

# **Explaining ADR/Domestic Security Pair Trading Differences**

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## **Table of Contents**

- I. Introduction
- II. Evidence of ADR premia
- III. Theories on ADR/Domestic security pair spreads
  - a. Market-Based theories
  - b. Information-Based theories
- IV. The TSMC and Infosys experience
  - a. Statistical analyses of spread and co-movement drivers
    - i. Co-movement of ADR with local stock
    - ii. Cohabitation
    - iii. Relative liquidity
    - iv. Multivariate regression of spread and ADR movements
  - b. Qualitative analysis and outlook of regulatory and other non-quantifiable drivers of ADR premia
    - i. Case study of TSMC and Taiwan
    - ii. Specifics of Taiwan
- V. Conclusion
- VI. Bibliography

## **Introduction**

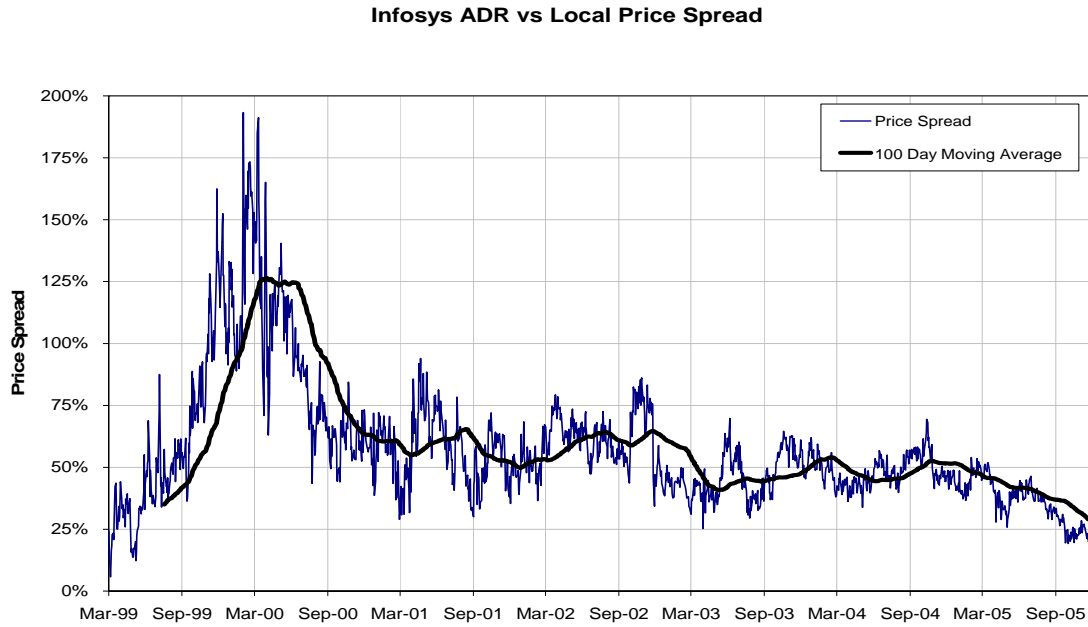
This study examines why securities that should trade at parity, deviate from one another in different markets around the world. We explore this topic through case studies of prices of American Depositary Receipts (ADR) and home-market shares for two of the most widely traded developing market companies in the world: Taiwan Semiconductor (TSMC) and Infosys (INFY). We identified the major theories on why such spreads exist and then attempted to employ these theories to explain ADR premia at TSMC and Infosys through quantitative and qualitative analyses.

In general, we found that while we could explain the longer term trend in the spreads, our analysis was not completely compelling when focusing on shorter term trends. Through statistical analysis, we were able to explain about half of the existing spreads at TSMC and Infosys. We found that the important explanatory variables concerned the issues of cohabitation and relative liquidity. Through more qualitative analysis, we also found that the impact of market-based regulatory restrictions is difficult to quantify and that premia are slow to react to adjustments to such regulations.

## **Presence of ADR spreads**

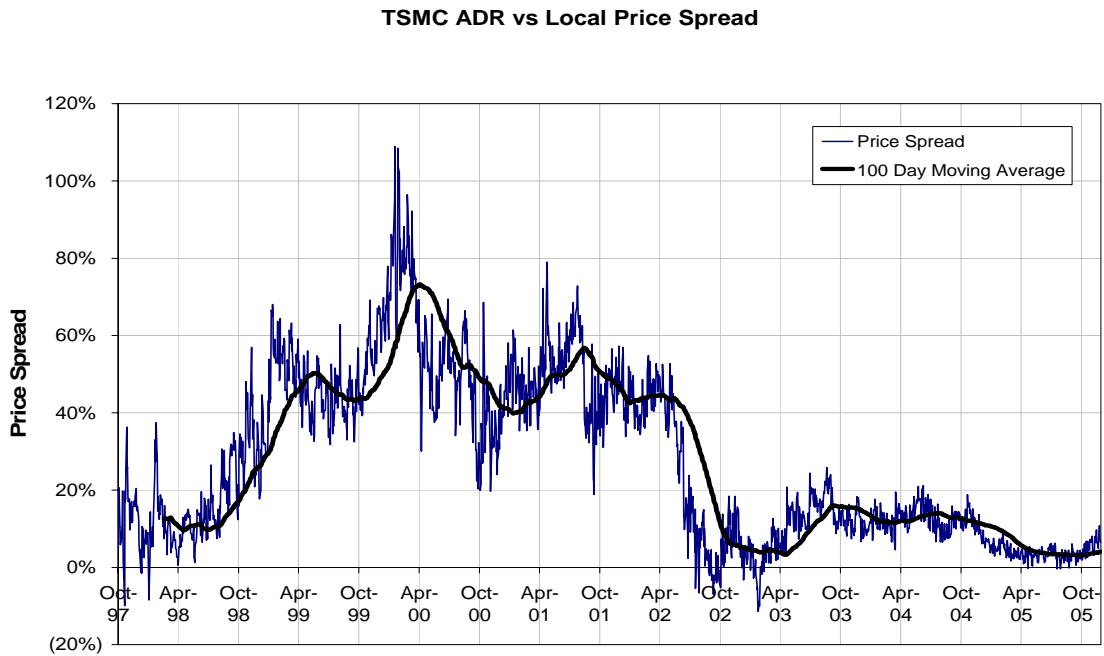
Price differentials between the securities of the same company trading in different exchanges are not only large, but also seem to persist over long periods of time. While examining the data for Taiwan Semiconductor (TSMC) and Infosys, we find that price differences between the locally traded stock and the US traded ADR are exceptionally large and at times the ADR trades at twice the value of the local stock. More surprisingly, however, these large spreads do seem to be arbitrated away, as one might expect. In the case of TSMC and Infosys such spreads have persisted for over five years. As we can see in Exhibits 1 and 2 below, ADRs have traded at a significant premium to the local stock since they were issued for both TSMC and Infosys.

### Exhibit 1: Infosys ADR spread



In the case of Infosys shown above, these spreads widened immediately after issuance in March 1999, widening to almost 200% by March 2000. While the spread has decreased since then, it has nevertheless averaged about 50% over the last five years.

### Exhibit 2: TSMC ADR Spread



TSMC shown above, exhibits a similar trend. After issuance in October 1997, the ADR spread over the local stock increased to over 100% by early 2000. This spread persisted in the 40-60% range from 2000 to 2002, after which it declined significantly and currently is less than 10%.

