Will AMLCD Prices Fall Slower?
Strategies for Making Things Better

Ian Hendy and David Barnes consider choices for a more profitable end game

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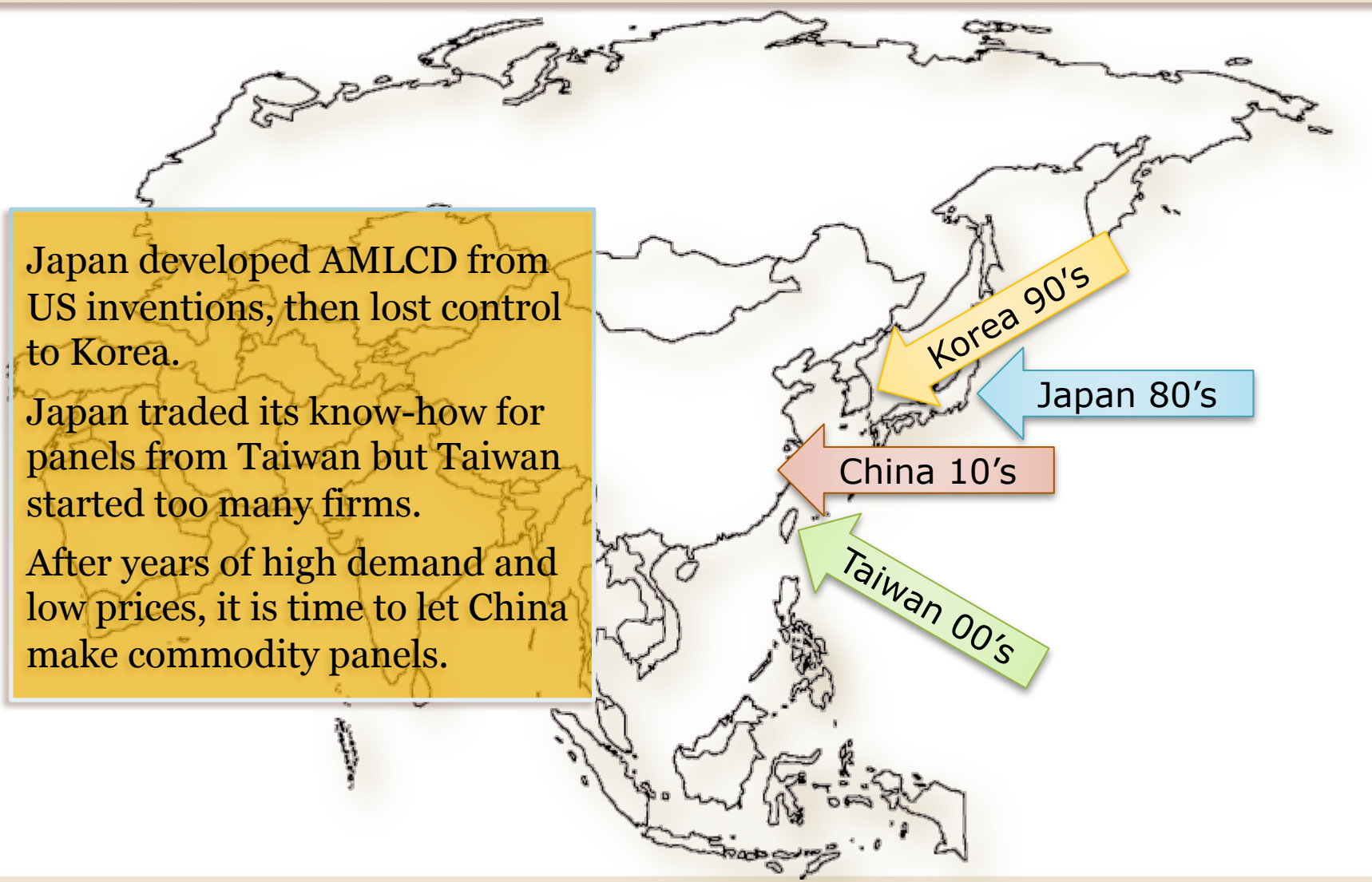
DISPLAY, HIGH TECH & MEDICAL IMAGING STRATEGY

Chinese fab investments may sustain historical supply-price dynamics in AMLCD (TFT LCD)



Japan developed AMLCD from US inventions, then lost control to Korea.

Japan traded its know-how for panels from Taiwan but Taiwan started too many firms.

After years of high demand and low prices, it is time to let China make commodity panels.

Capacity (supply) has increased about 29m m² a year since 2007 but its growth has slowed

Capacity grew about 50% a year until 2007. Since then, it slowed toward 20% a year.

The amount added each year has changed less, however.

