainable Trends.

Taiwan DRAM's 'hey day' was during the 1995-2000 "tech bubble" when the Taiwan DRAM industry generated around 8% ROE. However, balance sheet trends for the group, despite the 'hey day', was unsustainable as cash flows of US$3bn were still below the accumulated capex of US$5bn for the period. After the tech bubble burst, during 2001-2008, Taiwan's DRAM companies generated -5% ROE. Cumulatively, from 2001 to 2009, Taiwan DRAM's accumulated operating cash flows of US$13bn were well below the accumulated capex of US$23bn. It was obvious that Taiwan's Memory industry could not generate sufficient cash flow internally to fund its capital spending. The Taiwan DRAM industry had not only destroyed shareholders' capital but also wasted banks debt funding.

In an industry report, Mr Wang and Mr.Su of Morgan Stanley painted a gloomy picture for Taiwan DRAM as the industry had become ex-growth by the end of the first decade of the 21st century. The DRAM industry had become ex-growth because desktop PC, the main driving force for DRAM demand was starting to see declines in

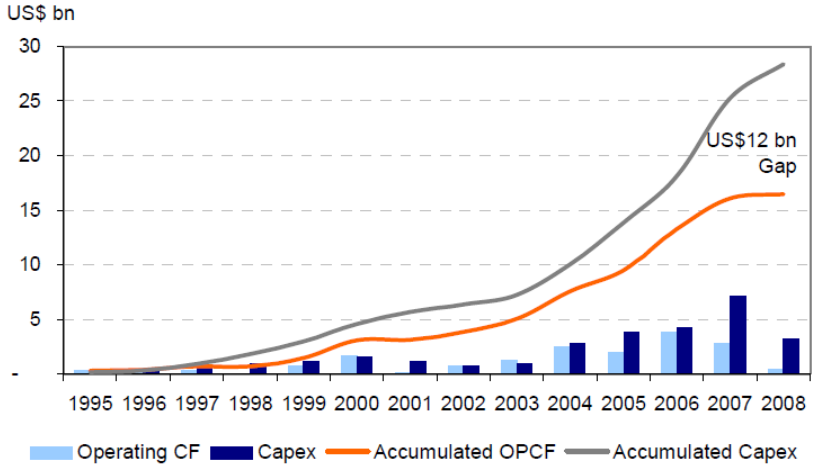
unit shipments on notebook replacement and the proliferation of netbook PCs as the latter required a lot less memory. 6

Exhibit 7. Taiwan DRAM's Infamous Past of (-2%) ROE Since 1995



Source: (Morgan Stanley. 2009)

Exhibit 8. Taiwan DRAM Never Earned Enough Cash Internally to Cover its Invested Capital (1995-2008)



Source: (Morgan Stanley. 2009)

2.1 State of Taiwanese DRAM Makers after Windows Vista

The latest Windows Vista cycle and the Great Recession were particularly terrible for Taiwanese DRAM makers. All of Taiwan's DRAM makers had posted three years of losses between 2006 and 2009, forcing them to scale back investments, and leading them to lag technologically to the other players in the industry. As a result of the scale-down in investment Taiwan's top four DRAM makers saw their combined market share slip to about 10% at the end of 2009 from 17% in 2006. 2.

Liu Szu-liang, a DRAM analyst with Taiwan based Yuanta Investment Consulting, echoed his JP Morgan peers by painting a gloomy future for Taiwanese DRAM firms. In October 2009 he noted that while some Taiwanese DRAM companies survived the last industrial slump in 2000, there was a low possibility that they could make a comeback after the latest slump. "Most Taiwanese DRAM makers may be forced out of the market in the foreseeable future. They have lagged far behind their global rivals in technology and are unable to catch up."7.

3. The Companies

The global DRAM industry had shrunk remarkably in the number of players since 1996 when there were 24 active companies. 9 companies entered the period of the Great Recession in 2008, but only 7 were to be left standing in 2010. Recently the industry has been led by 4 technology leaders: Samsung, Hynix, Micron and Elpida. The four lead the industry technologically while the Koreans (Samsung and Hynix) also lead in market share. Elpida and Micron, which lagged technologically and in market share to the Koreans allied themselves with Taiwanese companies. Taiwanese DRAM companies are divided into two technology camps. The Elpida camp and the Micron camp. The Elpida camp is composed of Elpida (which serves the role of technology provider), Powerchip (serves as commodity foundry), Rexchip (serves as a subsidiary), Winbond (serves as graphics foundry), and ProMOS (serves as a

commodity foundry). The Micron camp was less diverse and was composed of Micron (which served the role of technology provider) Nanya Tech (capital provider via the Formosa Petrochemical Group) and Inotera (a production JV between Micron and Nanya). 8.

Exhibit 9. 1996: 24 companies. 2010: 7 companies

1996		2010
Samsung	Powerchip	Samsung
Hyundai	ProMOS	Hynix
Micron	Winbond	Micron
Siemens	Oki	Elpida
NEC	IBM	Inotera
Hitachi	TI	Powerchip
Mitsubishi	Motorola	ProMOS
Toshiba	Matsushita	
Fujitsu	Seiko Epson	~~Qimonda~~
LG Semicon	Nippon Steel	~~Winbond~~
TI-Acer	UMC	
Vanguard	Mosel Vitelic	

Source: (SinoPac Securities. 2010)

3.1 Samsung

The semiconductor division of Korea based Samsung Electronics is the world's largest memory chip and second largest semiconductor manufacturer worldwide. By 3Q09 Samsung's DRAM global market share stood at 32.4%.

Samsung's memory business strategy of taking the leadership in investment in new manufacturing processes, allowed it to be the first to move to advanced semiconductor process geometries. Samsung had been leading the advancement of DRAM technology ever since it developed the industry's first DDR DRAM in 1997.

In 2001, the company introduced the first DDR2 DRAM and in 2005, it announced the first DDR3 DRAM using 80nm-class technology. 9. Samsung's leadership in technologically superior production processes led it to become one of the most profitable DRAM companies thanks in part to lower production costs.

3.2 Hynix

Korea based Hynix Semiconductor manufactures semiconductors such as DRAM and NAND flash memory. By 3Q09 Hynix was the 2nd biggest DRAM provider world wide with a market share of 23.4%. At that time, around 80% of Hynix's revenues were derived from DRAM and around 2% came from NAND. 10. The company is a survivor of previous DRAM routs, nearly collapsing twice under mountains of debt only to be bailed out by creditor banks and by the government. 11

In early 2005 Hynix formed a strategic alliance with Promos of Taiwan for DRAM manufacturing technology licensing and a 300mm wafer foundry. The alliance allowed Hynix to secure stable 300mm capacity using its own technology without any additional investments. 12. The alliance expanded in 2008 when ProMOS signed an agreement, securing Hynix`s pledge to transfer 54-nm process technology and inject NT$6 billion (US$181 million at US$1:NT$33) into the firm for a seat in its board of directors. 13.