### **Why do spreads exist?**

According to the law of one price, in any efficient market, the price of two identical goods should be the same. If it were not, then an arbitrage opportunity is created with all buyers purchasing the good at the lowest possible price and all sellers attempting to sell at the highest possible price. The same argument applies to financial instruments as well. Two identical securities that offer the same pay-off should have exactly the same price. Consequently, since an ADR represents ownership in the underlying shares of a company, in an efficient market, the price of an ADR should be exactly the same as the price of the underlying basket of shares that it represents.

Spreads exist between the prices of the underlying stock and the ADR because of inefficiencies in the market that prevent investors from being able to arbitrage the spread. The price of any security is determined by the demand and supply characteristics in the market. Due to the inefficiencies that exist, what should be fungible securities (ADR and underlying security) end up not being that interchangeable, and therefore many of the supply and demand characteristics that determine the price of the ADR are different from the supply and demand characteristics that determine the price of the underlying security. This section attempts to elaborate and discuss the various inefficiencies that cause the prices of the ADR and the underlying security to deviate from the fundamental law of one price.

Experts<sup>1</sup> argue that these inefficiencies can be broadly grouped into two major categories of frictions or barriers.

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<sup>1</sup> This section draws heavily from the following two papers: Gagnon and Karolyi (2003) and Aggarwal, Dahiya and Klapper (2005). See bibliography.

- Market-based barriers, which include investment barriers faced by international investors in any domestic market
- Information and trading-based barriers, which reflect frictions the arbitrageurs face when either the information flow in the market (typically local) is asymmetric or the local market does not efficiently reflect idiosyncratic risk in the price of the underlying stock

The next few sections attempt to describe these inefficiencies in greater detail.

### **Market-Based Barriers**

Gagnon and Karolyi (2003) argue that there are several direct and indirect investment barriers faced by foreign investors. They claim that “investment restrictions constitute the most important direct, market-based source of international capital market segmentation likely to impede inter-market arbitrage activity across jurisdictions.” Some of these direct barriers include the following.

- Certain governments place restrictions on either the total amount of direct investment made by a foreign investor or the amount of investment/ownership stake in any one company or industry. As an example, the Indian government places restrictions on the ownership by foreigners in Indian companies in several industries such as media, civil aviation, banking, and retailing. India also places a ceiling on the percentage of its shares a company can list as ADRs. As a consequence, the prices of ADRs of companies that are in high demand (e.g. Infosys) get bid up significantly higher than the underlying shares since the ADRs are the only avenue available to foreign investors to invest in certain companies<sup>2</sup>.
- Foreign exchange controls and limits on the repatriation of capital limit investors’ ability to engage in cross-market arbitrage. Typically, arbitrage does not require

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<sup>2</sup> Team Interview with Steve Schneider, Merrill Lynch Emerging Markets Trading. November 15, 2005

the investment of up front capital since the capital required to purchase one of the securities is offset by the capital received from the short position in the second. Capital controls limit arbitrageurs ability to transfer cash obtained by shorting one security in one currency to purchase the other security in the cross-border market.

- Other direct barriers to cross-border arbitrage include: government tax authorities impose with-holding taxes on investment income earned by international investors; certain countries require all foreign investors to seek government approval before investing in their country.

In cases of negative ADR premiums, one of the major reasons for the spread to continue to exist is that several countries restrict investors from short-selling shares. Short-selling allows investors to bet on a drop in the price of a security and involves borrowing the underlying security from a broker/dealer and selling it in the open market. To exit the investment, the investor purchases the shares in the open market and returns them to the broker/dealer. Regulators in most countries believe that short-sales increase the severity of market panics and have regulations in place to prevent such from happening. Even in the US, investors are only allowed to sell a borrowed stock on an up-tick in the stock price, or at a price higher than the one at which a previous trade was executed. According to Gagnon and Karolyi (2003)<sup>3</sup>, short-selling was practiced in only 24 of 47 countries surveyed, and for almost half those countries that allowed short-selling, the restrictions had been lifted only around 1993. “The asymmetric treatment of short-sales in the ADR and home market can affect the scope for arbitrage in that deviations from price parity in which home-market prices are relatively higher than ADR prices that arise are less likely to dissipate quickly. Also, excess comovements relative to market indexes in the U.S. and home markets are more likely to arise as arbitrageurs in the home market are more likely to be hampered in their ability to incorporate private information into prices.”<sup>4</sup>

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<sup>3</sup> Their paper in turn references the following paper: Bris, A., W. N. Goetzmann, and Z. Ning, 2003, Efficiency and the Bear: Short Sales and Markets around the World, Working Paper, Yale School of Management.

<sup>4</sup> Gagnon and Karolyi (2003).

It is interesting to note that although we are analyzing emerging market stocks where the ADRs trade at a significant premium to the underlying stock, for most companies, the prices of the ADRs and the home-market stock lie within a 15 to 20 basis point band of each other.<sup>5</sup> For such companies, arbitrage opportunities are affected by the number of time zones that separate the US and home trading markets. Since stocks trade on news that is mostly released during local trading hours, it is difficult to arbitrage when trading sessions do not overlap, as is the case with Japanese markets. When trading sessions do overlap, the trading of securities is concentrated in the hours of overlap.<sup>6</sup>

Along with direct investment barriers that restrict foreign investors' ability to invest directly in the underlying stock, there are several indirect market-based factors as well that create a price disparity by causing the investor to consciously decide to invest in the ADR over the underlying stock. These factors cause the demand for the ADR to be higher than that of the underlying stock, and along with direct factors that impede cross-border arbitrage, lead to a longer-term premium to exist.

Aggarwal, Dahiya and Klapper (2005) analyzes the investment allocation decision of mutual fund managers to invest in emerging market firms that are listed in their domestic markets and have also issued ADRs in the US. The paper claims that once the decision to invest in a particular firm has been made, the decision whether to invest in the ADR or the underlying security can depend on both country and firm-level factors. In particular, they argue that under the following conditions, a foreign investor will decide to invest in the ADR over the underlying stock.

- *“If a firm is based in a country that has poor investor protection laws, fund managers allocate a larger fraction of their investment in the ADR security of that company relative to the underlying domestic security.”<sup>7</sup>*

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<sup>5</sup> Ibid

<sup>6</sup> Ibid. Their paper in turn references Wener, I. and A. Kleidon, 1996, U.K. and U.S. Trading of British Cross-Listed Stocks: An Intraday Analysis of Market Integration, Review of Financial Studies 9, 619-664.

<sup>7</sup> Aggarwal, Dahiya and Klapper (2005)

This argument implies that the legal protection that a country affords its investors determines how attractive the underlying securities of companies in that country are. In countries where investor protection is low, a US listed ADR offers greater protection to minority shareholders relative to the underlying stock, “since an ADR listing makes a firm subject to rule 10b-5, which gives shareholders the right to sue for losses ensued because of fraudulent statements made by a company whose shares they own.”<sup>8</sup> It is important to note here that the protections underpinning a security are not inherent in the security itself, but are determined by the laws of the country where the security is listed. Moreover, the quality of enforcement of the various laws across different regimes is an important consideration as well. As an example, even though the laws and regulation in India are fairly similar to those under the British common-law system, India lacks in enforcement and it can take the over-burdened court system up to seven years in some instances to reach a verdict. Hence, according to Gagnon and Karolyi (2003), “depending on the country of origin, the bundle of rights underpinning an ADR and its home-share may be quite different from an arbitrageur’s perspective even though the cash-flow rights underpinning the security are exactly the same.”

- *“If a firm is based in a country that has a less developed stock market, fund managers allocate a larger fraction of their investment in the ADR security of that company relative to the underlying domestic security.”<sup>9</sup>*

This argument is based on the fact that the transaction costs (cost of trading, wider bid-ask spreads) of trading on a less-developed and less liquid stock market are significantly higher than those of trading on a well-developed stock exchange, such as those in the US. On net, therefore, an investor would be more likely to invest in the security that trades on a more developed stock exchange.