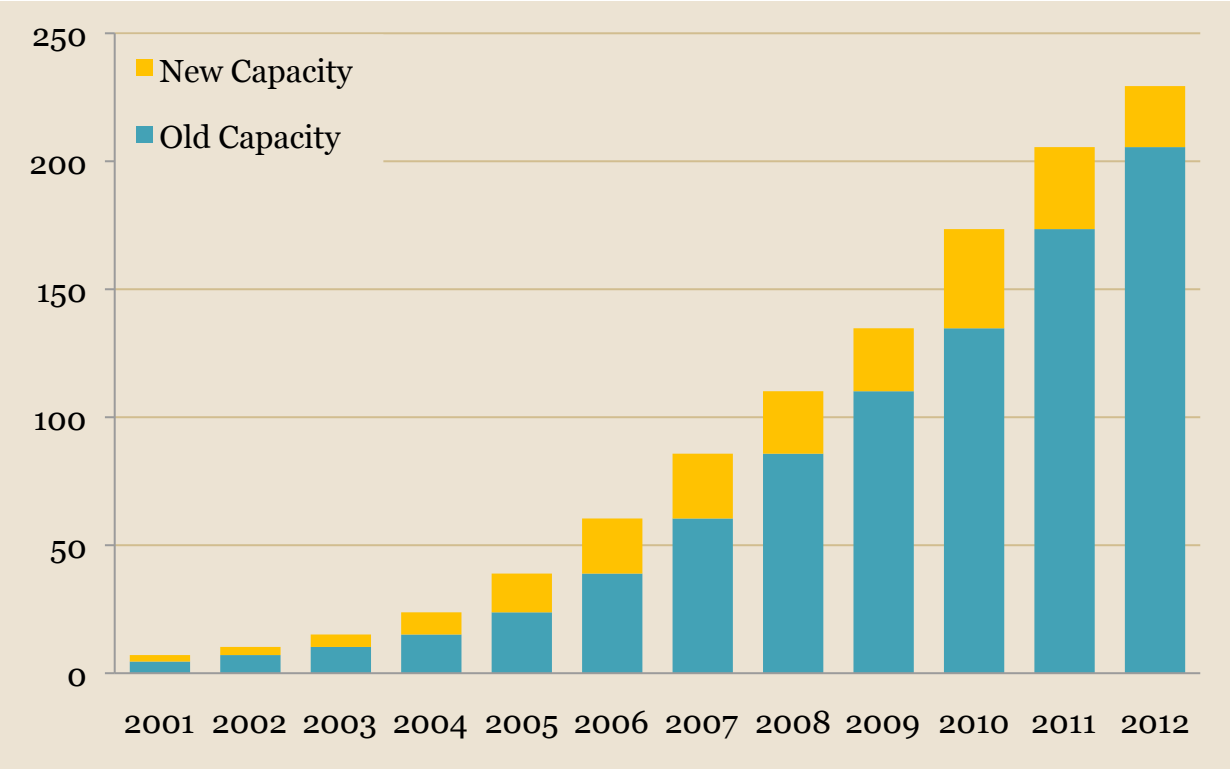
Thus, the question arises:

Will future prices vary with time or with total capacity?

So far, both have been true. The pace of areal price decay has corresponded to time and to capacity, which must be cleared through the market in the form of yielded supply.

If capacity growth slows, will prices fall more slowly than in the past?