In 2009, however, Promos ended its long-term partnership with Hynix Semiconductor after Promos made a deal with Elpida to manufacture chips based on Elpida's designs. ProMOS executives explained the partnership with Hynix was cancelled based on the concerns that Hynix's 54-nm tools demanded a lot of capital, which would have compounded the company`s struggling financial situation.

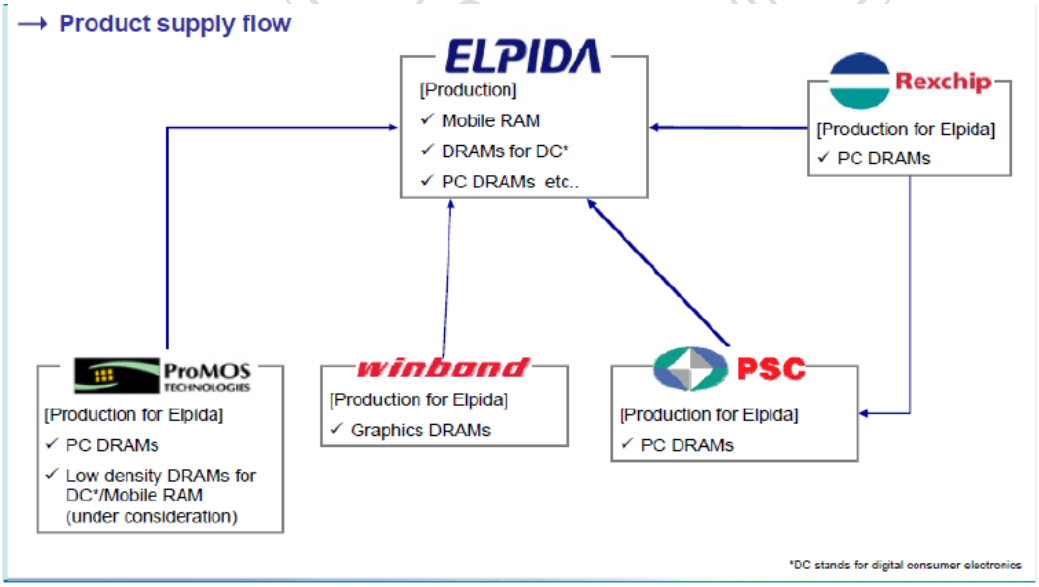
ProMOS, however, remained eligible to use Hynix`s 90-nm, 70-nm and lithographed 70-nm processes it had already licensed. 13.

3.3 Elpida

Japan based Elpida is the third largest DRAM maker worldwide with a market share of 20% (Third Quarter of 2009). Elpida's DRAM portfolio includes applications for personal computers, severs, mobile devices, and digital consumer electronics. The company has a flexible product portfolio, including standard DRAM, mobile DRAM, GDDR and NAND flash.

Elpida has strong ties with Taiwan's DRAM makers, which allow Elpida to expand capacity without raising capital expenditures. Elpida has a 65% stake in Rexchip, a joint-venture with Powerchip, and established strong ties with ProMOS and Winbond. 14.

Exhibit 10. Elpida Strong ties with Taiwan DRAM makers



Source: (Fubon Research. 2011)

In June 2009 the Japanese Government put together a package of $1.7 billion in public and private money for Elpida to deal with financial difficulties brought on by the great recession and the hang over effect from the Windows Vista overexpansion. Japanese officials feared that Elpida's demise would force domestic manufacturers to rely on overseas rivals like Samsung Electronics 15.

3.4 Rexchip

Rexchip is a Joint Venture between Powerchip and Elpida Memory. Rexchip is 34%-owned by Powerchip, while Elpida holds a 65% stake. **16.** As of 2010 Rexchip ran a 12-inch plant with a monthly capacity of 80,00-85,000 wafers, and uses Elpida's 40nm-class stack design as its major process technology. Powerchip accounts for about 34% of Rexchip's shipments. 17.

3.5 Powerchip

Powerchip Semiconductor Corporation is the second largest in Taiwan and 6th in the world with 3.8% Global market share (3Q09). The company specializes in DRAM chips used in computers. In order to increase PSC's international competitiveness and technological strength, PSC upon its establishment initially established a strategic alliance with Japan's Mitsubishi Electric. Today PSC partners with Japan's Elpida for the production and marketing of DRAM products. PSC also collaborates with Japan's Renesas Technology Corporation as a major foundry provider for Renesas' System LSI products. Since 2006, Elpida and PSC started joint development of 50nm DRAM process technology. In December of 2006, Elpida and PSC signed a memorandum of understanding, to establish the joint venture Rexchip Electronics Corporation. 24.

3.6 Micron

U.S based Micron is a global manufacturer and marketer of semiconductor devices, principally DRAM, NAND Flash and NOR Flash memory, as well as other memory technologies, packaging solutions and semiconductor systems. The company is the 4th largest DRAM supplier in terms of market share (11.1% on 3Q09).18.

Micron replaced Qimonda in the Inotera JV with Nanya Tech after Micron purchased Qimonda's 35.6% stake in Inotera Memories on 1Q09**.** Two members of Taiwan's Formosa Plastics Group played a crucial role in the transaction amid the credit crunch prevalent in the financial crisis by loaning US$285 million to Micron Technology to strengthen a new joint venture with the U.S. company and speed up the development of advanced chip manufacturing lines **19.**

By Mid 2009 Micron recorded its 10th consecutive quarterly loss. In the last two and a half years, the company's net losses totaled about $3.8 billion. At the time the company announced plans to lay off 20% of its work force and the closure of a plant.1.

3.7 Inotera Memories

Inotera was incorporated in 2003 as a JV between Nanya and Qimonda. The Qimonda stake was acquired by Micron after Qimonda went bankrupt. Inotera's primary business objective today is to provide wafer manufacturing process for Nanya and Micron. Thus, Inotera does not sell its products to external customers such as PC OEMs. As of 2011 , Nanya Tech and Micron both hold 29% shares of Inotera and share its wafer products at a 50:50 ratio, and then manage necessary back-end process to get finished DRAM chips. 20.