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<sup>8</sup> Ibid.

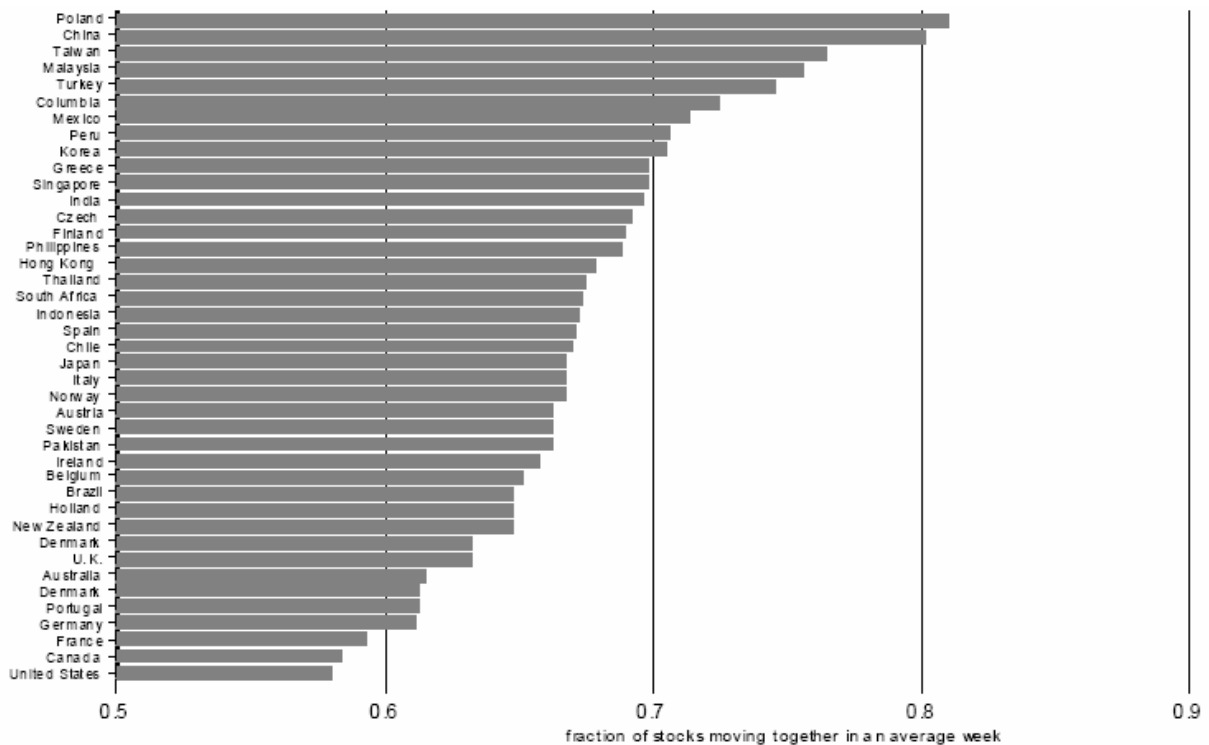
<sup>9</sup> Aggarwal, Dahiya and Klapper (2005).



## Information and Trading-Based Barriers

There appear to be two important information-based barriers that play an important part in why ADR and underlying stock prices are out-of-sync.

The first type of friction exists because certain underlying stocks, especially those that trade on exchanges of less-developed countries, are highly correlated to the movements of the underlying stock market and do not price in the idiosyncratic information has much more to do with the company rather than the market at large.<sup>10</sup>



According to Gagnon and Karolyi (2003), “if stocks with a higher R-squared [relative to the market] tend to have less firm-specific information capitalized into their prices, we would expect less arbitrage activity in these stocks since one of the main functions of risk-arbitrage is to impound firm-specific news into stock prices bringing prices to fundamental values in the process.”

<sup>10</sup> The following chart obtained from presentation from Professor Mihir Desai, Harvard Business School.

The second type of information-based friction exists due to the asymmetry of information between “insiders” and the public. It has been argued that in countries with poor property rights and where insider trading regulations are weak, it is difficult to profitably do informed arbitrage. Based on their research, Gagnon and Karolyi (2003) believe that in cases where management appears entrenched at the company, “the risk of appropriation associated with insider ownership could drive a wedge between the ADR and its home-shares.” They also argue that greater institutional ownership is associated with lesser information asymmetry and therefore co-movements in the prices of the ADR and the underlying security increases the greater the ownership stake held by institutional investors.

### **The TSMC and Infosys experience: Quantifiable explanations for spreads and security movements**

While it is difficult to quantify many of the frictions and inefficiencies discussed above, we have tried to examine to what degree these spreads and price movements can be explained statistically. While it is clear that for TSMC and Infosys there is an absolute difference between the prices of a local stock and its corresponding ADR, we have tried to examine to what extent these securities tend to move together. And to the extent that the daily price movement of the ADR is not explained by the underlying stock, how important are other variables. We examine such variable as local market movements (cohabitation theory), sector influence, and finally liquidity variances between the underlying stock and the ADR.

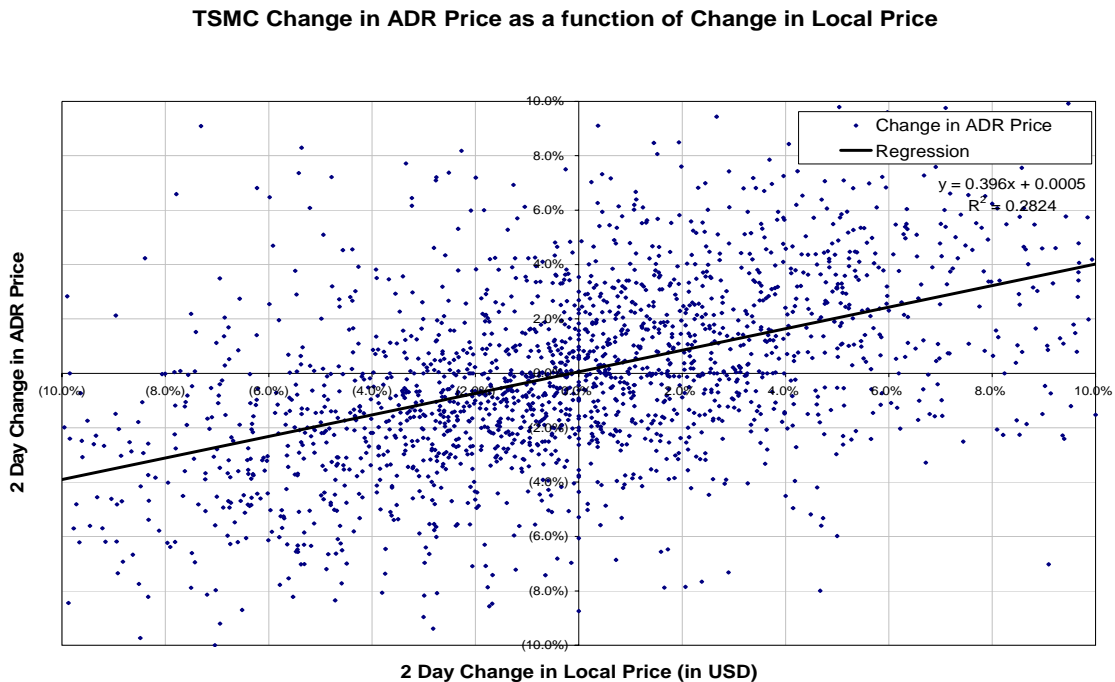
### **Price co-movements of ADRs and local stock**

Even though there might be a spread between an underlying stock and its ADR, one might expect the two securities to have similar price movements on a day to day basis. In Exhibits 3 and 4 below, we regressed the two-day price movement of the ADR

versus the two-day price movement of the local stock after normalizing for currency movements.