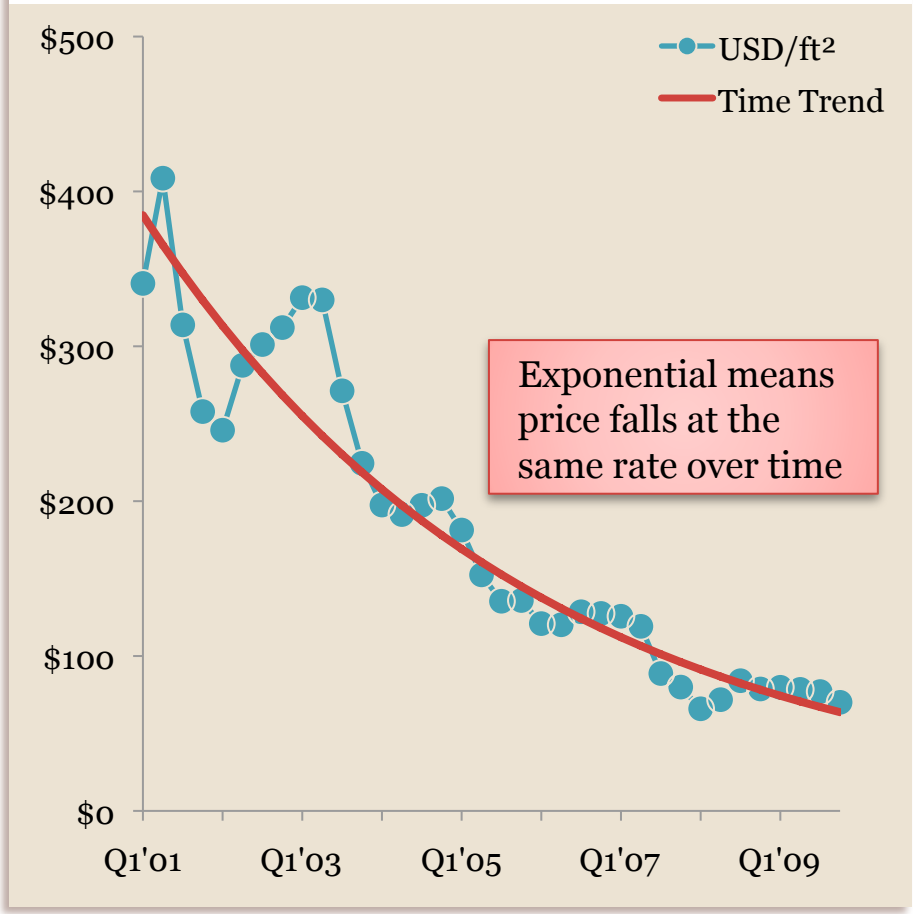
New and Old Capacity, millions m²



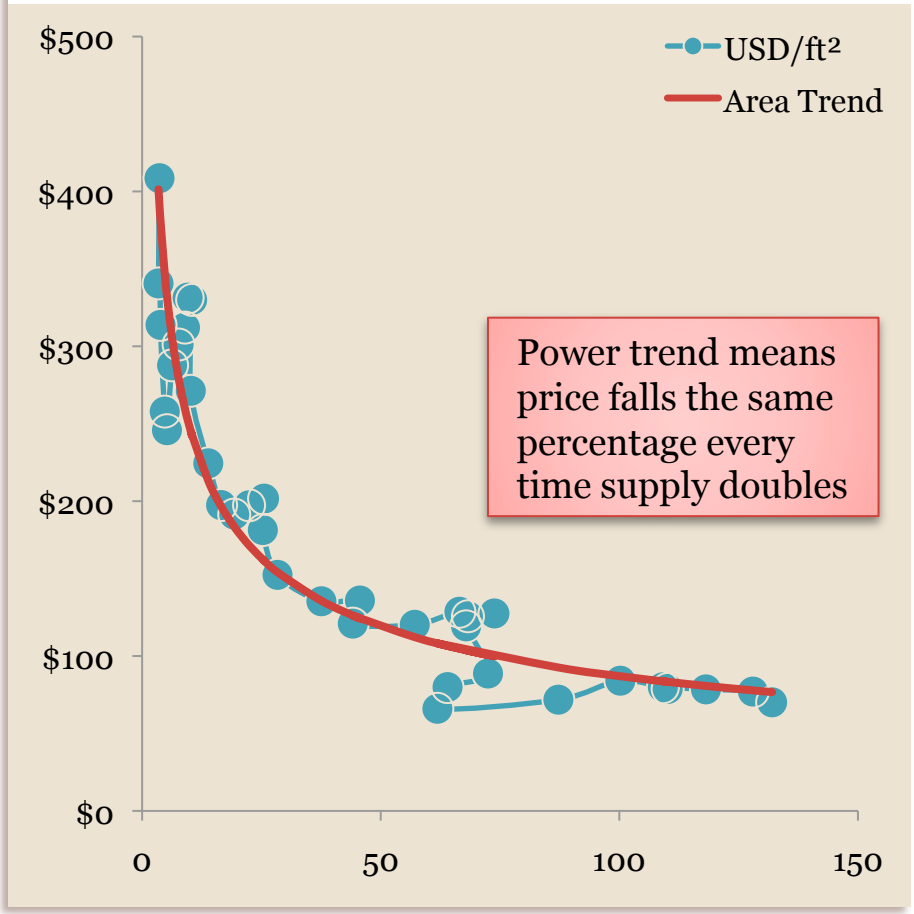
Source: DisplaySearch US FPD, Mar '11; Our analysis

Combining disclosed data from AUO and LGD provides views of price over time and area

Price falls about 5% a quarter or 19% a year on an exponential trend line



Price falls as a power function with area (area shown in millions of square feet)