3.8 Nanya Tech

An affiliate of the Formosa Plastics Group, Nanya Technology is Taiwan's largest DRAM manufacturer and the 5th largest globally with a 6-7% global market share(3Q09). Differing from Powerchip, Nanya focuses more on promoting its own-brand DRAM products in the contract market. The company manages Inotera, a 300mm JV with Micron. 21.

The company conducts research and development, design, manufacturing, and sales of DRAM products. Nanya Tech enjoys financial support from the Formosa Plastic Group and technology support from Micron. 22. 50 to 60% of Nanya Tech's commodity DRAM capacity comes from Inotera. 23.

3.9 Promos

ProMOS Technologies is Taiwan's third-largest maker of computer memory chips. It ranks 7th worldwide with 1.5% market share (Third quarter of 2009). A notable development for Promos in 2009 was a deal the company made to manufacture chips based on Elpida's designs, after having brought an end to its long-term partnership with Hynix Semiconductor. Under the deal Elpida agreed to provide DRAM manufacturing technology to ProMOS; while ProMOS was to perform foundry for Elpida on profit-loss sharing basis. ProMOS aimed to start 65nm-XS pilot run in 1H10 and to start mass production in 2H10. ProMOS aimed to account for 15-20% of Elpida's total DRAM shipments and to maintain foundry partnership for Elpida on 40nm and 65nm 4F2 technology in the future. Both companies benefited from the deal as Promos utilization rate would get a boost and Elpida would secure DDR3 supply. 8.

3.10 Qimonda

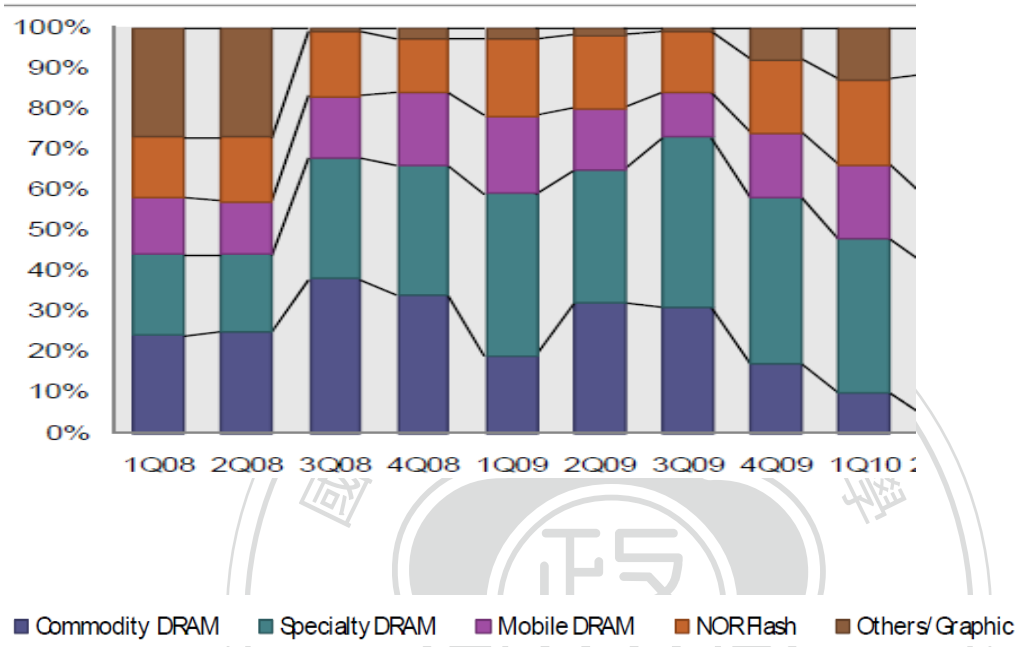
German based Qimonda exited the DRAM industry in 2009. At the time of its bankruptcy Qimonda ranked 7th in the DRAM industry with a market share of around 4%. The company had more than 12,000 workers worldwide. Qimonda had faced severe financial difficulties after the Windows Vista over expansion and the following Great recession. The company had managed to secure in December 2008 a rescue package of US$421.98 million in loans from the government of Saxony, parent company Infineon and a Portuguese state bank in order to try and stave off collapse. But the financing package failed to materialize in time to solve its problems. The company declared bankruptcy the following month (January), saying the rescue package of loans agreed to the previous month was insufficient to keep it viable. 25.

3.11 Winbond

Another company that exited the DRAM industry, but in a less spectacular manner was Winbond. Winbond aimed to turn itself into a specialty memory integrated design manufacturer (IDM) after the latest DRAM industry decline. After the bankruptcy of Qimonda, which was Winbond's DRAM technology partner, Winbond drew up its new strategy to spark a turnaround. Winbond planed to exit the DRAM business, which suffers from high price volatility and huge capital expenditures, and restructure itself as a specialty memory IDM company. By May 2010, commodity DRAM accounted for 10% of the total revenue and was expected to drop to 0% in the second half of 2010. The original capacity allocated to DRAM production was to be substituted by four main product lines: specialty DRAM, NOR flash, mobile RAM and graphic DRAM. By making a transition into a specialty memory company,

Winbond hoped to sustain stable growth. 26.

Exhibit 11. Winbond: Quarterly Product Mix



(SinoPac Securities. 2010)

4. Enter TMC: The Government's attempt at consolidation.

Taiwan's memory chip makers were heavily affected by the most recent DRAM slump and lost 5% of their market share over the previous six months up to February 2009. 27. In order to help the ailing national DRAM companies the Ministry of Economic Affairs (MOEA) announced the formation of TMC (Taiwan Memory Company) in March 2009 to spearhead efforts to consolidate the island's struggling DRAM chip sector into a single company while bringing in technology from Elpida or Micron with the hope that the new entity could continue to develop its own DRAM technology and compete with global giants such as Korea's Samsung and Hynix. 28. The government aimed to invite private investors to invest in the new

company, with the state owning less than 50%. 29.

The proposal to form TMC as an independent entity was aimed at restructuring rather than bailing out the cash-strapped chipmakers. 28. The government's view at the time was that the DRAM crisis was beyond the solution of a traditional rescue plan and needed a complete re-building of the business model. It aimed to inject minimal capital for maximum return focusing on industry-wide restructuring for long-term success, instead of an individual company bail-out. 6.