We found that while local price movements explained some of the ADR price movement, overall the regression had an explanatory power (R square) of 0.28 for TSMC and 0.33 for Infosys. It is a little surprising that only about 30% of the daily price movement of the ADR is due to the change in the local stock price.

Exhibit 3: TSMC ADR price movement versus local price movement



#### Exhibit 4: Infosys ADR price movement versus local price movement

**Infosys Change in ADR Price as a function of Change in Local Price**



This analysis is based on data for all years that the ADR has been issued. It is interesting, however, if the analysis is duplicated on a yearly basis (i.e. the same regressions done for each year separately). We find that local price movements are more important in explaining ADR price movements in more recent years than in earlier years. Exhibit 5 below shows the correlation coefficient and the explanatory power for the regressions on a yearly basis.

Exhibit 5: Summary of Yearly Regression Output

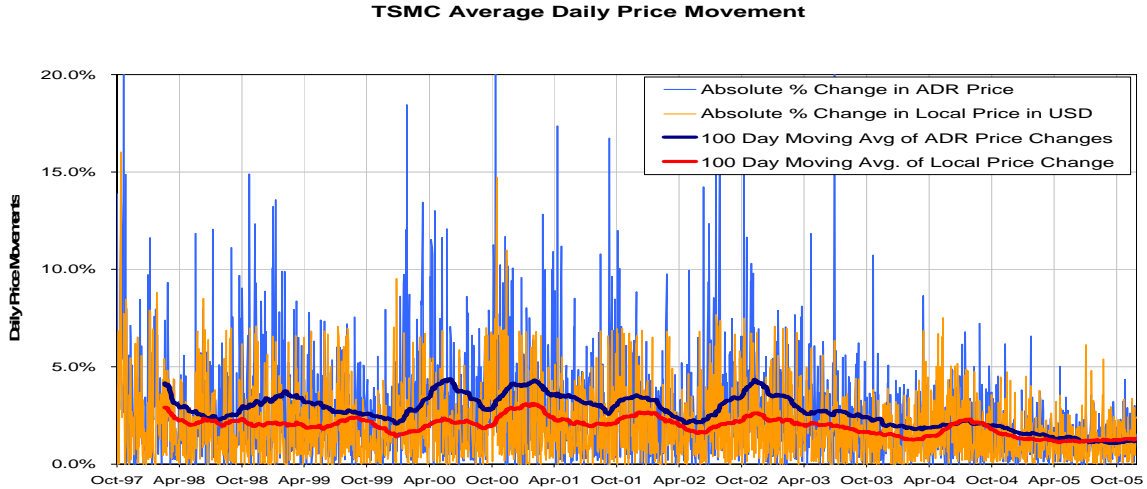
<b>Correlation of Change in ADR Price with Change in Local Price</b>				
	<b>TSMC</b>		<b>Infosys</b>	
	Coefficient	R Square	Coefficient	R Square
1998	0.73	0.29	NA	NA
1999	0.70	0.27	0.64	0.20
2000	0.56	0.15	0.81	0.32
2001	0.75	0.27	0.69	0.37
2002	0.81	0.32	0.85	0.31
2003	0.90	0.46	0.77	0.57
2004	0.67	0.42	0.68	0.34
2005	0.67	0.45	0.64	0.29
<b>Avg 98-02</b>	<b>0.71</b>	<b>0.26</b>	<b>0.75</b>	<b>0.30</b>
<b>Avg 03-05</b>	<b>0.75</b>	<b>0.44</b>	<b>0.70</b>	<b>0.40</b>

*Note: All regressions shown are statistically significant at a 95% confidence interval*

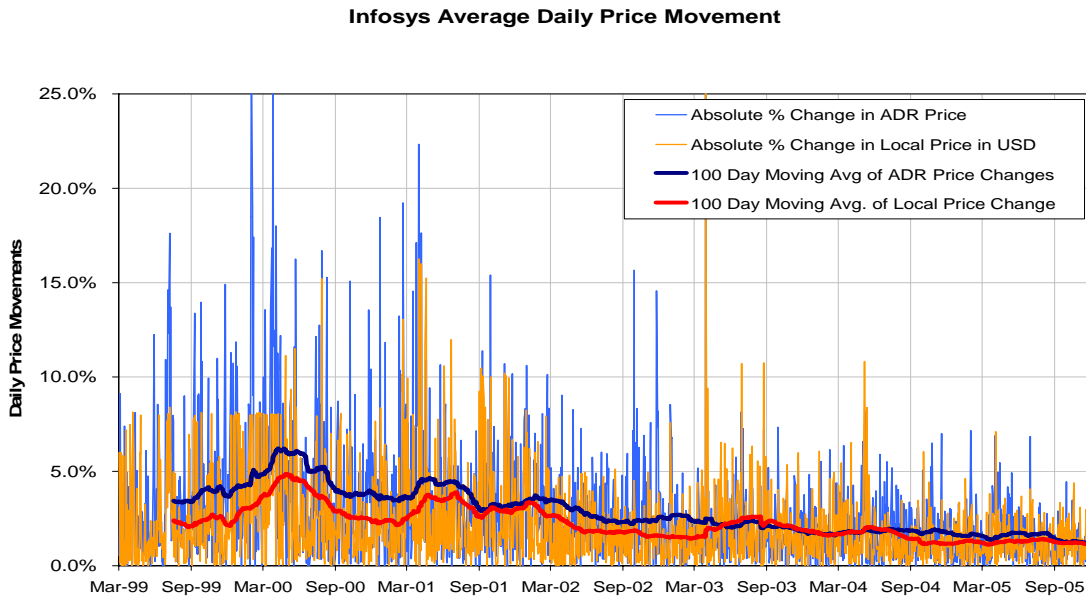
As can be seen above, the explanatory power of the regression increases quite significantly for TSMC when looking at the 03-05 period versus the 98-02 (from 0.26 to 0.44). Similarly for Infosys, the R-square increases from 0.30 to 0.40. The implication here is that global financial markets are increasingly trading the ADR and underlying stock together.

It is also interesting to note that the absolute level of daily price movements for both, the underlying stock and the ADR is declining. As we can see from Exhibits 6 and 7 below, both the ADR and the underlying stock are becoming less volatile.

### Exhibit 6: Volatility of TSMC stock and ADR



### Exhibit 7: Volatility of Infosys stock and ADR



The implication here is that whereas in the past the ADR and the underlying stock had larger movements and as result tended to move together, as volatility declines the securities might have much smaller movements but perhaps in opposite directions. As a result, the co-movement of the ADR and the underlying becomes less relevant as the magnitude of the price changes declines. In the extreme case, compare a +10% underlying movement and a corresponding +4% ADR movement, versus a +0.2%

underlying movement and a corresponding -0.2% ADR movement. Although the second example has a negative correlation, because the magnitude of the difference is so small, such a price movement is quite irrelevant.

## **Cohabitation**

As mentioned earlier, stocks often tend to move with the local market index. As a result, price movements of the ADR and its underlying stock may be driven by changes in the local markets rather than each other. When examining such data for TSMC and Infosys, we found that while this relationship tended to hold true for the local stock, the evidence was far less convincing for the ADR. For both TSMC and Infosys, we regressed the local stock with a broad local stock index, and the ADR with the S&P500. While changes in the local markets (Taiwan and India) are very important variables in explaining the price movements of TSMC and Infosys local stock, the ADRs were far less influenced by the S&P500.