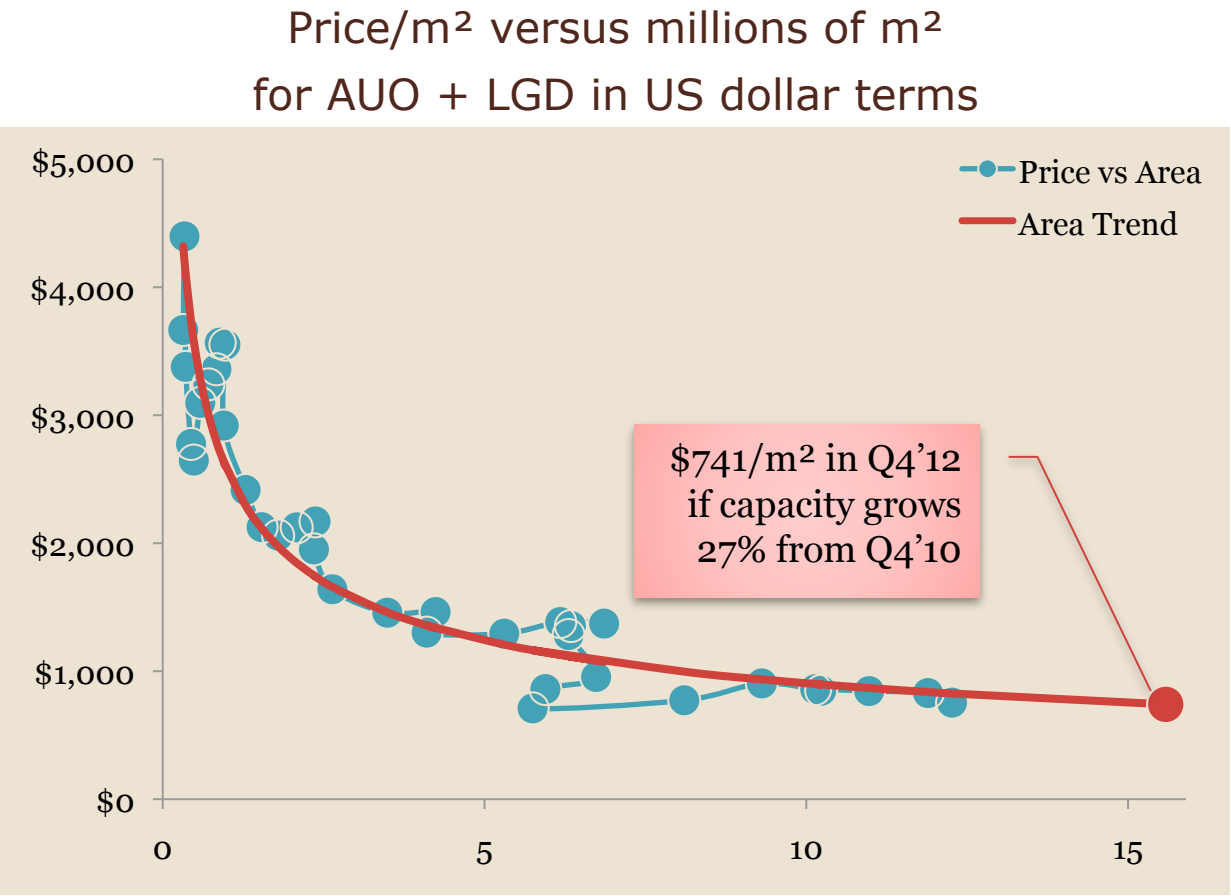


The DisplaySearch capacity forecast implies slower price decline at 5% a year instead of 19%

Based on the time-trend, we would expect continual price decay through 2012 but the slowing pace of fab capacity growth implies slower price development.

From this perspective, it looks rational for leading panel makers to slow their pace of investment in more AMLCD and shift investment to new technologies.

We note that Chinese analysts expect LCD TV demand there may grow only 10% in 2012. The forecast for 12% capacity growth in 2012 therefore seems reasonable.



Our analysis using USD/m² and capacity in millions of square meters

So which will it be: continued steep declines or slower price declines on slower growth?

This is not the first time we considered this question.

We hypothesized slower price development in support of a client's TV market entry plan in 2007. The plan did not go forward for several reasons.

In hindsight, that was good because price continued down the exponential time line.

The hypothesis failed because AMLCD makers failed to differentiate their new fabs.

They used new-gen glass to make old products.

They created a supply glut in most market segments.

Our Hypothesis in Support of AMLCD Market Entry in 2007 and Our Look Back in 2011

Our 2007 Hypothesis	Our Look Back in 2011
Capacity would not remain fungible. Bigger fabs would make bigger panels for more profit.	Capacity is fungible (interchangeable). Most large panels can be fab'd in most Gen-5½+ lines.
Continuous reinvestment in fungible capacity would be irrational for makers' shareholders.	They did it, anyway… Even HannStar Display plans a secondary issue.
Historical price development destroys value through the chain. It is unsustainable from the perspective of investors expecting risk-weighted returns on capital.	New material entrants reduced panel cost and grew their business. Brands and retailers sought cross-product sale synergies. Everyone in TV grew scale but most lost margin.
Serving the entire, global market would be uneconomic. Poor countries would generate poor margins on incremental supply.	Bread and circuses: national policies stimulate industrial and retail investment for TV sets, such as the rural subsidy program in China.
Green-field investments should be geared to match vertical integration demand, only.	Panel makers sought scale advantages for their affiliated stakeholders, not their shareholders.
Panel makers would discover that variable costs allowed them to support prices by reducing capacity utilization.	AUO led thinking about this in late 2007 and many producers moderated utilization in '09. This may be happening today with delays…

Source: project in support of a green-field AMLCD fab investment conducted in 2007 for a confidential client

Fungible capacity remains the main issue — differentiation will determine the future

Leaders learned how to make smallish panels on large glass

Maker	Fab	Small Size	Small Panels	Large Size*
LGD	P5	9.7”	35	27.0”
Samsung	L6	9.7”	36	27.0”
LGD	P6	9.7”	56	30.0”
Samsung	L7-2	17.0”	36	46.0”
LGD	P7	19.0”	35	47.0”
LGD	P8e	20.0”	40	55.0”
Samsung	L8-2	18.5”	50	55.0”

*6 panels per substrate is the typical target for new fab investments because larger panels command a price premium… making smaller panels makes new fabs undifferentiated…

Source: DisplaySearch US FPD 2011

Their capacity is fungible: it can serve most large panel markets

- Piling more capacity into commodity markets leads to hyper-competition.
- We believe this causes calendar-cyclic behavior in terms of price rivalry. Tit-for-tat reactions drive prices down, even for the leaders.
- Similar behavior occurs among retailers who face e-tail competitors.
- As a result, consumers see better prices but the supply chain sees worse profits.
- Differentiation is one way out of this commodity trap.