The ministry of economic affairs named former United Microelectronics Corp. executive John Hsuan to head the state-backed company. 30. A New York Times article quoted him stating that "The key is to secure and develop own technology in the future and then promote it to international level,". 29. Mr Hsuan's main tasks included: 1) coordinate set-up of the new TMC management team; 2) negotiate with Micron and Elpida for the best terms; 3) engage with the Government Development Fund and other potential investors; and 4) recruit talent in management, technology, design, and finance. The mandate is for TMC was to finalize Elpida or Micron's negotiations by June and complete the formation by September 2009 including consolidation and investments. 6.

In April 2009 both Micron Technology and Nanya Technology, along with their joint venture Inotera memories, opted out of discussions to be part of the new TMC led group. For Micron's part, the company wasn't comfortable with the risk of its

technology IP potentially leaking out if multiple patent holders began working under TMC. Micron stressed that its IP portfolio for specialty DRAM was more advanced than Elpida's, who was one of TMC's participants. At the time Micron, Nanya, and Inotera said they would continue to develop and improve their own partnership in preparation for competition from the new memory company. 31.

After Micron's announcement, it seemed that Taiwan's DRAM industry, with the entrance of TMC, was looking to still end up divided into two camps. One led by Elpida and TMC and the other led by Micron.

In September of that year Taiwan Memory Company (TMC) announced a deal in which it agreed to partner with Promos in chip production and R&D. Promos soon after indicated that it would cancel its unpaid leave program in October. Promos employees had been taking several days of unpaid leave each month since November 2008. UMC, which had been investing in Promos since June 2007 and become the second largest shareholder with a 7.03% stake was to cooperate with TMC to integrate the Memory chip supply chain. 32.

By October 2009, apart from the Promos deal, TMC had made little headway since a consolidation plan was unveiled in March apart from saying it was seeking a partnership with Elpida Memory. At that time DRAM prices had rebounded thanks in part to demand following the launch of Microsoft Corp's Windows 7. Global DRAM prices leaped 21 percent quarter-on-quarter in the third quarter of 2009, after a rise of 19 percent in the previous quarter. The second-quarter price rebound marked the first since the fourth quarter of 2006 ." Meanwhile Taiwan's major DRAM makers — Nanya Technology, Powerchip, Inotera Memories and ProMOS Technologies — had seen monthly revenues rise by 15 percent per month for the three months

between July and September 2009. 7.

Some industry experts such as Liu Szu-liang, a DRAM analyst with Yuanta Investment Consulting started to be quoted by the media saying that "The government's efforts are destined to be a flop" as "The optimal timing for consolidation and securing technological support from outside had passed." As he saw it almost impossible now to bring DRAM representatives back to the negotiating table as rebounding demand ignited their new hope of making a comeback without government controls 7.

On November 11th 2009 TMC received a blow after the Legislative Yuan of the Republic of China concluded that the Taiwan Economic Bureau was not allowed to invest in TMC. Later on, the Taiwan Economic Bureau announced that the DRAM reformation plan had ceased. According to Digitimes, TMC and Elpida's collaboration might also be cancelled as the Taiwanese government would not inject money into TMC and thus to Elpida.

SinoPac Semiconductor analyst, Sophie Chuang, opined at the time that the key issue to the unforthcoming government support was that other players in the industry (e.g. Micron and NanyaTech) saw the action as unjust. Moreover, Elpida's unwillingness to give up essential technology was also deemed critical to the government's decision. 33.

5. The Windows Vista Cycle recovery

TMC's failure was due in part to recovery in the industry which started in mid 2009 as the weakest producers shut down production, prices improved, margins expanded,

lessons were declared learned, and promises of no new capacity were made, except for improving production costs. 4.

Micron executives were optimistic in mid 2009 as their cash flow was improving. Moreover, Microsoft was about to release a major upgrade, which many in the industry believed should prompt many PC users to buy new machines that will be equipped with better memory chips made by Micron and others. Micron and Samsung had the lowest cost to produce, and were the only two companies generating cash at the time. Credit Suisse analyst John Pitzer stated in The New York Times that as the recession eased and corporations upgraded their PCs to the coming Windows 7 software from Microsoft DRAM demand would rise. He also noted that the installed base of PCs needed to be upgraded as over the previous nine months to July 2009, since the economy went into a recession, I.T. spending on new equipment had virtually stopped 1.

By the second quarter of 2010 the DRAM industry continued to improve as industry revenues had soared to US$10.8 bn, up 14.4% quarter on quarter. The industry seemed to have fully recovered to pre-financil crisis levels as iSuppli noted that 2Q10 was the best that the industry had seen since the end of 1995. Shipments for the period came in at 3.56 billion 1Gb-equivalent units, the highest level ever. Likewise, the US$3.03 Average selling prices for all DRAM parts was unequalled since the third quarter of 2008. 34.

Heading further into the middle of 2010, Elpida started echoing Micron's optimism at the prospects for 2010. "This year will be a good year for the DRAM industry," Elpida president Yukio Sakamoto said, citing supply constraints. "PC demand is very

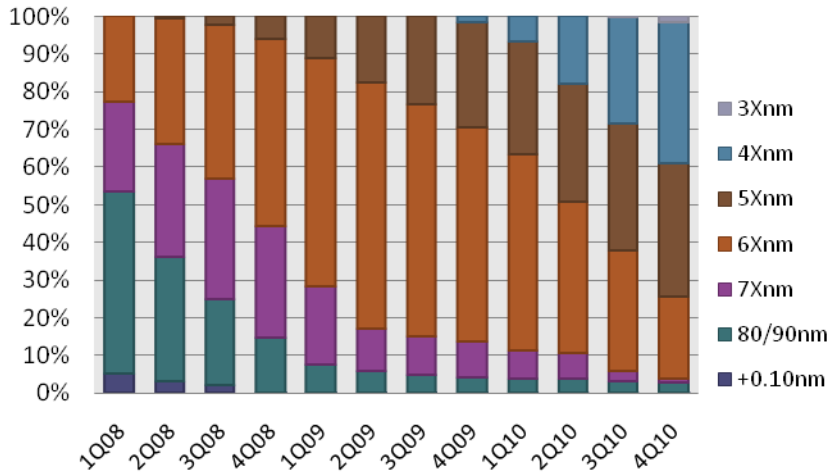
strong.” At the time he made the statements based on his estimate that global DRAM capacity would grow between 30% and 40% year-on-year, while demand would increase by more than 50%. 35.

Powerchip was also feeling positive and planed to pay back its huge debt with the target of becoming a debt free company by the end of 2012. At the time Powerchip aggressively targeted to lower its debt-to-asset ratio to 30% in 2011 from 75% in 1Q10 and become a debt-free company by the end of 2012. 36.

