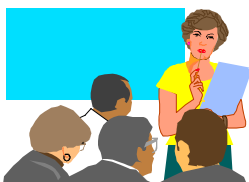


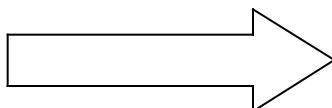
## I. Corporate Governance Analysis

### A. Management and Stockholders

#### *Balance of Power*



Stockholders



Incumbent Managers

Taken as a whole, the balance of power at the four following firms, Teradyne, Lam, KLAC-Tencor and Applied Materials lies clearly with the incumbent managers for the following reasons.

- ☛ With the exception of AMAT, insiders hold at least 40% of all board seats. In addition, anywhere from 8% to 33% are held by customers, suppliers or legal councils of the firm.
- ☛ Some of the power that these managers have emanates from their stock holdings. Primarily KLAC, Lam and Teradyne insiders hold over 4% of their respective company's stock. This is compared to a 2.99% average for the semiconductor capital equipment industry.
- ☛ One person in particular has himself on three of the boards in the analysis, Mr. James W. Bagley. The exception is AMAT.

#### *Manifestations*

One indicator of the power that incumbent managers yield is their compensation. Here is a comparative on our four firms. One should note that the cash salary despite being attractive on an absolute basis, is really secondary to the stock options imbedded in the overall compensation (which with the continued volatility of the underlying shares at times worth millions).

CEO	Company	Salary	Bonus	Stock Options
James C. Morgan	Applied Materials	\$671,539	\$602,640	160,000 shares
James W. Bagley	Lam	\$100,000	No Participation	475,000 shares
Jon D. Tompkins	Klac-Tencor	\$389,589	\$396,462	100,000 shares
Alex V. D'Arbeloff	Teradyne	\$382,374	\$366,980	80,000 shares

### B. Financial Markets

All four firms are well followed by external sources. In addition, each company provides information to the public through its annual and quarterly reports, web-sites and corporate communication departments.

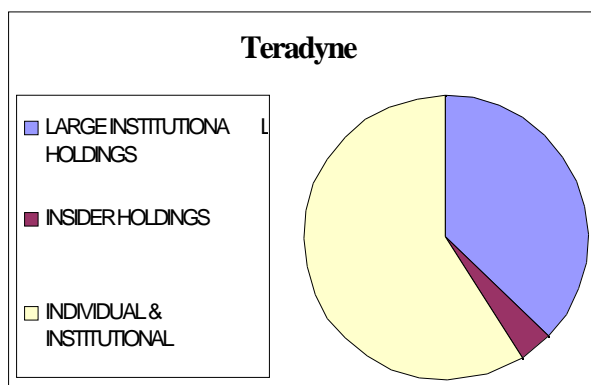
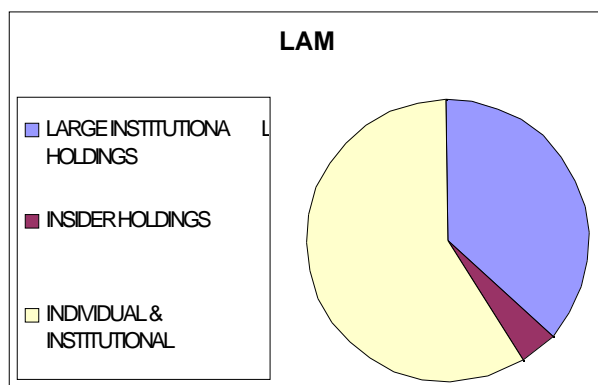
- ☛ AMAT is followed by 38 analysts with an average daily trading volume of approximately 6,500,000 shares per day.
- ☛ Lam is followed by 14 analysts with an average daily trading volume of approximately 1,400,000 shares per day.
- ☛ KLAC is followed by 17 analysts with an average daily trading volume of approximately 2,700,000 shares per day.
- ☛ Teradyne is followed by 10 analysts with an average daily trading volume of approximately 1,200,000 shares per day.

### C. Societal Constraints

None of the firms has a bad reputation with the public. At best, KLAC, Lam and Teradyne have a neutral standing in the public eye with AMAT garnering a slightly positive one with its Martin Luther King's "Acts of Service Recognition Award." AMAT is also actively involved in school computer donations and university grants programs. Finally, on an environmental front, none of the four have any pending litigation against them.

## II. Stockholder Composition

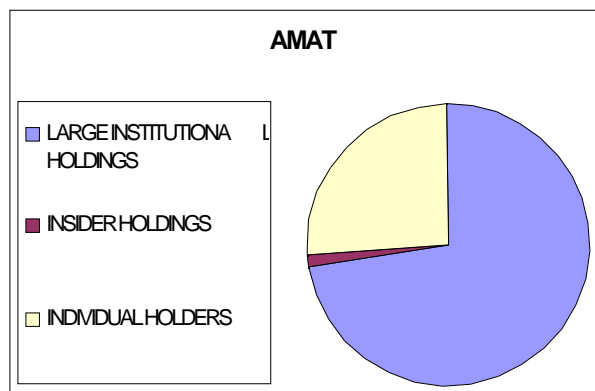
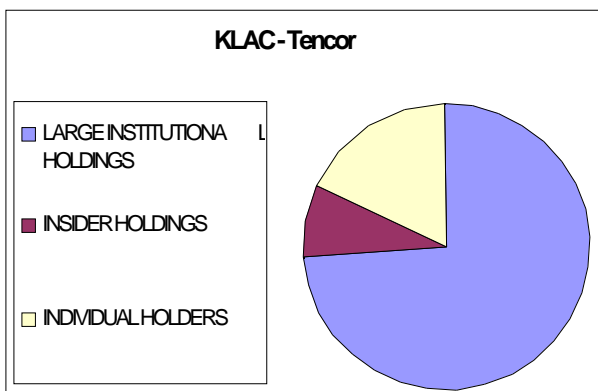
TERADYNE	ORGANIZATION	%
	The Capital Group Companies, Inc.	6.40%
	FMR Corporation	12.01%
	Metropolitan Life Insurance	5.77%
	Pioneering Management Corporation	7.30%
	State Street Research and Management	5.76%
	<b>LARGE INSTITUTIONAL HOLDINGS</b>	<b>37.2%</b>
	<b>INSIDER HOLDINGS</b>	<b>4.0%</b>
	<b>INDIVIDUAL &amp; INSTITUTIONAL</b>	<b>58.8%</b>



LAM	ORGANIZATION	%
	Fidelity Management & Research	14.46%
	T. Rowe Price	7.90%
	Capital Guardian Trust	7.30%
	Pioneering Management Corporation	7.00%
	<b>LARGE INSTITUTIONAL HOLDINGS</b>	<b>36.7%</b>
	<b>INSIDER HOLDINGS</b>	<b>4.2%</b>
	<b>INDIVIDUAL &amp; INSTITUTIONAL</b>	<b>59.1%</b>

KLAC-Tencor	ORGANIZATION	%
	<b>LARGE INSTITUTIONAL HOLDINGS</b>	<b>73.6%</b>
	<b>INSIDER HOLDINGS</b>	<b>8.5%</b>
	<b>INDIVIDUAL HOLDERS</b>	<b>17.9%</b>



AMAT	ORGANIZATION	%
	LARGE INSTITUTIONAL HOLDINGS	72.3%
	INSIDER HOLDINGS	1.2%
	INDIVIDUAL HOLDERS	26.5%

### Concluding points

- ☉ The insider holdings ratio at KLAC, Teradyne and Lam are very similar.
- ☉ All stockholders at these firms are not interested in dividends since historically none of these four firms have paid any dividends.
- ☉ At Teradyne and Lam there are several large institutions which own more than 5% of the outstanding shares. Therefore, at these two companies there is some, albeit muted, power wielded by these larger stockholders.