The IC industry evolved a differentiated model after emerging from a common source

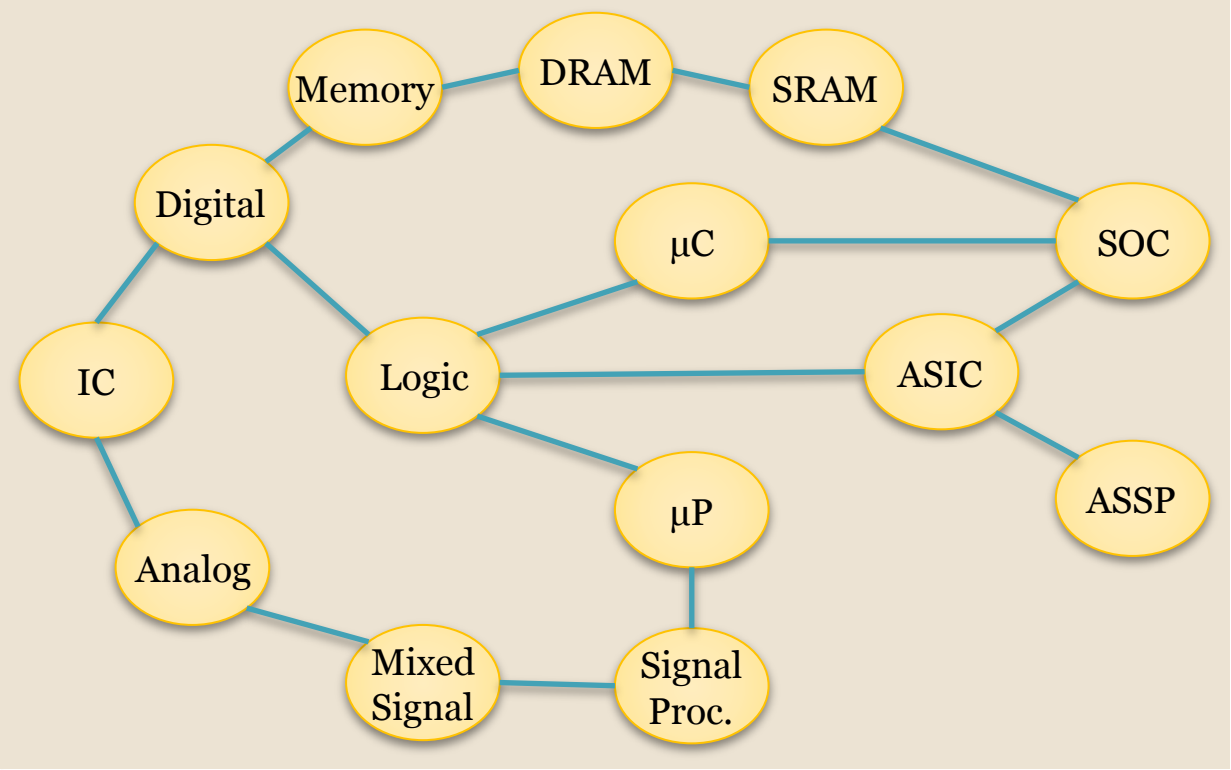
IC makers began carving out specialty positions several decades ago. Much of the present constellation of firms was visible by the 1990's.

News of TI buying National Semiconductor reinforces this view: as TI's baseband signal processing business declined, it stayed in Analog rather than moving into logic.

IC makers differentiate their fabs and platforms to become stronger in specific segments.

They do not try to compete with all other producers.

Simplified Diagram of IC Differentiation



AMLCD makers have not exploited sources of distinction as well has IC makers have, so far

Japanese AMLCD producers tried to integrate functions with LTPS technology ten years ago. Attaching silicon proved more cost-effective.

Thus, they had the right idea but were unable to lever their technical lead.

Challenges to increasing the level of functional integration persist even as IC leaders reach 20 nm design rules.

Therefore, it has been logical to concentrate on making larger pixels on larger panels.

That requires technology but not the same sort that enables functional integration.