6. The Geometry Migration Race.

During the recovery phase of the up-cycle, as in previous ones, producers were mostly concerned with applying the latest process technologies in order to cut costs and expand profit margins rapidly. More importantly, laggards’ primary concern was the expanding technology gap with the industry leader Samsung. Generally speaking, chipmakers can double the output of a 12-inch factory by migrating. to 50-nanometer technology from 75-nanometer, saving 50 percent on costs.36.

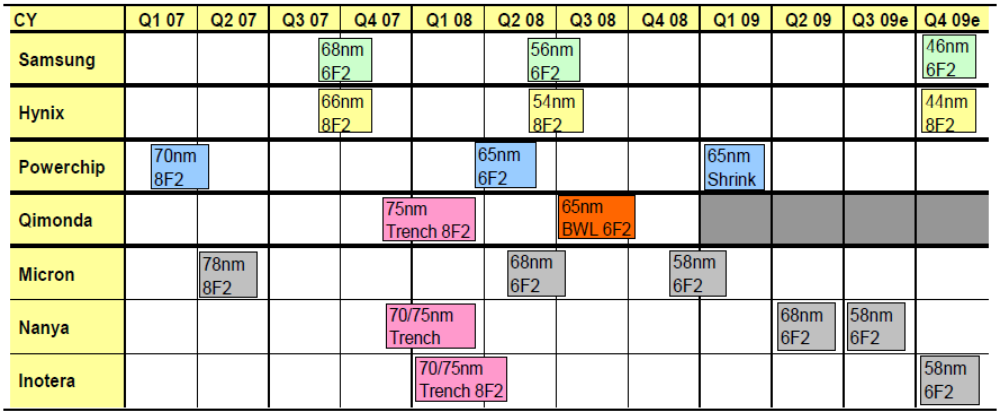
Exhibit 12. DRAM Technology Migration



Source: (SinoPac Securities. 2010)

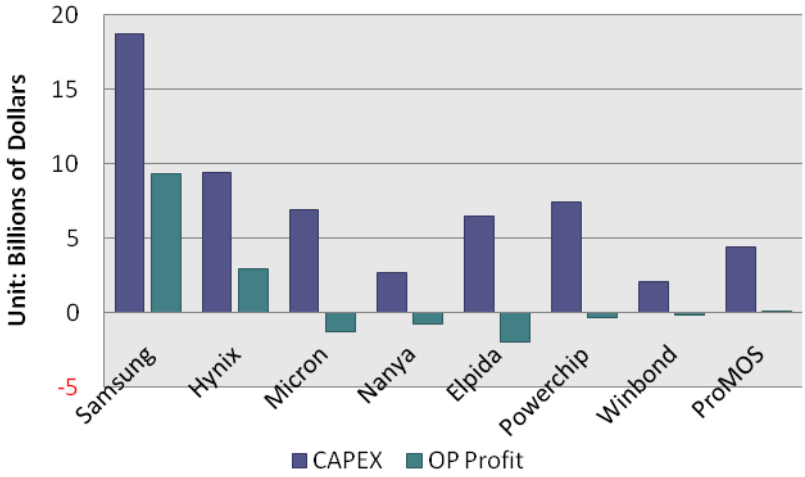
By 4Q09 Samsung and Hynix were leading in technology process, using 46nm and 44nm respectively, while the next closest competitors were Micron, Nanya, and Inotera which relied on the 58nm process at the time. (figure DRAM: Technology Gaps) The more advanced technology led the Korean companies to make semiconductors at a lower cost and at greater efficiency than competitors. By the second quarter of 2010 Samsung's aggressive push into 40nm semiconductor lithography for DRAM manufacturing boosted the volume of its bit production dramatically allowing the company to out-produce competitors and expand its lead in the global DRAM technology market. With revenues of US$3.8 billion in the second quarter of 2010, Samsung's DRAM revenues expanded by 24.3% from US$3.1 bn in 1Q, the highest growth rate among the top-five suppliers. The rise gave Samsung a 34.3% share of global DRAM revenues in the second quarter, up from 32.6% in the first. 34.

Exhibit 13. DRAM: Technology Gaps



Source: (Morgan Stanley. 2009)

Exhibit 14. Accumulated CAPEX vs. Op. Profit (2004-2009)



Source: (SinoPac Securities. 2010)

6.1 Elpida, Rexchip and Powerchip Technology migration

In early 2010, Senior management from Rexchip (Stephen Chen, CEO), Elpida (Hideki Gomi, CTO) and Powerchip (Eric Tan, VP) announced joint construction of an R&D Center in Taiwan to focus on 40nm and below technology development starting in 1Q10. Under the announced plan For the R&D center, 45% of the engineers were to be from Powerchip, 30% from Rexchip and 15% from Elpida. The center targeted 60-80 workers in 2010 on US$30-50 mn R&D expense and 100-120 workers on US$50-80 mn R&D expense by 2011, booked under RexChip. 37.

6.2 Micron and Inotera Technology Migration

Micron and manufacturing partner Inotera experienced operational difficulties in their technology migration process efforts during the second quarter of 2010 as Inotera faced the daunting task over the previous quarters of not only transitioning to the 50nm process node but also of migrating from Qimonda's trench technology to Micron's stack technology. Due to those difficulties Micron, posted the weakest growth among the top-five DRAM suppliers in the second quarter of 2010, with

revenues rising by 4.1% as it struggled with manufacturing challenges at its Inotera facility. 34.

6.3 Nanya Tech and Technology Migration

Nanya Tech started to pilot-run the 40nm process in June 2010 after a test run at Micron delivered good results. Nanya Tech at the time also planned to diversify into mobile DRAM and other non-PC products. 38. Similarly to Inotera, Nanya was likely to face execution risk over the next several quarters on adopting new stack technologies from Micron. The company was also facing Negative free cash flow with poor margins and uncertainty on outsourced capacity from Inotera, which was to be co-managed by both Nanya and Micron using Micron's new technologies. 21.