## III. Risk Profile

### Top-Down Beta Estimation

We first look at the risk profiles of our firms through a top down beta by performing a regression of monthly stock prices of each firm against the S&P 500 for the last five years. In so doing we came up with the following results.

Company	Standard Error	Beta	Intercept	Rf*(1-B)	Jenson's Alpha	Annual Return	R-sq.
TER	0.60	1.69	1.30	-0.31%	1.61%	21.1%	12%
LAM	0.61	2.37	-1.96	-0.60%	-1.36%	-17.6%	21%
KLAC	0.61	2.03	1.35	-0.45%	1.80%	23.9%	16%
AMAT	0.44	2.46	0.47	-0.64%	1.11%	14.2%	34%

- ☉ From the table the only significant under-performer of the last five-year bull market has been LAM at around a negative 17.6% return relative to the S&P 500.
- ☉ AMAT has the least amount of firm specific risk at around 66% with TER having the greatest amount of firm specific risk at around 88%. These numbers are the amount of risk that is diversifiable and therefore will go unrewarded in under CAPM.
- ☉ All four of the firms have sizable standard errors hinting that the top down beta is not a reliable measure of risk for these firms.
- ☉ Both KLAC and TER have low if not zero leverage so that their firm specific risk is due primarily to business factors.
- ☉ Lam has a sizable amount of leverage, approximately 31%, which will account for some of the firm specific risk with the rest being accounted for by business risk.

### Bottom - Up Beta Estimate

For the following reasons a bottom-up beta is a more reasonable and reliable estimate of the beta for our firms.

- ☉ The firms have high standard errors leading to the unreliability of this estimate.

To begin the bottom-up beta calculation, we compiled a list of about 10 firms (ours incl.) from which to average out an unlevered beta. Unfortunately, due to the capital-intensive nature of the semiconductor capital equipment business and the movement towards equipment integration (“clustering”) there are no sizable firms that specialize in only one segment. Instead there are several companies that are participants in various phases of the semiconductor manufacturing process. Hence, a business-line beta for

semiconductor capital equipment companies has been calculated to estimate a bottom-up beta for our four firms.

Company	Raw Beta	Market Cap (\$B)	Total Debt (\$M)	LT D/E
Lam Research	2.37	1.19	370.50	0.3113
Teradyne	1.69	3.25	21.50	0.0066
KLAC-Tencor	1.93	3.23	25.10	0.0078
Applied Materials	2.46	13.73	689.60	0.0502
Novellus Systems	2.24	1.54	76.70	0.0498
Ultratech Stepper	1.29	0.47	0.10	0.0002
Credence Systems Corp.	1.67	0.60	250.00	0.4167
Silicon Valley Group	1.18	0.67	6.50	0.0097
LTX Corp	1.85	0.18	32.40	0.1800
Kulicke & Soffa Industries	3.22	0.48	1.00	0.0021
<b>Averages:</b>	<b>1.99</b>	<b>2.53</b>	<b>147.34</b>	<b>0.0581</b>
<b>UnLevered Beta (overall)</b>	<b>1.92</b>	<b>assumption 36% tax rate</b>		

Using the above unlevered beta and applying it to our firms yielded the following results.

Company	Levered Beta	Cost of Equity	Debt Debt + Equity	Debt Rating	AT Cost of Debt	WACC
TER	1.93	16.40%	1.86%	AAA	3.90%	16.17%
LAM	2.32	18.56%	21.45%	BB	5.91%	15.85%
KLAC	1.95	16.50%	2.44%	AAA	3.67%	16.20%
AMAT	1.98	16.69%	4.98%	BBB	4.55%	16.09%

- ⊕ The risk free rate used was the long term government bond rate of 5.8%.
- ⊕ Synthetic debt ratings for TER and KLAC were calculated using the rating.xls spreadsheet, since neither company had publicly traded debt.
- ⊕ The cost of debt for LAM was based on the market rated rate of 8.76% and not the rate inferred by the rating and spread.
- ⊕ Operating leases were included in the debt calculations for TER and KLAC of \$29m and \$55m respectively.

#### IV. Investment Return Analysis

##### Typical Project

Project Type	Project Cash Flow Characteristics
Servicing - Equipment	Projects are likely to <ul style="list-style-type: none"> <li>⊕ Be short term</li> <li>⊕ Be primarily in dollar cash flows with a significant foreign component due to customers in Japan and Asia</li> <li>⊕ Be driven by increasing market share and an overall growing market</li> </ul>
Producing - Equipment	Projects are likely to <ul style="list-style-type: none"> <li>⊕ Be medium term, mainly because of the nature of the industry</li> <li>⊕ Be in dollar cash flows, although as international sales increases so will the foreign denomination of cash flows</li> <li>⊕ Be driven by a growing market and increasing market share</li> </ul>

Research & Development - Equipment	<p>Projects are likely to</p> <ul style="list-style-type: none"> <li>☉ Be long term, due to the nature of the project type</li> <li>☉ Be in dollars since most of the heavy R&amp;D is done in the U.S.</li> <li>☉ Be driven by the need to get to smaller and more complex IC's (as derived by Moore's law); right now most machines are configured for 0.35 microns; technology for 0.25 micron machines will mean another product cycle for these semi-cap companies</li> </ul>
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### Evaluation of Past Returns

The table summarizes are results for ROE for each of our four firms. The formula for ROE is

$$\text{Net income} / \text{average BV of equity for period } t \text{ and } t-1.$$

<i>AMAT</i>					
YEAR	1997	1996	1995	1994	1993
ROE	18.76%	28.87%	33.02%	28.12%	21.13%
Average over five years 25.98%					
<i>LAM</i>					
YEAR	1997	1996	1995	1994	1993
ROE	-5.60%	28.08%	31.19%	24.59%	16.03%
Average over five years 18.86%					
<i>KLAC</i>					
YEAR	1997	1996	1995	1994	1993
ROE	11.18%	30.85%	18.57%	17.68%	6.41%
Average over five years 16.94%					
<i>TER</i>					
YEAR	1997	1996	1995	1994	1993
ROE	14.35%	11.68%	23.90%	15.39%	9.20%
Average over five years 14.90%					