We can see in Exhibits 8 and 9 below that there is quite a strong relationship between the price movements in each of the two local markets.

Exhibit 8: Change in TSMC local stock as a function of Change in the TSE 100

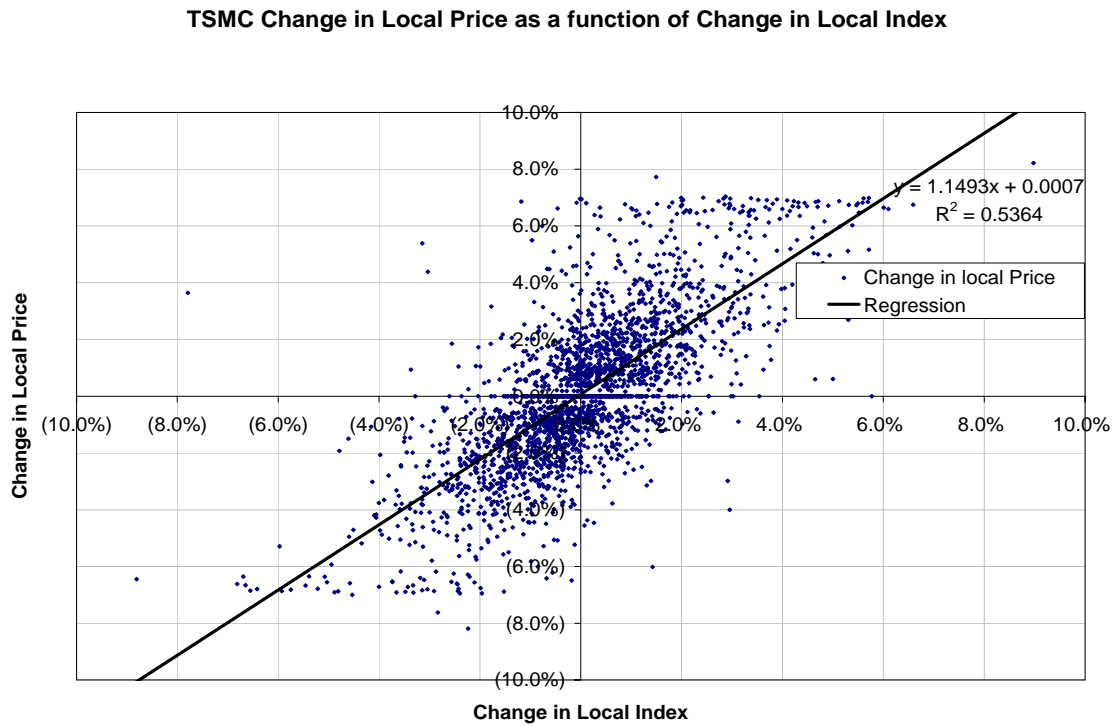
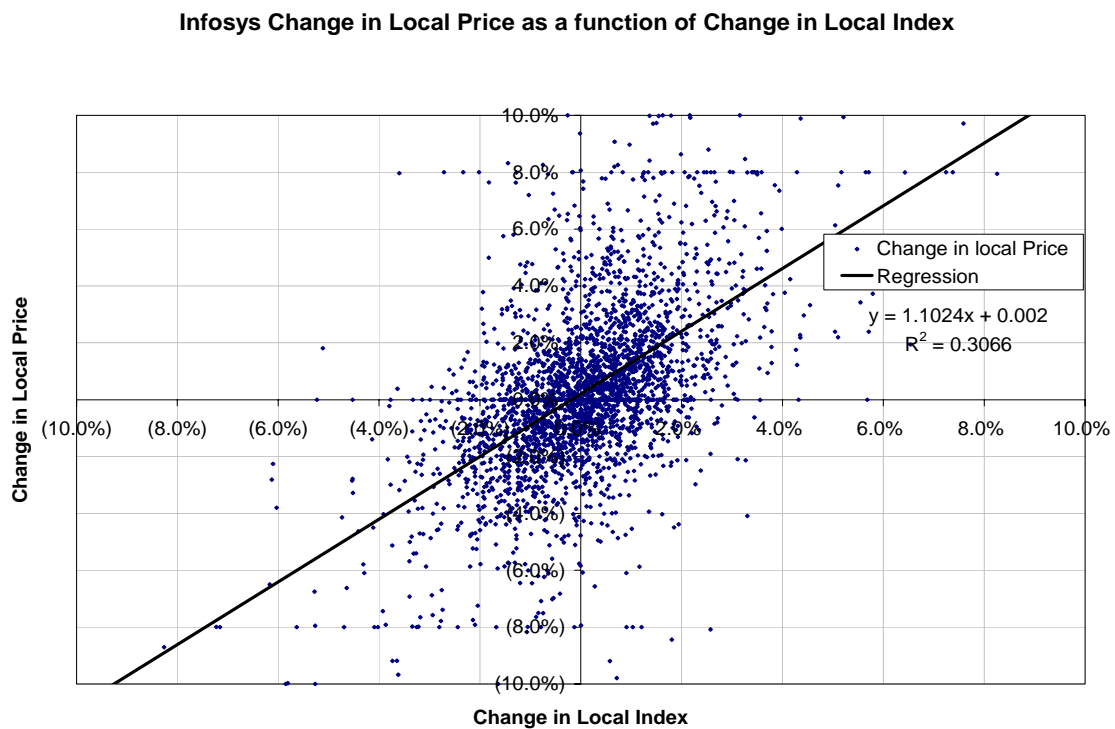


Exhibit 9: Change in Infosys local stock as a function of Change in the BSE 30

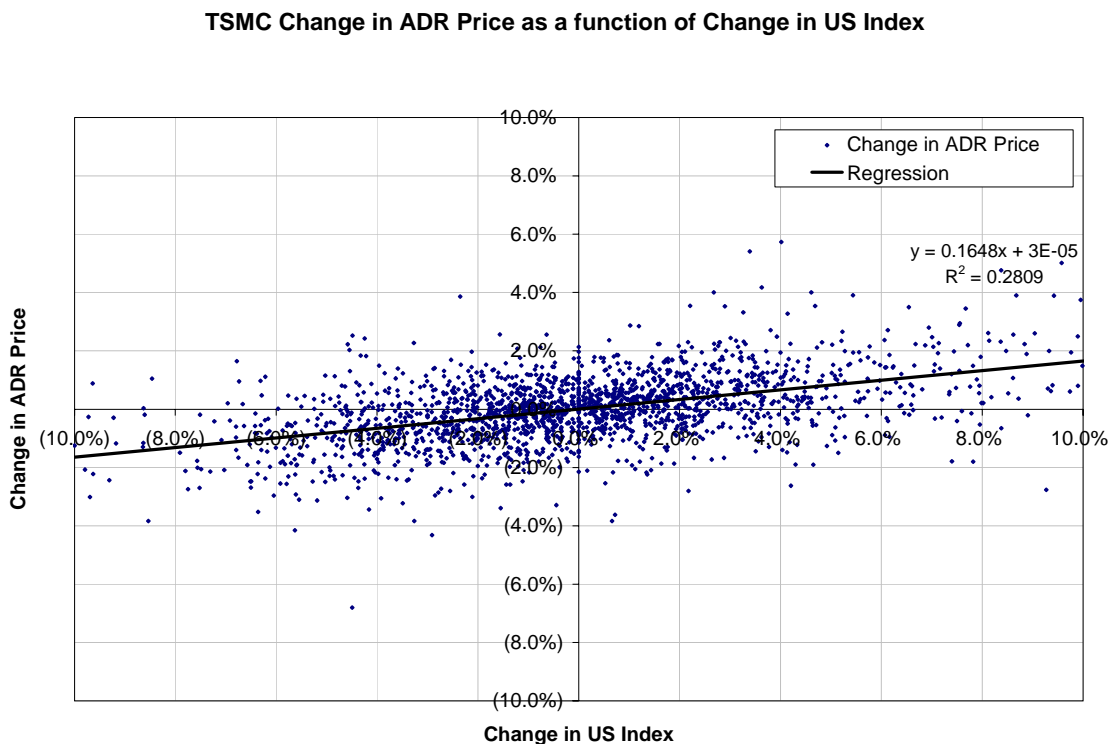




The relationship is particularly strong in Taiwan where the 50% of daily price change in the local stock can be explained by changes in the local index. For Infosys, the regression is significant albeit with a lower R-square of 31%.