Sources of Distinction

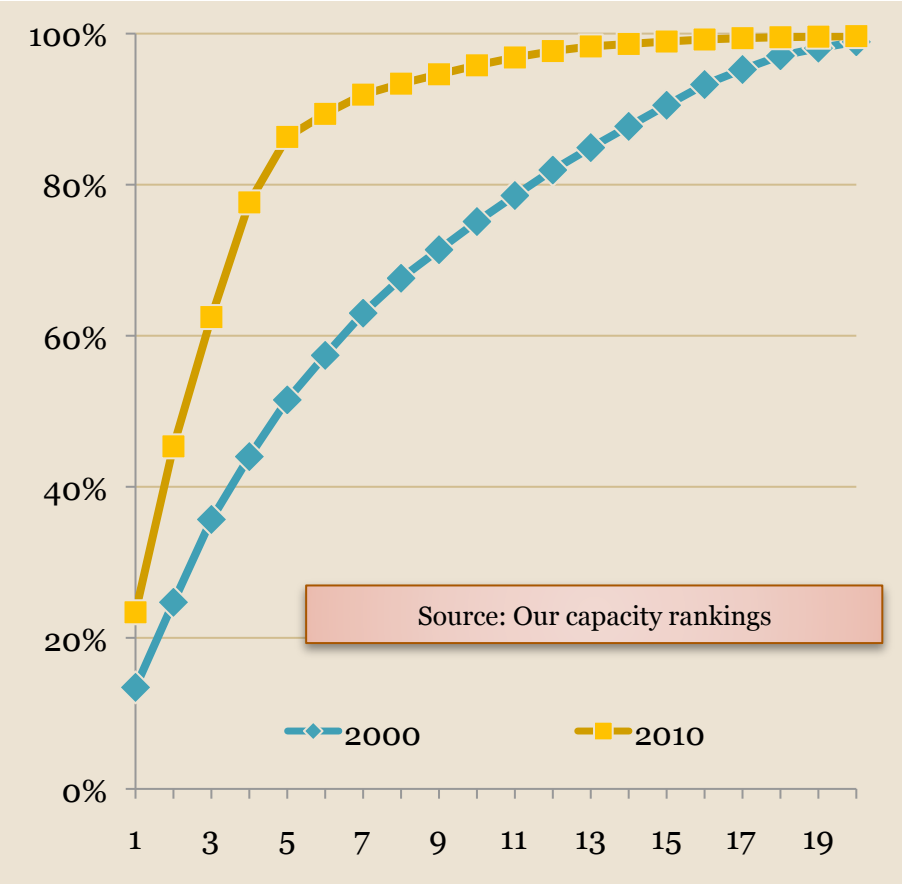
Distinction	IC	AMLCD
Functional Integration	Capture sockets, take share from others	Potential for non-pixel TFT integration
Platform Products	Use proprietary µcode or architecture	Not available without more integration
Product Extensions	Lever platform, offer compatible parts	Not available without stronger architecture
Design Services	Offer design knowhow or (software) tools	Adverse trend of more cell-based sales
Cost (economic scale)	Raise entry barriers with focused invest.	Diminished returns; rising marginal costs

Source: Our insights (conceptual)

AMLCD producer shares have become more concentrated and less diverse relative to IC

IC Producers
Cumulative Share of top-20

AMLCD Producers
Cumulative Share of top-20



As a result, their cash cost has increased with scale… not a good thing for investors

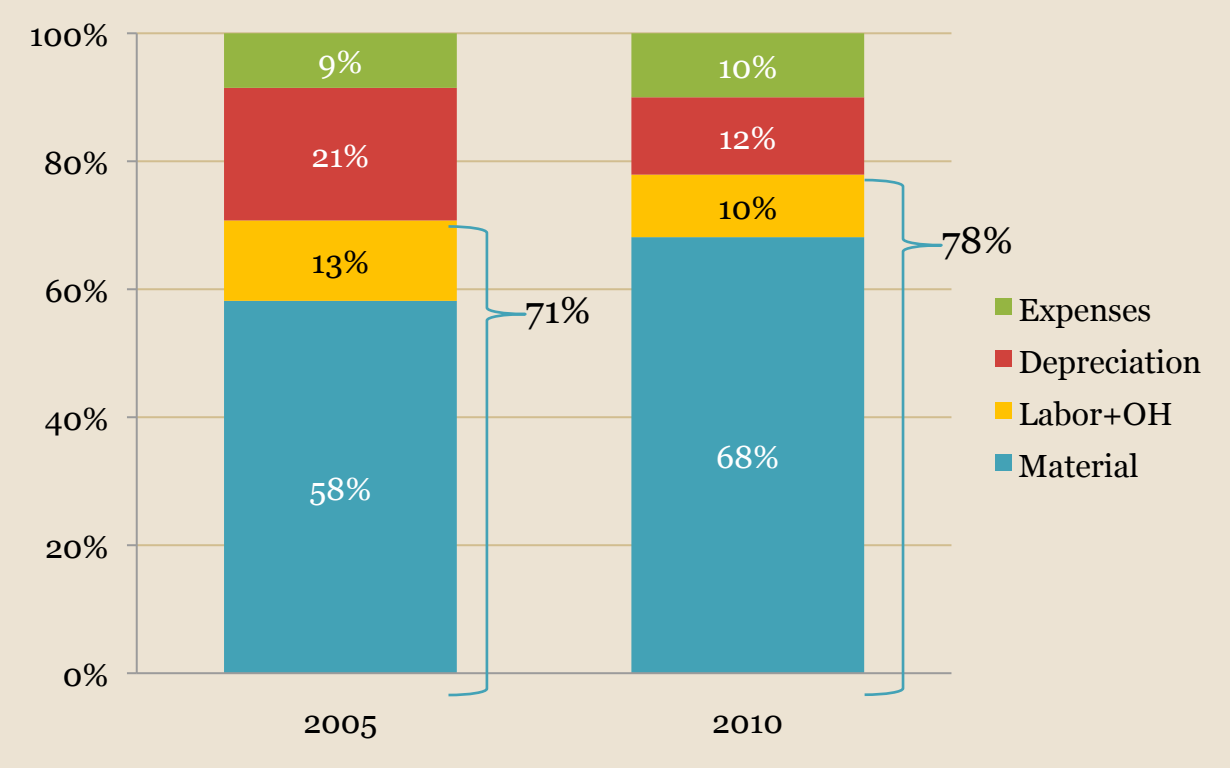
IC makers who differentiate benefit from scale. Their costs are mostly fixed, so their marginal costs decline as they increase scale.