The following table summarizes our results for the WACC over the past 5 years. The formula for ROC is

$$\text{EBIT}(1-t) / \text{average BV of debt} + \text{average BV of equity (period } t \text{ and } t-1)$$

<i>AMAT</i>					
YEAR	1997	1996	1995	1994	1993
after-tax ROC	15.00%	24.68%	26.69%	21.76%	18.93%
average over five years 21.41%					
<i>LAM</i>					
YEAR	1997	1996	1995	1994	1993
after-tax ROC	-3.86%	23.97%	21.77%	16.60%	6.61%
average over five years 13.02%					
<i>KLAC</i>					
YEAR	1997	1996	1995	1994	1993
after-tax ROC	12.80%	27.80%	15.90%	15.30%	5.90%
Average over five years 15.50%					
<i>TER</i>					
YEAR	1997	1996	1995	1994	1993
after-tax ROC	12.68%	9.94%	22.58%	14.08%	8.79%
average over five years 13.61%					

### *AMAT*

The accounting returns were on an upward trend from 1993-1996. However, in 1997 the returns decreased somewhat. This is probably due to the Asian currency crisis and not bad projects since it was seen throughout the industry.

### *LAM*

The projects Lam Research is taking appear to be adequate because Lam is earning a return on equity slightly larger than their cost of equity. Lam Research's 5-year average return on equity is 18.9%, exceeding their cost of equity of 18.56%, albeit by a small amount.

The projects Lam Research is taking appear to be unfavorable by the return on capital measure. The return on capital averages out to 13.0% for the five years covered above. The cost of capital for Lam Research is 15.85%.

Both returns were trending strongly upward over the last five years until 1997. The majority of the problems in 1997 can be attributed to the Asian financial crisis, which had a large effect on Lam Research due to the large number of chip fabrication facilities on Southeast Asia. In fact, if a 1993-1996 average return is used in place of 1997's, return on equity moves to an even more impressive 25.0% five-year average, and return on capital moves to 17.2%, slightly more than the 15.9% cost of capital.

### *KLAC*

Compared to the previously calculated Cost of Equity of 16.6%, KLA-Tencor is earning slightly more on its projects than that demanded by its equity shareholders (as evidenced by its average ROE over the past 5-year period). This excess return might be further understated due to the charges to net income KLAC has taken in recent years to complete several acquisitions. In the short-term analysis, however, the firm is not earning sufficient net income for its equity holders, and thus, could be considered to be choosing bad projects.

Compared to the cost of capital, average ATROC 12.0% trails this benchmark. This indicates that the firm is not picking good projects. Again, a short-term analysis would reveal concerns regarding the past year's decrease in ROC.

The trends in ROE and ROC have generally been increasing over the past 5 years. However, in the last year, due to the merger with Tencor, the company accessed a total charge of \$76.8 million for merger related expenses and in process R&D write-offs. Excluding this charge increases 1997 ROE to 16.0%. This downward pressure in ROE in the past fiscal year is attributed to the general slow down in the semiconductor industry (due to over-capacity) coupled with a currency crisis in South East Asia. Should both of these trends continue, then KLAC's profitability will continue to come under pressure.

Accounting return, if taken over the long term, is a fair measure of the returns that this firm is making on its projects. Long term returns are stressed due to the cyclical nature of the semiconductor capital equipment industry.

### *TER*

This firm did very badly in 1996, the year of correction for the semiconductor test systems segment of this industry. Although the other three did incredibly well in these years, TER is perhaps the least similar of the four. In addition, TER completed the acquisition of Megatest at the end of 1995. That made them the world's second largest supplier of DRAM test systems. Too bad 1996 was the year of overcapacity in the DRAM chip market, which probably had some impact on the ROE and ROC. In any case, 1996 served as the anchor that pulled down the overall accounting returns.

*Economic Value Added*

1997	AMAT	LAM	KLAC	TER	INDUSTRY
Equity EVA	\$252,144,055	\$1,141,800	(\$54,992,025)	(\$13,300,000)	\$12,532,928
Firm EVA	\$196,478,270	(\$15,173,000)	(\$37,220,000)	(\$23,270,000)	\$51,948,096

**V. Capital Structure Choices**

*Benefits of Debt*

	Teradyne	KLAC	Lam Research	AMAT
Tax rate	35%	39.4%	35%	37.61%
EBITDA/firm value	8.79%	7.86%	-1.07%	7.1%

**Teradyne** primarily funds all of its projects and capital needs through retained earnings. The company used cash to fund additions to property, plant and equipment of roughly 75 million dollars in 1996 and 93 million dollars in 1995. In addition, cash was used to repurchase stock to the tune of 5.0 million shares of stock on the open market. Teradyne will be most likely to use a moderate amount of debt.

$$EBITDA/Firm\ Value\ (1997) = \$234,450,000/\$2.67\ Billion = 0.0879$$

In Fiscal 1997, **KLAC** had an effective tax rate of 39.4%. Federal taxes accounted for 35.0%, while State income taxes net of federal benefit amounted to 3.3%. Depreciation and amortization amounted to \$52.34 million in 1997 and was included in COGS on the income statement.

$$EBITDA/Firm\ Value\ (1997) = \$258,720,000/\$3.29\ Billion = 0.0786$$

The firm seems to have taken good projects in the past, as ROE in the 3 years prior to 1997 were significantly higher than the cost of capital. It should be noted that **KLAC** (like many other firms in this industry), do not need debt in order to be responsive to shareholders. Instead, many shareholders are content to “vote with their feet” and sell the stock in response to management announcing an unfavorable project or an ill-advised acquisition. Hence the extreme volatility in the stock price.

**Lam Research** had a net loss in 1997, leading them to record a tax benefit of 48.5% of their pre-tax loss. The company had depreciation and amortization expenses of \$53,109 in. In addition to the depreciation deductions, Lam also has R&D tax credits to lessen taxable income. Finally, Lam Research’s recent move to issue \$310 million in medium-term bonds will add significantly to their interest expense, which will lower taxable income as well.

According to Lam Research’s return on equity and capital, Lam is taking on investment projects that yield returns approximately equal to Lam’s cost of equity and capital. Since institutional investors own the largest part of Lam Research, I would expect the biggest penalty of not being responsive to shareholders to be a mass exodus from the stock, sharply lowering its price. With the large amount of stock options used as compensation for managers in the semiconductor industry, congruence between equity investors and management objectives can be assumed.