In contrast, when regressing the price movements of the ADR versus changes in the S&P, we see a much weaker relationship. As can be seen in Exhibits 10 and 11, the R-square of both regressions is less than 0.3.

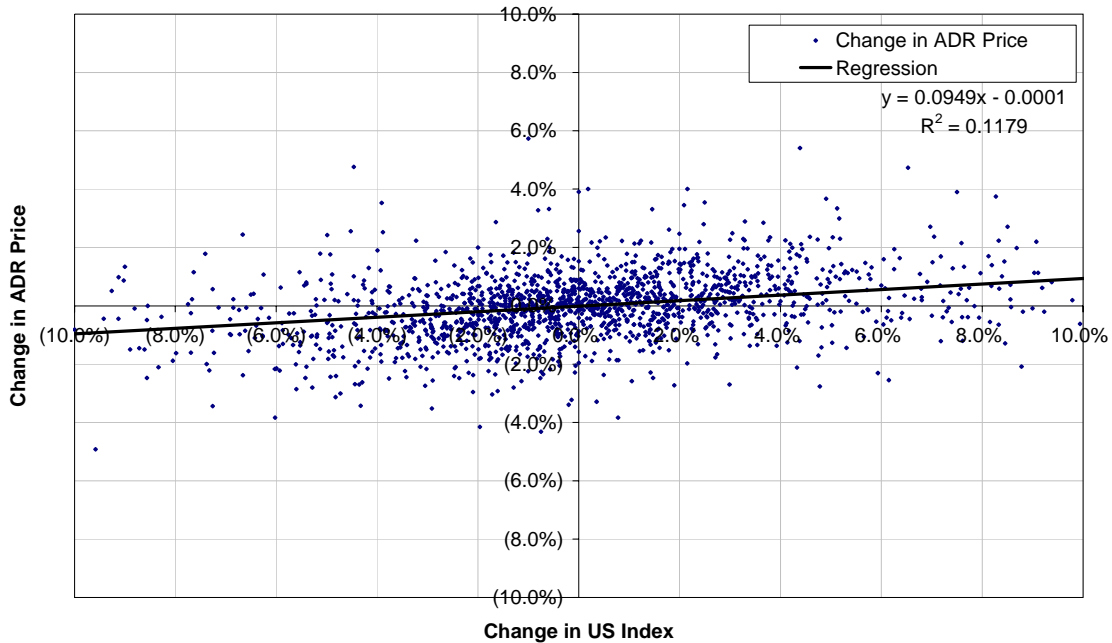
Exhibit 10: Change in TSMC ADR as a function of Change in the S&P 500



While the TSMC regression is statistically significant, its R-square is somewhat low (0.28). The Infosys regression is even lower at 0.1 and is not statistically significant.

### Exhibit 11: Change in TSMC ADR as a function of Change in the S&P 500

**Infosys Change in ADR Price as a function of Change in US Index**



While the cohabitation argument is not particularly convincing for the US ADRs, the data becomes more compelling when we use a sector specific index such as the NASDAQ Computer Index. Both regressions are statistically significant with slightly higher explanatory power (R-square: TSMC 0.35; Infosys 0.18).

### **Liquidity**

One potential reason for the change in the ADR premium could be the liquidity of the ADR relative to the local stock. As the ADR is more easily available (as evidenced by higher trading volumes), we might expect the price premium to decline. While there is some evidence for this hypothesis, it is not completely compelling on a statistical basis.

Exhibit 12: TSMC ADR price premium and relative trading volume

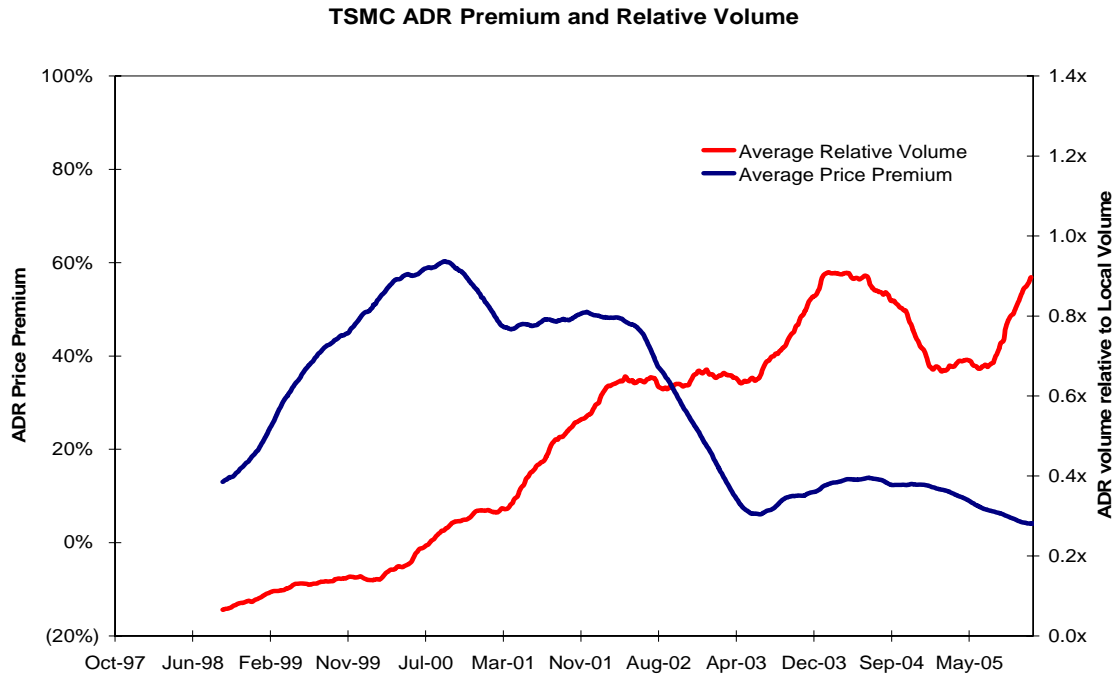
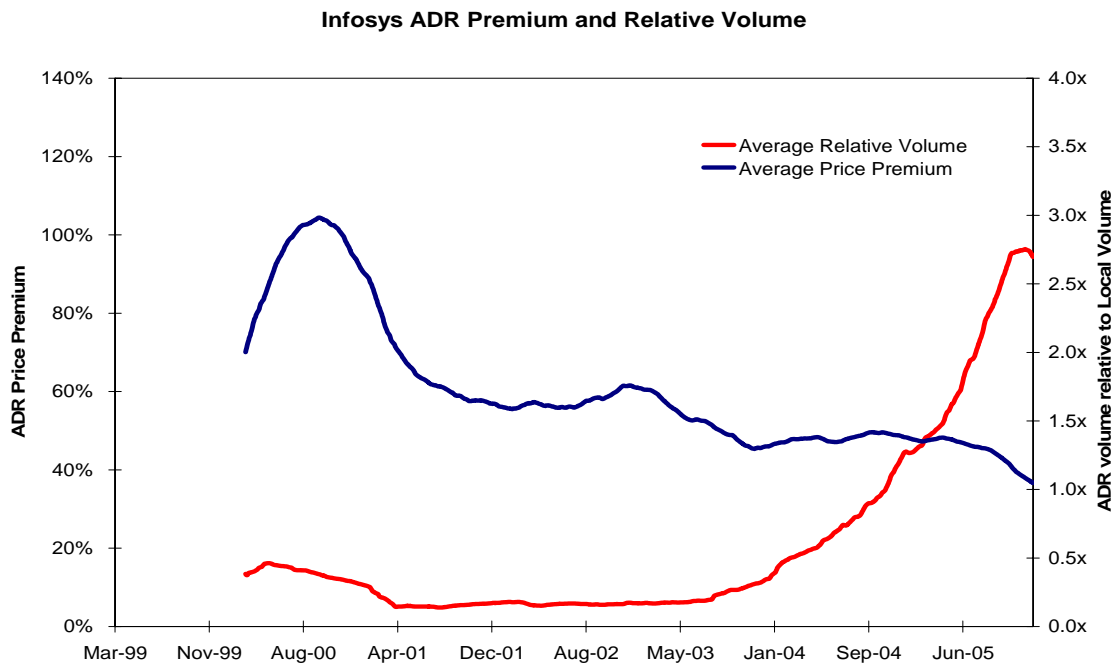