6.4 Powerchip and Technology Migration

Powerchip in an attempt to acquire funding for technology migration applied to issue up to US$179mn in global depository receipts, however as a result of the large accumulated losses, the Financial Supervisory Commission of Taiwan in July 2010 turned down the application. Despite the setback, in the third quarter of 2010, Powerchip decided to raise its capital expenditure for 2011 by about 40% to upgrade its production technology. The board of directors approved the proposal to increase the company’s capital expenditure to NT$17 billion (US$533 million) from the previously planned NT$12 billion via an increase in capital. 39. The company planed to increase capital by 650~800mn shares with the main intent of using the funds for technology migration to 63nm and 45nm. 36. Bank of America analysts, however, were worried that Powerchip was not doing enough. In a note to investors in October 2010 they noted that Powerchip hadn’t installed any immersion tools which are must-have machines for 50nm and beyond. Thus, they feared that Powerchip’s cost

competitiveness might deteriorate sharply after 2011. 40.

6.5 ProMos and Technology Migration

ProMos, in order to support its migration to more advanced process technology sold an old 12-inch fab for NT$8.5 billion (US$271 million) to Macronix International in April of 2010. ProMos chairman stated that the deal would “aid ProMOS in ramping up production using Elpida Memory’s technology in time,” The proceeds for the sale were used to purchase new equipment to migrate from 65-nanometer process technology to 63-nanometer technology at an advanced 12-inch plant in Taichung. The new Elpida technology was expected to enable ProMOS to make new DDR3 chips cost-efficiently beginning in the third quarter of 2010 and to rapidly ramp up mobile DRAM in the middle of the following year. Macronix, in the meantime, which mainly produces flash chips said the transaction would help it double output in time to help ease supply shortages on strong demand for consumer electronics chips used in products such as Nintendo’s Wii video game consoles. 35.

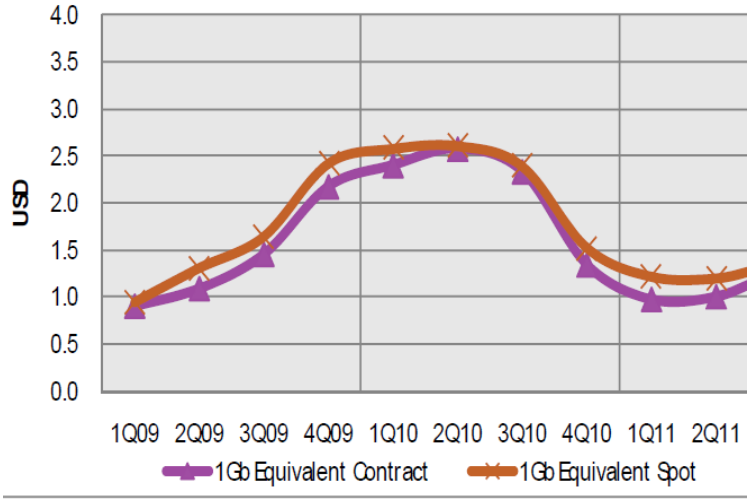
7. DRAM Slowdown of 2H10

DRAM prices showed signs that the uptrend in prices was ending during the Taipei spring computer show in the second quarter of 2010 as some analysts noticed lower DRAM content per box compared to 2009’s Taipei IT month computer show in November. Whereas DRAM content per box in the first half of 2009 jumped to 4GB owing to weak memory pricing at the time, content per box of mainstream PC models during the computer show held in early April exhibited averages of 2GB as the cost of DDR3 2GB DRAM modules had risen to US$46. According to analyst Ryan Chen of SinoPac Securities the reduction of content per box from 4GB to 2GB was mainly due to difficulties PC-OEMs (original equipment manufacturers) faced in obtaining

enough DRAM modules due to supply shortages and with stable PC retail pricing of US$500~US$800 on average. The 4GB DRAM module cost at the time had already surpassed PC-OEMs Bill of Material cost tolerance of 10~15%. 40.

Apart from the lower content per box trend, another blow to the industry was that by the third quarter of 2010, the recent aggressive migration to more advanced production technology, combined with weaker than expected PC sales, caused massive DRAM oversupply in the second half of 2010. In the third quarter of 2010 DRAM industry revenues increased by a mere 3.4% from the second quarter, despite a 15% growth in total production output. 41. On the fourth quarter memory chip prices plunged by nearly 50% from the previous quarter. **42.**

Exhibit 15. DRAM Prices



(SinoPac Securities. 2011).

Hynix Semiconductor, Elpida Memory and Micron Technology all saw their market shares in the third quarter slide sequentially on lower sales while Samsung Electronics continued to retain its lead. 42. Over in Taiwan, Nanya Tech and

Winbond also saw QoQ revenue declines while Powerchip and ProMos' saw increases.

Exhibit 16. Leading DRAM suppliers' revenues and market shares, 3Q10 (US$m)					
	3Q10		**2Q10**		**Q/Q**
	Revenues	Market share	Revenues	Market share	
Samsung	4,353	40.4%	3,572	34.3%	19.1%
Hynix	2,139	19.8%	2,252	21.6%	(5.0%)
Elpida	1,734	16.1%	1,915	18.4%	(9.4%)
Micron	1,296	12.0%	1,442	13.8%	(10.1%)
Nanya	449	4.2%	474	4.5%	(5.2%)
Powerchip	275	2.6%	243	2.3%	12.9%
ProMOS	197	1.8%	181	1.7%	8.6%
Winbond	170	1.6%	174	1.7%	(2.7%)
Others	164	1.5%	168	1.6%	(2.6%)
Total	10,777	100.0%	10,421	100.0%	3.4%

Source: (Digitimes, 2010)

7.1 Financial difficulties haunt Taiwanese players once again.

Despite the ongoing industry slow-down, Nanya Tech was able to continue process technology migration despite losses. Nanya Tech's net losses widened to NT$2.27 billion in the third quarter of 2010 from losses of NT$1.09 billion in the second quarter. In order to transfer to the 42nm process technology amid the mounting losses the company relied on the Formosa Plastics Group (FPG) members for funding. In November the DRAM maker successfully raised NT$9.9 billion from FPG members through a rights issue. While in December it also secured a total of NT$17 billion (US$577 million) in loans from Formosa Plastics and Nan Ya Plastics, two affiliates of its parent company FPG. Furthermore Formosa Petrochemical, another FPG affiliate, soon after also agreed to provide one-year loans totaling NT$5 billion to Nanya Tech which were expected to arrive in the first quarter of 2011. 43.

Without the help of an organization such as the Formosa Plastics Group, Powerchip's difficulties became very public in the fourth quarter of 2010 after it was unable to fulfill payments owed to Rexchip. Rexchip, in turn, on December 13 2010 announced the suspension of DRAM shipments to Powerchip. 44. The shipment suspension lasted for 1 week after the contract between Powerchip and Rexchip was renegotiated.