Lam recently levered up its debt ratio to 31% by issuing \$310 million in medium-term notes. This amounted to an estimated additional interest cost of \$27 million dollars, a significant portion of Lam’s EBITDA. Given this level of indebtedness, I expect a large amount of discipline has been instilled in Lam Research’s management already.

**AMAT** had depreciation expenses in 1997 of \$219.43 (in millions). This lessened the tax bite somewhat but the company had a tax rate of 37.6% in 1997 due to a non-deductible charge for in-process research and development of \$59.5 million.

$$EBITDA/firm\ value = \$986,150,000/\$1,3845,410,000 = 7.1\%$$

The company does seem to take on good projects. The ROE exceeded the cost of equity and the ROC exceeded the cost of capital in 1997. As is common throughout this sector, if investors are not satisfied with management's decision making, they will sell the stock. Therefore, debt issuance is not necessary to keep management in line.

#### *Cost of Debt*

The table below displays the volatility in operating income of the four companies we analyzed.

YEAR	Teradyne	KLAC	Lam Research	AMAT
1988	190.88%	-9.66%	-125.4%	3290.87%
1989	-12.62%	47.68%	226.26%	18.35%
1990	-221.82%	-1.82%	-203.41%	-29.38%
1991	211.44%	-71.92%	-203.99%	-10.62%
1992	15.02%	-208.98%	61.83%	37.84%
1993	87.53%	-298.49%	84.4%	125.62%
1994	110.71%	272.09	113.85%	105.72%
1995	126.20%	104.71%	96.64%	105.84%
1996	-49.75%	261.08%	79.86%	33.82%
1997	42.76%	-30.34%	-125.72%	-17.44%
<b>Sta. dev. Years 88 - 97</b>	<b>127%</b>	<b>180.73%</b>	<b>155.29%</b>	<b>1029%</b>
<b>Sta. dev. Years 90 - 97</b>	<b>132%</b>	<b>204.22%</b>	<b>140.03%</b>	<b>62%</b>
<b>Average 88 - 97</b>	<b>50%</b>	<b>6.44%</b>	<b>-2.27%</b>	<b>66%</b>
<b>Average 90 - 97</b>	<b>40%</b>	<b>29%</b>	<b>-12.07%</b>	<b>44%</b>

Teradyne's operating income increased from 1991 to 1995. 1996 was a down year, but the company recovered in 1997. Given the inherent volatility in the last ten decade of operating income, it's easy to see what would concern bondholders and stockholders the most if Teradyne were to take on a substantial amount of debt. Because in the face of bankruptcy, the only ones who seem to get paid are the government and the lawyers. Therefore, some flexibility is desirable.

Considering that KLAC (even with operating leases included) has only \$80.14 million in debt, its 1997 EBIT of \$206.38 million is sufficient to pay off all of its existing debt! However, the stability of these cash flows could be questioned. Over the past several years, the industry and KLAC in particular, have experienced tremendous growth. For KLAC, its 5-year average growth rate in EBIT has amounted to +181.21%.

It would be very easy for bondholders to observe what equity investors are doing. Since KLAC is one of the top ten semiconductor equipment manufacturers in the world and is a member of the S&P 500, there are sufficient analysts and investors following the company that bondholders should have no trouble collecting information regarding the company. The assets are tangible (the recent merger with Tencor Instruments was a pooling transaction).

Due to the long lead times for delivery of semiconductor equipment, KLAC often has several months of backlog with which it can forecast future demand for its products. This has of course led to the well-watched "book-to-bill" ratio (a measure of how many new order are received per order shipped). In addition, discretionary R&D amounted to well over \$100 million annually. These facts allow KLAC to better forecast their future investment opportunities and financing needs. Due to the cyclical nature of the

semiconductor industry (as noted above in the variability of operating income), KLAC values the flexibility of having low leverage.

Lam Research spends large amounts on capital expenditures and changes in working capital. Lam Research had a strong upward trend in operating income until the recent slowdown in semiconductor demand and the Asian Crisis. Clearly, the variability in Lam's operating income make taking on extremely large amounts of debt unwise.

Lam Research is one of the ten largest semiconductor companies in the world, and approximately twelve Wall Street research analysts follow the stock. Because of this, debt investors should not have a problem uncovering the activities of equity investors. The debt Lam recently issued is convertible, adding another layer of security for bondholders.

Lam Research has a large amount of tangible assets, including plants and equipment to manufacture semiconductor-manufacturing equipment. However, an appreciable amount of Lam's value lies in the proprietary patents and production methods it possesses.

AMAT's operating income has been increasing over the past 5 years. Last year was an outlier, primarily due to the Asian currency crisis. The average change in operating income over the past five years is 366%. This is so high because the growth rate from 1987-1988 was tremendous and very unusual. The standard deviation was very high because of this one observation.

The current cash flows are high enough to cover almost all of the debt outstanding. Most of the company's assets are tangible, except for patents and goodwill. It is very easy for bondholders to see what stockholders are doing. Many equity analysts cover the company and thus research reports are easily accessible. While it is not very easy for the firm to forecast future investment opportunities because of the difficulty in estimating demand for its products, the previously cited book-to-bill number offers some cushion. Despite this, the industry remains a cyclical industry and thus varies a lot with economic conditions. For this reason, the company prefers more flexibility and less leverage.

## VI. Optimal Capital Structure

*Current cost of Capital for each firm*

YEAR	Teradyne	KLAC	LAM Research	AMAT
Cost of debt	3.9%	3.67%	5.74%	4.6%
Cost of equity	16.4%	16.5%	18.76%	16.6%
Cost of Capital	16.16%	16.12%	15.74%	16%

The average cost of capital for the four firms is 15.975%. In order for all of the firms to get to their respective optimal cost of capital (and thus maximize firm value), they all will have to take on more debt.

*Weighted Average Cost of Capital at different debt ratios (This table is on the following page)*

DEBT RATIO	TER	KLAC	LAM	AMAT
0%	16.28%	16.48%	16.62%	19.11%
10%	15.77%	15.86%	16.13%	18.44%
20%	15.46%	15.36%	15.74%	17.86%
30%	15.74%	15.12%	15.66%	17.75%
40%	15.82%	14.91%	15.81%	17.48%
50%	17.33%	15.05%	15.94%	17.76%
60%	19.76%	15.41%	17.46%	19.51%
70%	20.76%	17.31%	18.21%	20.26%
80%	21.76%	18.06%	21.21%	21.01%
90%	22.76%	18.81%	22.21%	24.33%

The optimal debt ratios correspond to the following optimal firm values:

#### Firm Value- at optimal debt ratio

	TER	KLAC	LAM	AMAT
<i>Debt level</i>	20%	40%	30%	40%
<i>Firm Value - no growth</i>	\$ 2,844,332	\$ 3,613,429,072	\$1,558,451,954	\$14,873,069,633
<i>Firm Value - growth</i>	\$ 2,935,887	\$ 3,829,040,217	\$1,566,176,730	\$15,496,409,815

If a rating constraint were imposed on any of the firms, it would most likely be BBB1 (minimum investment grade) due to the volatility inherent in the industry. Couple this with a "stability in operating earnings" constraint and we get the following results in firm value.