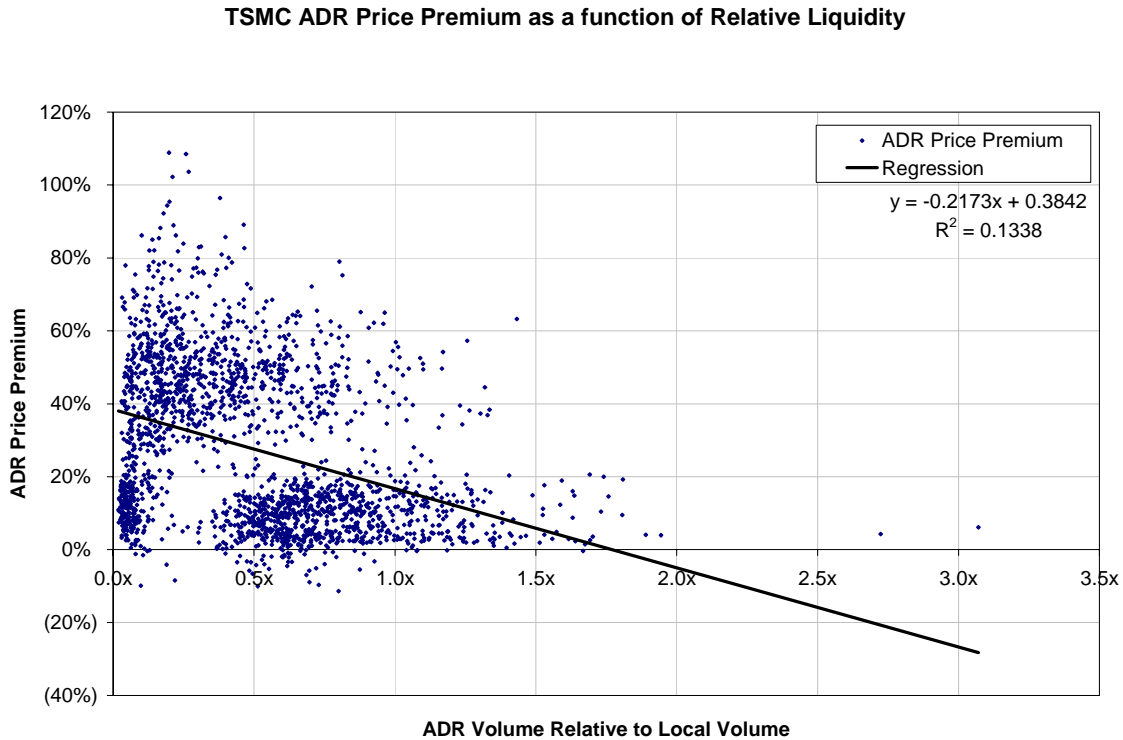
Exhibit 13: Infosys ADR price premium and relative trading volume



We can see in exhibits 12 and 13 above that as relative liquidity (average daily volume for ADR relative the average daily volume for local stock) for both TSMC and

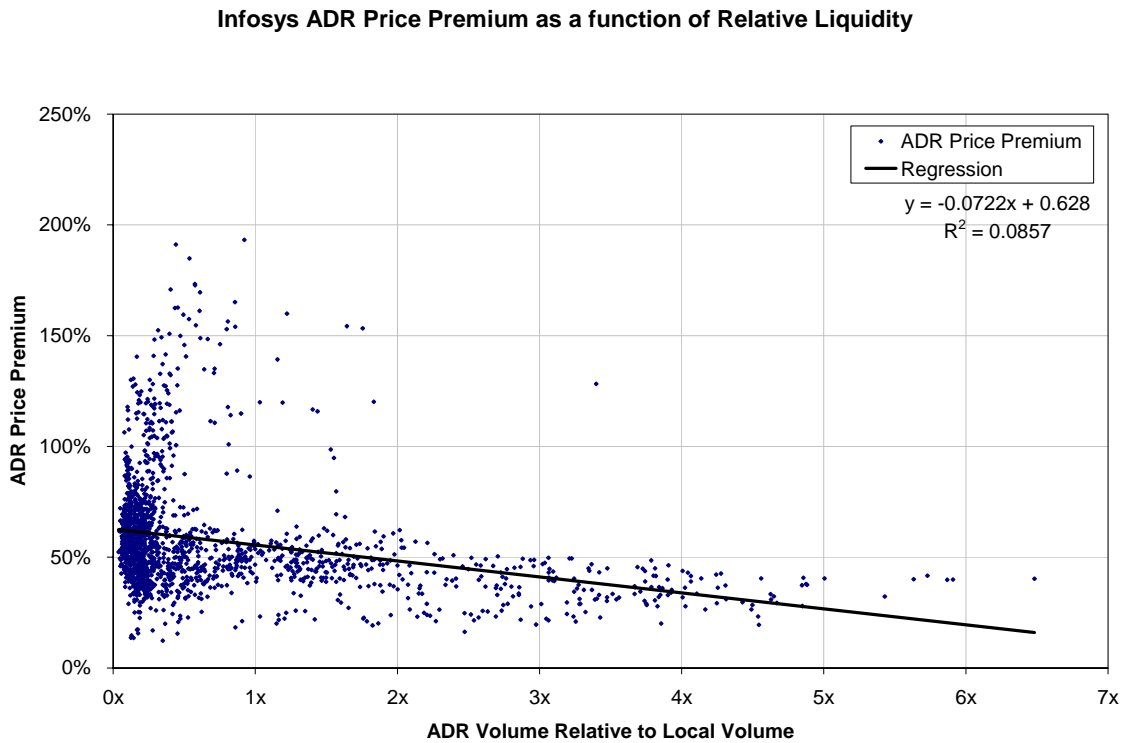
Infosys ADRs increases, the spread declines. However the relationship appears to be true at a broad level across the entire time-period. If we look at shorter, more specific time periods, the relationship does not appear to hold. In fact, as we can see from the regressions below in exhibits 14 and 15, the relationship is only partially visible.