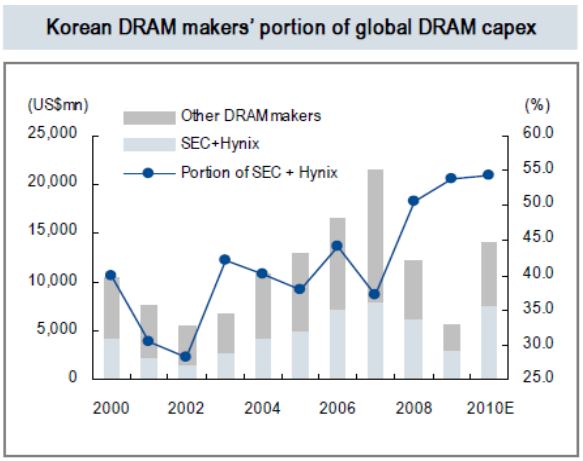
7.2 Samsung Further Expands Lead

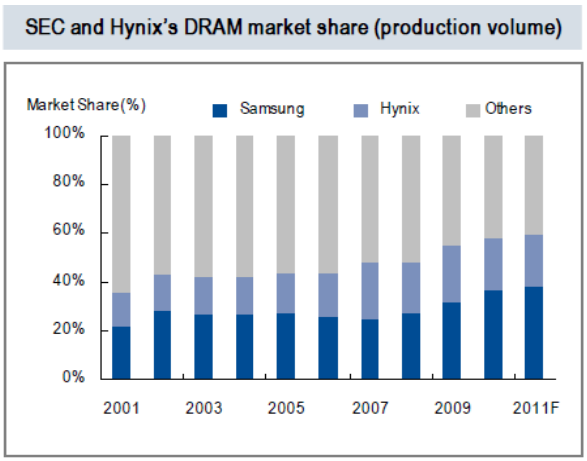
Samsung in the meantime was doing fine and dandy in the latest industry decline. The company sold US$4.35 billion worth of DRAM in the third quarter of 2010, up 19.1% from the second quarter. The rise gave the market leader a 40.4% share of global DRAM revenues in the third quarter, up from 34.3% in the second quarter. Geographically speaking, South Korea's share of the global DRAM market expanded

to 61.2% in 3Q10 from 56.8% in the second, the share held by Japan and the US slid to 16.3% and 12.2%, respectively, from 18.7% and 14.1% in the prior quarter. 41.

On November 16, 2010 Woori Investment & Securities, one of the largest securities firms in S. Korea published a Semiconductor Industry report titled “Snowball begins to roll” which painted a gloomy picture of tier 2 DRAM companies (mostly Taiwanese companies) and a coming rosy overall industry picture as the DRAM industry was bound to consolidate with Korean companies Samsung and Hynix ending bigger, stronger and presiding over a more disciplined industry. In the report Woori analysts theorized that tier-1 DRAM makers such as Samsung Electronics and Hynix would continue to enjoy a larger market share on higher capex spending, with the gap between the tier-1 players and the late-starters in the market gradually widening (Korean DRAM makers’ portion of global DRAM capex chart). The analysts mentioned that Tier-2 companies were likely to have difficulty in catching up with the tier-1 group, given that: 1) when DRAM prices fall sharply their financial health declines, restricting them from investing at opportune times; 2) even when they are able to invest, their investment efficiency is lower than that for tier-1 companies; and 3) they are disadvantaged compared to tier-1 makers in terms of immersion equipment supply/demand conditions. 45.

Exhibit 17. Korean DRAM makers' capex share and market share





(Woori Investment & Securities. 2010)

The Woori analysts reasoned that Tier-2 DRAM makers were very unlikely to start their own snowball effect because to do so they would need to keep up with the tier-1 peers in terms of capex. However, keeping up was expected to be very difficult as following the steep DRAM price declines of 2H10, the financial health of the tier-2 companies was eroding, making it difficult for them to invest in a timely fashion. Moreover, even if they decided to invest, the tier-2 makers would face great difficulty in catching up with the tier-1 makers as the pace of technology migration grew increasingly more advanced along with rising costs related to the technology migration (for the explanation please see appendix titled "Woori reasons for continued Technological lag"). The Woori analysts concluded that by having steadily widened their market share through the snowball effect, Tier 1 companies had entered a virtuous cycle which would enable them to maintain and improve their absolute margin levels going forward as the Tier 2 companies continued to lag. This, in turn, would lead to another big round of consolidation in the industry. 45.

8. Elpida's Bold Ambitions

On October 2010 Elpida president Yukio Sakamoto stated that Elpida Memory was considering buying shares of Taiwanese chipmakers to counter competition from Samsung Electronics. Sakamoto identified Powerchip, ProMOS and Winbond Electronics among possible targets. Sakamoto also said that he was also open to tie-ups with Nanya Technology and subsidiary Inotera Memories. "It's almost impossible for the Taiwanese to survive by themselves," Sakamoto was quoted by Bloomberg. "Without doing something, it will be tough for us to survive, too. We don't have the scale." 2.

Soon after Taiwanese periodical Digitimes, citing industry sources, reported that Elpida Memory had plotted a three-year plan to raise its competitiveness in the global DRAM market and counter the threat from Samsung Electronics which involved deepening alliances with Taiwanese companies. Elpida's plan reportedly involved deepening its existing partnership with ProMOS Technologies in 2011 and possibly other Taiwan-based fellow companies to jointly set up a manufacturing spot in China in 2012. 46.

In December the speculation on Elpida's Taiwan moves seemed to become reality as Elpida agreed to let ProMos use the company's 63nm stack process technology for its own-brand niche DRAM products. 47. Elpida at around the same time obtained approval from the Industrial Development Bureau under the Ministry of Economic Affairs of Taiwan to list Taiwan Depository Receipts in the Taiwan Stock Exchange. 48. William Wang of Fubon stated in a report dated February 25, 2011 that Elpida's Taiwan listing was an attempt to facilitate further tie ups with its Taiwanese peers. In his report William stated that external financing was clearly not the main purpose of the TDR since the company's financial condition was improving. In William's view

the goals of the listing were threefold: 1) raising the visibility in Taiwan to strengthen ties with Taiwan's government and the capital market, 2) facilitating inroads into Rexchip's oncoming public listing (Elpida owns 65% of Rexchip's shares), and 3) further strengthening ties with Taiwan's DRAM makers to secure capacity. Mr. Wang added that Elpida needs the capacity of Taiwan's DRAM makers as much as Taiwan's DRAM makers need Elpida's technology. The ties with Taiwan makers enable Elpida to secure capacity without raising capex, thereby reducing operating leverage and financing needs. 14.