#### Firm Value- w/ rating constraint

	TER	KLAC	LAM	AMAT
<i>Debt level</i>	10%	20%	20%	20%
<i>Firm Value - no growth</i>	\$ 2,732,183	\$ 3,540,961,467	\$1,550,082,131	\$14,559,325,763
<i>Firm Value - growth</i>	\$ 2,741,073	\$ 3,696,196,189	\$1,551,779,591	\$14,977,704,843

#### Relative Analysis

COMPANY	DEBT RATIO (MV)	DEBT RATIO (BV)	EFFECTIVE TAX RATE
TERADYNE	1.9%	5.4%	35.0%
KLAC-TENCOR	2.4%	2.5%	39.4%
LAM RESEARCH	23.7%	41.1%	31.6%
APPLIED MATERIALS	5.2%	21.0%	37.6%
Semiconductor Capital Equipment	6.5%	17.3%	34.1%

Lam Research has a much higher debt level than the typical semiconductor equipment manufacturer. This may be due to a belief by Lam that earnings volatility will drop and the shift to optimum debt level does not endanger the company. KLAC has lower debt than the industry with greater insider holdings. AMAT has a fairly low debt ratio compared with its optimal ratio of 40% and the industry average of 6.49%.

## VII. Mechanism of Moving to the Optimal

### *The Immediacy Question*

The following is a summary of the leverage position and attractiveness for takeover of each of our firms, as well as an estimation of the bankruptcy risk.

**Applied Materials:** The firm is underlevered but is unlikely to be the target of a hostile takeover. AMAT is one of the largest companies in the semiconductor industry. The stock has done very well over the past few years, except for 1996.

**KLAC-Tencor:** While KLAC is underlevered, it does not represent a firm that is a likely taken over. The firm is not small (one of the top ten semiconductor manufacturers in the world), and its stock has significantly outperformed the S&P 500 over the past 5 years. Furthermore, compared to the industry, KLAC has a higher percentage of insider holdings.

**Lam Research:** Given the high volatility of Lam research's business, I do not believe they are underlevered at their current debt ratio. The move to 30% debt would add approximately \$100 million dollars in additional debt on Lam's balance sheet, requiring roughly \$8.5 million in interest costs annually. The return to this increased leverage is very small in terms of lowered cost of capital and firm value. Lam Research has traditional returns on capital and equity that approximate or exceed its costs of capital and equity. The combination of the Asian crisis, a recent slowdown in world semiconductor demand, Lam's intermediate size, large institutional holdings and poor stock performance make Lam a takeover target. This may be one of the reasons for the recent addition of sizable amounts of debt to Lam's balance sheet. The current debt rating of Lam Research is one notch below investment grade, indicating scrutiny from rating agencies, but not a strong likelihood of bankruptcy. Further addition of debt would lower Lam into a junk bond rating.

**Teradyne:** Teradyne's actual debt ratio of 1.89% is below the market average of 6.49% and below its optimal debt ratio of 20%. So the firm is underlevered. Teradyne is not a potential takeover target because it has one of the larger market caps in the industry (\$3.4 billion), has delivered excellent returns to investors (39.9% annualized over the last five years) and has a fairly large amount of insider holdings (4.0%).

### *Alter Financing Mix or Take Projects*

This section analyzes our firm's project history and the type of investors to determine whether cash should be returned or new projects should be undertaken.

**Applied Materials:** Given the industry that AMAT is in, it will probably take projects to develop machines capable of manufacturing more technologically advanced semiconductors (faster and smaller). As long as there are no unexpected currency crises, AMAT can expect to make approximately the same return on projects as it has in the past.

**KLA-Tencor:** In the future, KLAC is forecasted to concentrate on its core yield management business. This will involve designing, manufacturing, and servicing the equipment used by semiconductor makers as they migrate to smaller linewidths on integrated circuits (0.35 to 0.25 microns). Due to the higher complexity and cost of these new semiconductors, detecting defects during the manufacturing process becomes more critical. This augurs well for KLAC's future projects. Except for 1997, the 1990's have shown that KLAC takes on good projects. KLAC has not historically paid dividends. Hence its shareholders are most likely to prefer capital gains (in the form of stock buybacks).

**Lam Research:** Lam Research has historically taken projects with returns that approximate Lam's costs. If Lam wished to further lever up their debt level, they should do so by taking on new projects.

The strategy of taking on new projects also fits the stockholder profile of Lam. The institutional investors holding the overwhelming majority of Lam are not interested in returned cash in the form of dividends or stock buybacks. They are looking for Lam to invest in high-risk, high-return projects and earn appropriate returns on them. Therefore, Lam should be taking on new projects using debt issuance's to pay for them.

**Teradyne:** In the future, the major players in semiconductor industry are forecasted to concentrate on their core yield management business. This will involve designing, manufacturing, and servicing the equipment used by semiconductor makers as they migrate to smaller line-widths on integrated circuits (0.35 to 0.25 microns). Due to the higher complexity and cost of these new semiconductors, detecting defects during the manufacturing process becomes more critical. Unfortunately, these advances are more favorable to front-end companies and not back-end equipment suppliers such as Teradyne. The industry is trending towards technology promoting smaller linewidths and larger wafer sizes, both of which will not fare well for certain types of back-end equipment. Although the industry is forecasted to have strong growth for the next five to ten years, back-end equipment growth will lag front-end growth.

#### *Financing Type*

The following is a summary of our firm's value and operating earnings versus changes in macroeconomic factors and how they affect the kind of financing that should be used:

#### **Applied Materials**

Y Variable	X Variable	Intercept	t-value	Slope	t-value	R <sup>2</sup>
in Firm Value	in Interest Rates	0.59	4.33	-23.89	-2.39	0.53
in Firm Value	in Weighted \$	0.66	2.78	-0.58	-0.12	0.003
in Firm Value	in Inflation	0.60	2.88	-11.7	-0.72	0.09
in Firm Value	in GDP Growth	0.89	2.03	-8.36	-0.5	0.06
in Op. Income	in Interest Rates	0.55	2.23	3.19	0.18	0.01
in Op. Income	in Weighted \$	0.73	3.98	-7.07	-1.85	0.46
in Op. Income	in Inflation	0.71	3.19	-27.73	-1.6	0.34
in Op. Income	in GDP Growth	0.23	0.42	11.9	0.64	0.08

AMAT's debt should be long term (approximately 24 years). Operating income is very sensitive to changes in the dollar so a portion of the debt should be in foreign currency. Due to the inflation rate sensitivity, a portion of the debt should be floating rate debt. Applied Materials should also attempt to make the debt responsive to changes in the economic cycle due to their sensitivity to business cycle downturns.