Such dynamics created a winner-take-all opportunity for Samsung in DRAM.

In contrast, AMLCD makers have seen their marginal costs increase with scale. Larger substrate fabs have increased material and reduced fixed cost contributions.

Such dynamics create a no-win condition that permits low-scale producers to remain price spoilers if they can cover their material costs.

Cost of Product Structure for LG Display



Source: disclosures; our analysis

Note: expenses include SG&A plus R&D

Commoditization and declining return to scale leave AMLCD producers with two options

Decrease their cost of capital

- Use other peoples' money
  - Get state-sponsored loans (China?)
  - Trade technology for funding (JV)
- Sell equity or convertible bonds
  - Impair non-performing assets
  - Float new shares
- Acquire capacity at a discount
  - Seek underwriters or guarantors
  - Buy old fabs and convert them

and/or
Differentiate their capacity

- Reduce asset utilization
  - Refuse to serve all demand with all fabs
  - Starve some application markets
- Develop unique processes, e.g.
  - Optimize one fab for transflectives
  - Give a fab more spatial resolution
- Invest in distinct capacity, only
  - Spend only on Metal Oxide, perhaps
  - Spend only on AMOLED or printables
  - Buy and impair assets of price spoilers

We imagine AMLCD leaders will seek ways out by creating alternative display technologies

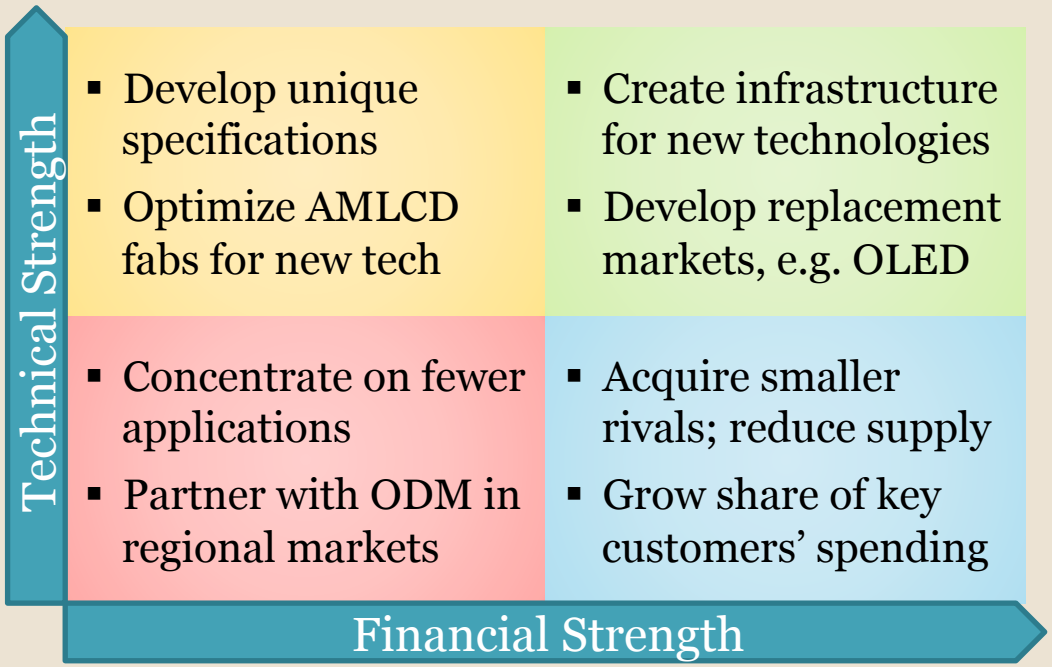
Samsung Mobile Devices is creating unique AMOLED capacity through proprietary infrastructure developments.

Other leaders may adopt less risky strategies but create alternatives to AMLCD also.

Weaker producers may be left with few options other than reducing their product range and partnering with regional product integrators.

Those with financial strength may choose to stay in AMLCD but take price spoilers out of the market and capture a larger share of key customers.