"He's casting a very wide net, but he may only catch a small fish — or maybe no fish at all," Yuuki Sakurai, chief executive officer of Fukoku Capital Management Inc in Tokyo was quoted by Bloomberg on Sakamoto's broad plans of deepening alliances with Taiwan peers. "Sakamoto-san is very outspoken' but what he says and what the company achieves aren't always the same." 2.

Discussion Questions

-Why did Taiwan Memory Company fail?

- What are the biggest challenges Taiwan DRAM firms face?

- What are the objectives/goals of each party? Shared goals?

-If you were the CEO of Elpida what would you propose to Taiwanese DRAM makers?

-Should Taiwanese DRAM players do like Winbond and leave the DRAM industry or stay and seek alliances?

Appendix

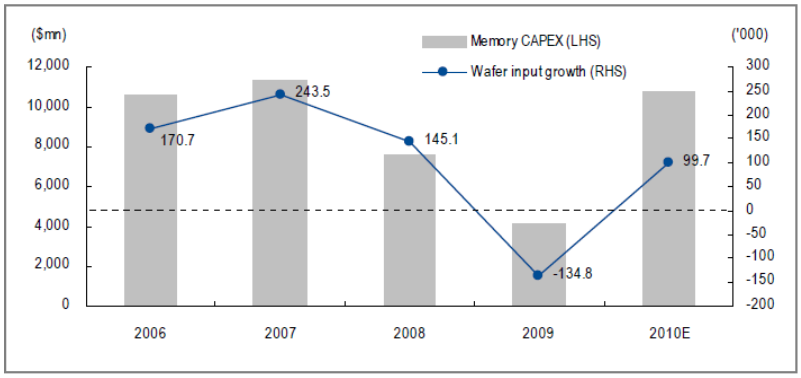
Woori reasons for continued Technological lag

“Technology migration is growing increasingly difficult in the semiconductor memory industry, thereby driving up costs, for the following two reasons.

1) Semiconductor memory makers are focusing on upgrading their existing lines through technology migration rather than directly expanding output capacity by building new lines.

2) Compared to the past, more time and expense is being spent on adopting and stabilizing new technology. In particular, the second reason indicates that technology migration efficiency is weakening compared to the past. The graph below compares the annual facility investment amount and wafer input increase of tier-1 companies (Samsung Electronics and Hynix). The graph shows the increasing amount of facility investment that is required to achieve a wafer unit input increase. This necessity for this facility investment is resulting in greater time being needed to recover the same amount of wafer input. With their weaker funding capacity, tier-2 companies require significantly more time to achieve wafer unit input increase. 45.

Annual Capex and wafer input growth (increment) trend of tier-1 memory makers



Source: Gartnet, DRAMeXchange, Woori I&S Research Center estimates

Facility capacity investment amount incurred for increasing wafer unit by tier-1 companies

	2006	2007	2008	2009	2010E
Memory capex (US$mn)	10,597	11,333	7,619	4,150	10,790
Wafer input increment ('000)	170.7	243.5	145.1	-134.8	99.7
Capex incurred upon increasing wafer unit (US$'000)	62.1	46.6	52.5	N/A	108.2

Source: Gartner, DRAMeXchange, Woori I&S Research Center

In addition, the preparation time for technology migration is stretching due to tight equipment supply and the ever-expanding sophistication level of the required technology. The table below describes the immersion equipment supply and demand status by company, illustrating that tier-2 companies are still lagging behind tier-1 companies in acquiring relevant equipment. If such a trend continues, the price gap between tier-1 and tier-2 companies is unlikely to narrow. The use of immersion equipment is limited if the technology node reaches 20nm, which in turn will likely result in the need for a new type of equipment called extreme ultra-violet lithography (EUV). As the relevant investment amount is continuing to increase, the possibility of further widening in the gap between tier-1 and tier-2 companies cannot be ruled out."

45.

Amount of immersion equipment procurement status as of 4Q (DRAM only)

Company	Amount of immersion equipment	Monthly average wafer starts (K units)	Amount of immersion equipment per 10K wafer
Samsung Electronics	36	397	0.91
Hynix	21	307	0.68
Elpida + PSC + Rexchip	11	327	0.34
Micron + Nanya + Inotera	13	268	0.49
Total	81	1,298	0.62

Source: Each company, DRAMeXchange, Woori I&S Research Center

Selected Nanya Technology Financials

Million NT$	4Q10	3Q10	2Q10	1Q10	4Q09	3Q09	2Q09	1Q09	4Q08	3Q08	2Q08	1Q08
Net Sales	11,790	14916	15718	14121	16690	11509	8085	6172	6134	11504	9530	9143
COGS	17737	14000	14128	13931	14711	12876	11882	13161	10715	14808	12983	13595
SG&A Expenses	755	457	388	399	705	511	604	486	101	583	575	670
Operating Income	-8680	-1373	-516	-1225	343	-2684	-5232	-8347	-6037	-5687	-5866	-6525
Non-operating Income	-1495	-894	-570	-400	-145	-1215	-1309	-2166	-5849	-3082	-1426	-2258
Income Before Tax	-10175	-2267	-1086	-1625	199	-3899	-6541	-10513	-11886	-8769	-7292	-8783
Income Tax Expense	21	0	0	0	0	0	0	0	0	0	0	0
Net Income	-10153	-2267	-1086	-1625	199	-3899	-6541	-10513	-11887	-8769	-7292	-8783

Selected Hynix Semiconductor Financials

Billion KRW	4Q10	3Q10	2Q10	1Q10	4Q09	3Q09	2Q09	1Q09	4Q08	3Q08	2Q08	1Q08
Revenues	2748	3250	3279	2821	2799	2118	1676	1313	1512	1839	1864	1604
COGS	1994	1849	1821	1656	1700	1540	1546	1494	1955	1960	1672	1777
SG&A												
Expenses	337	390	412	367	391	368	341	333	339	343	364	309
Operating												
Income	418	1011	1045	799	708	209	-211	-515	-782	-465	-172	-482
Non-operating												
Income	-239	40	-408	30	-97	35	163	-663	-565	-1215	-540	-194
Earnings Before												
Tax	178	1052	637	829	611	244	-48	-1178	-1347	-1680	-712	-676
Income Tax												
Expense	68	-8	-28	7	-45	-2	10	0	-20	-10	-1	0
Net Income	110	1060	665	822	657	246	-58	-1178	-1670	-1670	-711	-676

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