#### **KLA-Tencor:**

Y Variable	X Variable	Intercept	t-value	Slope	t-value	R <sup>2</sup>
in Firm Value	in Interest Rates	0.41	1.77	-1.34	-0.07	0.001
in Firm Value	in Weighted \$	0.49	2.55	-7.30	-1.88	0.305
in Firm Value	in Inflation	0.40	1.78	-10.7	-0.65	0.05
in Firm Value	in GDP Growth	0.001	0.00	18.0	1.09	0.13
in Op. Income	in Interest Rates	0.31	0.56	79.88	1.69	0.26
in Op. Income	in Weighted \$	0.14	0.24	-7.7	-0.63	0.05
in Op. Income	in Inflation	63.7	2.05	-441	-0.22	0.14
in Op. Income	in GDP Growth	-0.49	-0.39	24.0	0.51	0.03

The duration (interest rate sensitivity) of KLAC's asset values is about 1.3 years. Its debt should have at least as long a duration. KLAC's operating income shows a tremendous variation from its firm value reaction to changes in interest rates. GDP growth seems to have a tremendous effect on KLAC firm value and operating income. This is likely due to the additional volatility seen in the high tech sector. Over the last ten years, a strong dollar has hurt KLAC's firm value and operating income. This is most likely due to the significantly overseas exposure of KLAC's business; as sales to Japan, Korea, Taiwan, and Southeast Asia would be hurt by a strong dollar. KLAC's firm value and operating income show a strong negative bias toward changes in the inflation rate.

Overall, any debt KLAC takes on should be short term, currency denominated (according to percentages of revenue or operating income from overseas currencies), and fixed rate debt.

### Lam Research

Y Variable	X Variable	Intercept	t-value	Slope	t-value	R <sup>2</sup>
in Firm Value	in Interest Rates	0.62	2.47	-19.48	-1.05	0.18
in Firm Value	in Weighted \$	-5.83	-0.82	0.06	0.91	0.14
in Firm Value	in Inflation	0.48	1.95	-30.79	-1.71	0.37
in Firm Value	in GDP Growth	1.14	1.95	-17.74	-0.87	0.13
in Op. Income	in Interest Rates	0.72	1.68	-4.30	-0.14	0.004
in Op. Income	in Weighted \$	14.87	1.48	-0.14	-1.41	0.29
in Op. Income	in Inflation	0.71	1.50	-2.68	-0.08	0.001
in Op. Income	in GDP Growth	1.74	2.10	-38.89	-1.35	0.27

Looking at the Firm Value regressions, all the regressions show at least a moderate amount of predictive ability. This makes sense because a part of any firm's debt and equity value is tied into macroeconomic factors beyond the firm's control. The regressions of Lam's operating income against the same macroeconomic factors are less promising. Only the regression against the weighted dollar and GDP growth have moderate predictive power. This may be due to the availability of overseas substitutes for Lam's products.

According to these regressions, Lam should issue 20-year, fixed-rate debt that protects against market downturns. Lam should consider issuing some of this debt in foreign-denominated currency.

### Teradyne

Y Variable	X Variable	Intercept	t-value	Slope	t-value	R <sup>2</sup>
in Firm Value	in Interest Rates	0.26	1.53	-15.53	-1.16	0.16
in Firm Value	in Weighted \$	0.32	1.77	-0.68	-0.68	0.05
in Firm Value	in Inflation	0.22	1.93	-22.87	-22.87	0.61
in Firm Value	in GDP Growth	0.48	1.28	-5.94	-0.44	0.03
in Op. Income	in Interest Rates	0.24	0.54	-30.10	-0.86	0.10
in Op. Income	in Weighted \$	0.33	0.73	0.94	0.11	0.02
in Op. Income	in Inflation	0.11	0.39	71.91	-3.24	0.60
in Op. Income	in GDP Growth	0.22	0.22	6.46	0.19	0.05

Both Teradyne's firm value and operating income are sensitive to interest rate changes. The FV value regression implies a duration of 15.5 years and the OI regression yields an even higher duration of 30

years. As suspected and confirmed by observation of historical operating income, Teradyne's FV and OI is cyclical with regards to changes in GDP. Teradyne is marginally sensitive to the strength of the dollar suggesting that Teradyne does not have much international exposure and should venture into foreign debt. Since Teradyne's FV and cash flows are negatively impacted by inflation, suggesting that Teradyne not take on any floating rate debt.

Based on the analysis of Teradyne, it is recommended that Teradyne not issue any debt beyond the constrained level of 10%. Due to their sensitivity to the change in GDP, Teradyne is highly cyclical and therefore should not take on the optimal debt ratio of 20%. Furthermore, from the previous section, a standard deviation of 127% in operating income is another indication that Teradyne should exercise caution before moving beyond the 10% debt ratio prescribed by the constraints.

## VIII. Dividend Policy

This section details the history of dividends and stock buybacks for our firms, and analyzes whether they should return more or less:

### *Historical Dividends*

**Applied Materials:** Applied Materials has never paid out dividends. The company bought back \$115,249,000 worth of stock in the past few years. Currently, Applied Materials has \$448 million in cash on their balance sheet.

**KLA-Tencor:** KLAC does not have a history of paying out any cash dividends. Over the past ten years, the company has bought back \$6,040,000 worth of capital stock. KLA-Tencor has \$279 million in cash on its balance sheet.

**Lam Research:** Lam Research has not issued cash dividends or repurchased stock in recent years, typical for a high-growth technology company in the semiconductor industry. Cash in the amount of \$164,000,000 resides on Lam's balance sheet.

**Teradyne:** Teradyne historically does not pay dividends, like many of the semiconductor capital equipment. Teradyne has over the past 10 years repurchased \$161.25 million dollars worth of stock. The current cash balance for Teradyne is \$99,330,000 in cash and marketable securities.

### *Firm Characteristics*

**Applied Materials:** It is easy for the company to convey information to financial markets so it does not need a dividend policy to confer additional information. The average stockholder in AMAT does not expect dividends. The firm can forecast future financing needs up to a point fairly easily due to the lag in the market for semiconductor equipment. But due to the cyclical nature of the industry, flexibility is important.

**KLA-Tencor:** KLAC has multiple avenues to convey information regarding the company to investors. It does not need dividend policy as another means of communication. Furthermore, the average shareholder in the firm has not, and hence, likely does not, expect the firm to pay out cash dividends in the future. Instead, most shareholders would probably prefer stock buybacks over dividends.

KLAC, due to the available backlog information, can predict fairly well, its financing needs over a 6-month horizon. Beyond this period, the firm is subject to the whiplash gyrations of the overall semiconductor market. Therefore, preserving financing flexibility is extremely valuable to KLAC. There are no known bond covenants on the firms dividend policy.