Hypothetical Strategies



Our conceptual diagram of strategies based on relative technical or financial strength

Suppliers and customers of panel producers may find differentiation neutral to positive

Suppliers—
Materials or Tools

- Bulk material suppliers may find few benefits in differentiation other than less price pressure from more profitable buyers.
- Formulary or semi-custom suppliers of LC, IC or compound films may find more ways to capture premiums.
- Leading tool makers may face more rivals as panel makers foster local tool makers with unique abilities but leaders may also profit from semi-custom tool requirements.

Customers—
Brands or Retailers

- Brands may face problems with second-sourcing but benefit from more differentiated products.
- Brands may seek ways to use Apple's strategy of orchestrating technology changes such as FFS, also. That may conflict with differentiation for leading panel makers, however.
- Retailers may benefit from offering more differentiated products that reduce price pressure, inventory risk or working capital.

The tactics for differentiation vary with strategy but most rely on separation from competitors

Separation is the goal.

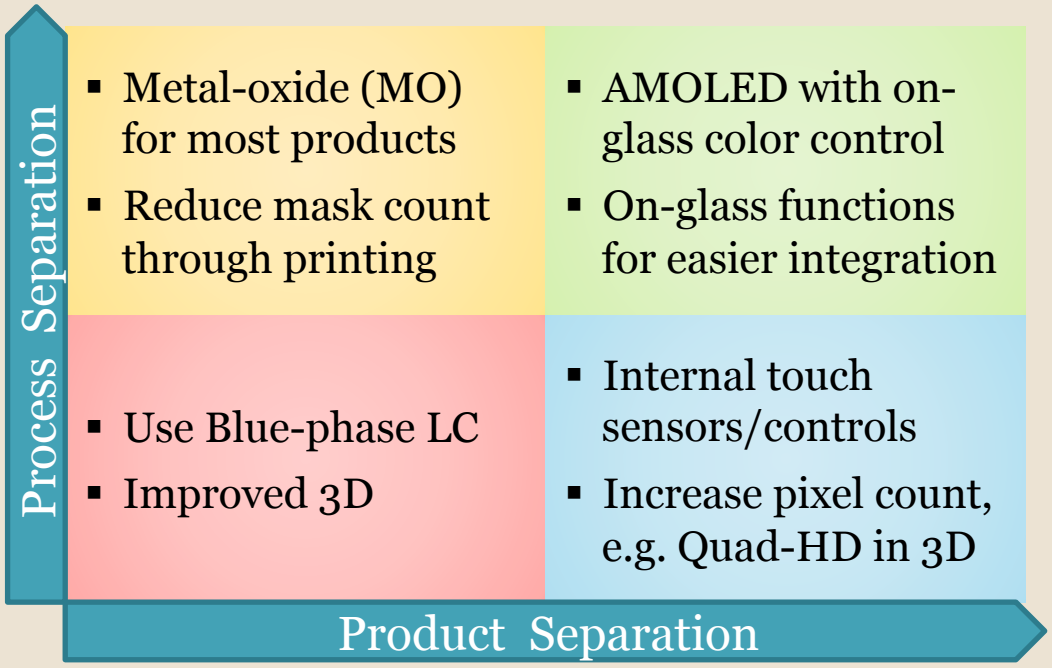
So far, most so-called unique technology, such as IPS versus MVA, has not created real separation. Consumers have not perceived the difference.

Leaders must create more separation between them using processes or products customers or consumers see as unique offerings.

JV partners and new entrants may want such know-how, but leaders should retain control.

Tensions, commercial and political, might arise but differentiation is crucial.

Examples of Process and Product Separation



Our conceptual diagram of strategies based on relative technical or financial strength

Summary—slower capacity growth has not been enough… real differentiation is needed

Slower capacity growth has not enabled slower price decline

- The amount of capacity added each year has remained similar but the annual growth has decreased
- So far, the areal price of AMLCD has fallen at a constant rate over time
- In addition, price has declined at a consistent rate as capacity doubles
- If producers add capacity more slowly, they may be able to slow the pace of price decline, which has squeezed profit margins over time

AMLCD profits may rise if panel makers differentiate their capacity

- Capacity growth started to slow in 2007 but prices continued falling
- New fabs were used to make more panels, not larger panels
- This reduced depreciation charges per m^2 but material costs increased
- The supply of panels increased in most market segments
- Producers should differentiate their capacity so it does not serve all market segments
- They should also consolidate and constrain supply where possible

We hope you find these ideas provocative and useful: your decisions can alter the future

- Our principal consultants have advised on more than $10b of deals in the display industry
  - Market entry for suppliers of flexible materials and touch panels
  - CapEx valuations for bankers, investors and regulators
  - Joint ventures for electronics and display makers
  - IP valuations and sales for institutional investors
  - Acquisitions for chemical suppliers
- Our principal consultants are realists
  - Investments in displays may have benefitted consumers more than investors but…
  - Reinvestment in AMOLED or other alternatives might create a winner-take-all, DRAM-like scenario
- Let's consider the opportunities together…