**Lam Research:** With the extensive analyst coverage of Lam's industry, Lam can easily convey information about the firm's prospects without resorting to dividends. Well-known ratios such as the "book-to-bill" ratio ensure monthly investor scrutiny of Lam.

The average investor in this company, an institutional investor, would prefer the company to invest in attractive projects, and in the absence of near-term projects to buy back stock or build a small stockpile of cash for when attractive projects appear. Since firms such as Lam are supposed to have high-risk, high-return projects available to them due to their technological bent, investors do not wish to have cash returned to them unless the firm has an extended period without attractive projects.

Since Lam pursues projects to develop the equipment needed to manufacture semiconductors, and this equipment is complex and requires an extensive development process, Lam can forecast their financing needs well. A fair amount of flexibility is critical in the semiconductor equipment manufacturing industry, due to the cyclical nature of the business.

No known covenants exist binding Lam to certain dividend policies. Since Lam has not historically issued dividends and the bonds have a five-year maturity, the need for covenants has minimal. Lam's bonds are convertible at the rate of 11.4 common shares per \$1000-par of bond, this covenant helps ensure debtholders are not disadvantaged by stockholders by providing the option to convert debt holdings to stock holdings.

**Teradyne:** Teradyne communicates with the public through the numerous analysts covering its stock in addition to announcements through its public relations department. The average shareholder does not value dividends since Teradyne has not paid a dividend since the company went public. In fact most of Teradyne's shareholders value capital gains and stock buy-backs and not dividends.

Despite the cyclicity of the semiconductor test industry, Teradyne's management does considerably well hedging against this risk. After an incredible year in 1995, the industry had a downturn in 1996, yet Teradyne avoided posting a loss in that year. They hedged their risk through three methods, 1. Teradyne entered 1996 with a huge backlog in orders, 2. Teradyne anticipated the production slowdown and slowed down their production in return, and 3. Teradyne had increased sales outside the semiconductor industry. But even management's ability to predict the industry trend is subject to the whiplash gyrations of the overall semiconductor market. Therefore, preserving financing flexibility is extremely valuable to Teradyne.

## **IX. Dividend Policy: A Framework**

### *Historical FCFE and Dividends*

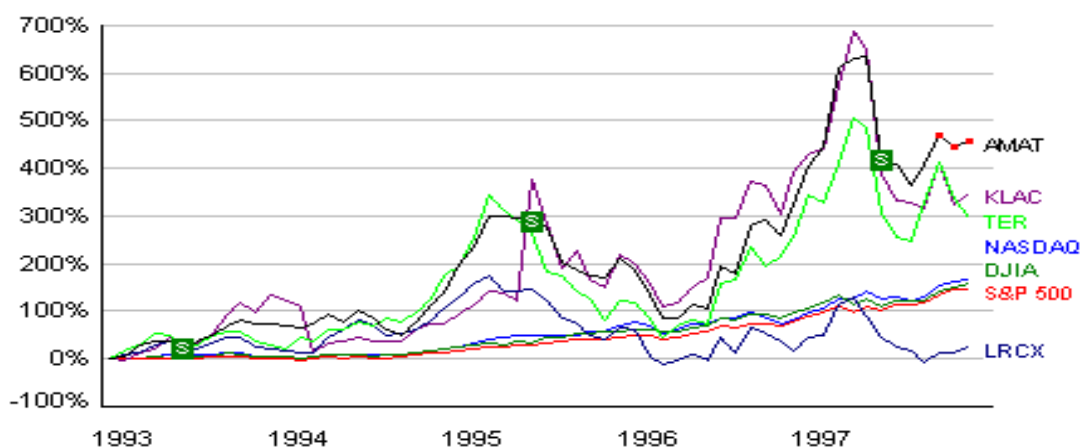
To evaluate to how much each of our companies could have paid out in dividends between 1993 and 1997, we calculated the free cash flows to equity for each. The following table summarizes our results (The table is on the next page).

Year	AMAT FCFE	LRCX FCFE	TER FCFE	KLAC FCFE
1997	\$398.89	\$92.1	(\$118.67)	\$227.95
1996	\$375.23	(\$16.22)	\$175.59	\$74.51
1995	\$661.50	(\$19.67)	\$22.34	\$33.59
1994	\$265.12	\$7.63	\$66.33	(\$1.35)
1993	\$62.75	(\$12.07)	\$59.59	(\$25.0)
<b>Average</b>	<b>\$352.7</b>	<b>\$10.4</b>	<b>\$41.0</b>	<b>\$61.94</b>

Average debt ratios over this time period for each were used to compute the free cash flows. Based upon this analysis, all the firms we studied could have returned money to its shareholders – either in the form of dividends or share buybacks. However, as already been noted, none of these firms currently pay out any cash dividends. Similarly, share buybacks have occurred infrequently and on a very limited basis (TER had the only share buyback of note: 5 million shares over the period in study). For example, in the case of KLAC: the firm could have returned \$310 million to shareholders over the last five years. Instead, it only repurchased less than \$6 million of stock during the same time frame. It should also be noted that this lack of share repurchases as a method of returning cash to shareholders is often restricted for these firms since several have used pooling-of-interests accounting for acquisitions.

#### Management Trust

Management's main corporate finance objective is to maximize shareholder value. By doing so, management garners the trust of shareholders over time. Examining the returns of our firms which the most widely cited indices yields:



As can be clearly discerned from the chart, AMAT, KLAC, and TER has significantly outperformed the S&P 500, the DJIA, and the NASDAQ Index over the past five years. Only LRCX is under-performing the benchmarks. This is also evident in the divergence of calculated Jensen's alpha for the 4 firms (KLAC, AMAT, TER: positive; LRCX: negative). This result yields insight into the types of investors attracted to the stocks of these companies. The stocks that are clearly out-performing are the stocks that generate the highest FCFE over the past five years, but don't pay any of it out as dividends. The lowest

FCFE generator, LRCX, also doesn't pay dividends, but is not performing well relative to its comparables. This indicates that investors in this sector are less concerned with actual dividend payout and are more concerned with FCFE generation. Hence, KLAC, TER, and AMAT have earned some flexibility in their dividend policy. It is interesting to note that the outperforming firms have on average higher institutional holders than the under-performing firm (60.9% institutional ownership vs. 37.2%). Thus, if institutional stockholders were to demand dividends, they would actually have more clout with the stocks that are performing well than the under-performing stock.

An evaluation of the 4 firms' investment policy also offered insight regarding the dividend policy. While 1997 was a tough year due to over-capacity and the Asian crisis, the previous analysis on accounting returns show that during cyclical upswings, there is a realizable potential of making returns in excess of the cost of equity and cost of capital. This evidenced by the outstanding accounting performances of all four firms during the 1994-1996 period. This cyclicity demands that the firms have some discretion and flexibility regarding dividend policy so that there is sufficient investment funds to take advantage of the upswings. For firms which have long operating histories (in an industry where companies are short-lived), their survival is an indication of prudent management.

Furthermore, as was evidenced in the prior section, due to the capital-intensive nature of the semiconductor equipment business and the attractiveness of projects, few firms in this industry pay out any dividends. This gives management some justification for not currently paying back cash in the form of dividends.

#### *Conclusions of Dividend Policy*

In summary, firms in this industry are expected not to pay out any dividends. This is due to the capital-intensive nature of the industry and the existing opportunities to invest in attractive projects. Instead, investors are more focused on FCFE generation and stock price performance. Accordingly, firms that outperform the market (KLAC, AMAT, and TER) have the trust of investors and more flexibility regarding dividends. Firms that do not (LRCX), have less flexibility. In the case of LRCX, their FCFE generation hasn't been prolific anyway, so the point may be moot.

## **X. Valuation**

#### *The Model*

We valued KLAC, AMAT, and TER, using

- ④ A 3-stage model, since all have substantial barriers to entry (due to technology leadership and established customer bases) and have high expected growth (due to the continued proliferation of semiconductors into everyday life).
- ④ A FCFF model, since the leverage at these firms are expected to change (move closer to an optimal as the firms mature).

We valued LRCX, using a

- ④ A 3-stage model, since it have substantial barriers to entry (due to technology leadership and established customer bases) and has high expected growth (due to the continued proliferation of semiconductors into everyday life).
- ④ A FCFE model, since the leverage is not expected to change (LRCX is already very close to optimum).

#### *Inputs to Valuation Models*

The inputs to the models are summarized in the "Semiconductor Capital Equipment Comp: Inputs to Valuation" chart. In addition, the following assumption is made:

- Ⓣ A resumption of growth (in earning, revenue, and returns) during the high growth period similar to the relative peak in 1994-1996 period. This is assuming that the Asia crisis is resolved and the continued demand for semiconductor equipment continues to grows geometrically (indirectly derived from “Moore’s Law”). Also, that the barriers to entry due to technology and mind share will continue to allow for rapid growth. Except for LRCX, which competes with AMAT directly, AMAT, KLAC, and TER are roughly in non-overlapping segments of the industry. This allows them to are share in the same growth in the semiconductor business in general without suffering a lost of margin due to competition. Incidentally, the compound annual growth rate in revenues over the 36-year history of the industry has been 22% p.a. It should be noted that LRCX’s slower growth rate relative to the other 3 firms is in part due to the fact it competes with a much larger AMAT.

### Valuation

Summaries of valuation for KLC, AMAT, and TER are included in the attached flowcharts at the end of the report.

The valuation results for **LRCX** are as follows:

#### High-Growth Period:

Length of High-Growth Period: **5 Years**

Growth Rate during High-Growth Period: **15%**

Revenue, Capital Spending and Depreciation will grow at **15%** during high-growth stage.

Working Capital will remain at a **stable %** of Revenues.

Approximately **23.7% of external financing** will come from debt.

The Beta for the High-Growth Period is **2.32**.

#### Transitional Period:

Length of Transitional Period: **5 Years**

Growth Rate will decline from **15%** in Year 5 to **5%** in Year 10 linearly.

Capital Spending will grow at **8%** during this period, while depreciation will grow at **12%**.

Revenues will grow at **10%** during this period, working capital remains a **stable percent**.

Debt Ratio will remain at **23.7%**.

Beta will decline linearly from **2.32** to **1.53** (Industry Average) during this period.

#### Stable-Growth Period:

Earnings will grow at a **5%** rate in perpetuity.

Capital Spending and Depreciation will **offset each other**.

Revenues will also grow at **5%** per year, working capital will remain a **stable percent**.

Debt Ratio will remain at **23.7%**.

Beta for the stock will be **1.00**. (Industry Average)

#### Results:

$$\begin{aligned} \text{Equity Value} &= \$74.28 / \text{share} \\ &\quad - \$35.01 / \text{share} \text{ (Value from Stable-Growth Model for Lam Research)} \\ &= \$39.27 / \text{share} \text{ (Value from Expected Growth)} \end{aligned}$$

$$\begin{aligned} \text{Firm Value} &= \text{Equity Value} + \text{Debt Value} \\ &= (37.98 \text{ shares} \times \$74.28 / \text{share}) + \$269 \text{ million} \\ &= \$2.8 \text{ Billion} \end{aligned}$$

The value of Lam stock reached a high of \$67.43 preceding the Asian crisis.

**Relative to market prices as of May 1, 1998:**

	<b>AMAT</b>	<b>KLAC</b>	<b>LRCX</b>	<b>TER</b>
Valuation Price	<b>\$38.54</b>	<b>\$45.56</b>	<b>\$74.28</b>	<b>\$39.52</b>
Market Price	<b>\$36.125</b>	<b>\$40.50</b>	<b>\$31.38</b>	<b>\$36.8125</b>
Overpriced/Underpriced by Difference	<b>Under by \$2.42</b>	<b>Under by \$5.06</b>	<b>Under by \$42.90</b>	<b>Under by \$2.71</b>

The results of our valuation process indicate that the market is undervaluing all four firms that we studied. This may be due to the continued unfavorable perception that the industry is receiving due to the Asian currency debacle. Similarly, the industry trades closely with the stocks of its customers (semiconductor companies) who are similarly receiving unfavorable perception due to over-capacity and the recent movement towards lower priced PC's.

It is possible also that we have overestimated the growth rates of our firms. The past several years growth has been especially robust and may not continue for another 5 years. To address such issues, a sensitivity analysis was performed changing: 1) the assumed growth rate, 2) the assumed stable debt/capital ratio. The summary results follow:

Growth Rate (during high growth period)	AMAT Per share value	KLAC Per share value	LRCX Growth Rate	LRCX Per share value	TER Per share value
20%	\$24.26	\$33.62	10%*	\$53.72	\$33.65
22%	\$27.84	\$38.04	12%*	\$61.33	\$37.46
24%	\$31.81	\$42.93	15%*	\$74.28	\$41.68
26%	\$36.19	\$48.33	18%*	\$89.28	\$46.34
28%	\$41.02	\$54.28	20%*	\$100.58	\$51.48

\*Note: Lam Research has much lower analyst growth estimates than the other firms.

Debt/Capital Ratio at Stable Period	AMAT Per share value	KLAC Per share value	LRCX Per share value	TER Per share value
10%	\$33.91	\$45.56	N/A*	\$39.52
20%	\$38.34	\$52.15	N/A	\$45.19
30%	\$44.54	\$60.91	N/A	\$52.71
40%	\$52.61	\$73.15	N/A	\$63.15
50%	\$64.03	\$91.44	N/A	\$78.61
60%	\$81.47	\$121.75	N/A	\$103.87

\*Note: Lam Research used FCFE model, since leverage assumed to be constant over time.