Exhibit 14: TSMC ADR price premium as a function of relative volume



While there appears to be somewhat of a relationship for TSMC, as we can see below, the regression simply does not hold for Infosys.

### Exhibit 15: Infosys ADR price premium as a function of relative volume



### **Multivariate Regression Analysis**

We attempted to put together all of the statistical analysis through step-wise multivariate regressions trying to explain daily price movements of the ADRs and the actual ADR spread itself.

To explain price movements of the ADRs, we started with four variables:

1. Change in price of local stock (currency adjusted)
2. Change in a broad US index (S&P 500)
3. Change in a US sector index (Nasdaq Computer Index)
4. Relative liquidity of ADR versus local stock

Running step-wise multivariate regressions, we reduced these variables to only two that were statistically significant. As seen below the only two variables that explain changes in the US ADR price are (1) change in local stock price and (2) change in the US sector index.

### Exhibit 16: Regression Summary of Change in TSMC ADR price

#### TSMC CHANGE IN ADR PRICE SUMMARY OUTPUT

<i>Regression Statistics</i>						
Multiple R	0.68					
R Square	0.46					
Adjusted R Square	0.46					
Standard Error	0.03					
Observations	2,124					

ANOVA						
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	2	1.420	0.710	897	0.000	
Residual	2121	1.679	0.001			
Total	2123	3.100				

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.00	0.001	0.4	67.8%	(0.001)	0.001
% 2 Day Change in Local Price in USD	0.47	0.023	20.6	0.0%	0.42	0.51
% 2 Day Change in US Sector Index	0.90	0.026	35.1	0.0%	0.85	0.95

### Exhibit 17: Regression Summary of Change in TSMC ADR price

#### INFOSYS CHANGE IN ADR PRICE SUMMARY OUTPUT

<i>Regression Statistics</i>						
Multiple R	0.58					
R Square	0.33					
Adjusted R Square	0.33					
Standard Error	0.03					
Observations	1,754					

ANOVA						
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	2	1.042	0.521	439	0.000	
Residual	1751	2.081	0.001			
Total	1753	3.123				

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.00	0.001	1.3	18.7%	(0.001)	0.003
% 2 Day Change in Local Price in USD	0.50	0.025	19.7	0.0%	0.45	0.55
% 2 Day Change in US Sector Index	0.67	0.034	19.6	0.0%	0.61	0.74

From Exhibits 16 and 17 above, we can see that these two variables explain 46% of the ADR price changes for TSMC and 33% for Infosys.

We did a similar multivariate analysis to explain the actual spread itself. We started with five variables:

1. Relative Liquidity of ADR versus Local Stock
2. Local General Index (TSE 100 & BSE 30)

3. Local Sector Specific Index (TSE Electronics Index; BSE IT Index)
4. US General Index (S&P 500)
5. US Sector Specific Index (Nasdaq Computer Index)

All variables turned out to be significant with the regression having a fairly high overall explanatory power as can be seen for Exhibits 18 and 19 below:

#### Exhibit 18: Regression Summary of TSMC ADR Spread

##### **TSMC ADR SPREAD REGRESSION**

##### **SUMMARY OUTPUT**

<i>Regression Statistics</i>	
Multiple R	0.83
R Square	0.68
Adjusted R Square	0.68
Standard Error	0.12
Observations	2,124

##### **ANOVA**

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
Regression	5	69.79	13.96	917.70
Residual	2,118	32.21	0.02	
Total	2,123	102.01		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	(0.012)	0.03	(0.38)	70.4%
Relative Liquidity	(0.16)	0.01	(20.5)	0.0%
Local General Index	(0.000700)	0.00	(30.7)	0.0%
Local Sector Index	0.002360	0.00	23.0	0.0%
US General Index	0.000519	0.00	15.5	0.0%
US Sector Index	0.000040	0.00	2.6	1.0%

## Exhibit 19: Regression Summary of Infosys ADR Spread

### INFOSYS ADR SPREAD REGRESSION SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.67
R Square	0.45
Adjusted R Square	0.45
Standard Error	0.11
Observations	1,436

ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
Regression	5	14.09	2.82	232.31
Residual	1,430	17.35	0.01	
Total	1,435	31.44		

	<i>Coefficients</i>	<i>standard Err</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.448	0.03	13.33	0.0%
Relative Liquidity	(0.010)	0.00	(2.2)	3.1%
Local General Index	(0.000055)	0.00	(11.9)	0.0%
Local Sector Index	0.000026	0.00	2.4	1.9%
US General Index	0.000180	0.00	4.0	0.0%
US Sector Index	0.000078	0.00	3.7	0.0%

The TSMC model has an explanatory power of 0.68 and the Infosys model of 0.45. We can see that relative liquidity has a negative coefficient (as the ADR becomes more relatively more liquid, its price comes down and therefore the spread); the local general index has a negative coefficient (the local stock moves with the broad local index; as the index goes up so does the local stock and therefore the spread comes down); both US indices have positive coefficients (the ADR moves with these indices; as they go up so does the ADR and therefore the spread increases). The surprising outcome is the positive coefficient of the local sector index which implies that the ADR reacts more to the local sector index than the local underlying stock.

In general we can explain about half of the ADR spread of these two companies through the liquidity, cohabitation and sector based hypotheses. However, there are a number of other reasons that are not as easily quantifiable and therefore less likely to lend themselves to statistical analyses.



## **Regulatory drivers and the outlook for ADR Premia**

One question that emerges from this research is what will happen to ADR premiums as world markets become increasingly open? If ADR premiums have mostly been arbitrated away for companies that trade in markets that are fully open, what will happen to premiums of ADRs like Infosys as India attempts to liberalize restrictions on foreign capital? To explore this topic, this paper examines the case of TSMC and Taiwan.

### ***Why Taiwan and TSMC?***

TSMC's ADR premium has frequently been cited as a prime example of a premium created by market-based restrictions. According to the Economist,

“There are more than 3,000 DRs, and most trade at a small premium to the underlying local shares. They owe their higher price to the convenience of buying in America, and the freedom they offer from currency risks. But the premiums commanded by ADRs in Infosys, TSMC and Korea Telecom, of South Korea, go far beyond that. The main reason is that all three come from semi-closed financial markets. In Taiwan, India and South Korea, only approved foreign institutional investors can buy shares, and there are limits on how much even they can own. Taiwan also has currency controls that make it hard for foreign investors to sell their shares and repatriate the proceeds. In contrast, in open markets such as Singapore and Britain, big differences between local and ADR prices are soon eroded by traders who spot the opportunity for arbitrage<sup>11</sup>.”

Fortunately, Taiwan now provides an ideal case study for the impact of foreign investment regulations on securities prices because it has gradually deregulated over the past 10-15 years. It is also a very prominent developing country with a relatively robust market and legal system, thereby increasing the likelihood that theories of market

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<sup>11</sup> The Economist. “Over the odds,” January 15, 2000

efficiency should hold in the absence of regulation. By the end of October 2005, there were 693 companies listed on the Taiwanese exchange with a total market capitalization of US\$408 billion. Average daily trading volume was 2.4 million shares<sup>12</sup>.

Within Taiwan, Taiwan Semiconductor's size, high international profile, and liquidity in both the domestic and ADR markets make it the logical candidate for understanding the impact of Taiwanese regulations on securities prices. Taiwan Semiconductor Manufacturing Company (TSMC) is the world's largest semiconductor foundry with over 50% market share<sup>13</sup>. The company generated \$7.4B in revenues over the twelve months ended September 30, 2005 and according to Forbes Global 2000 had the 123<sup>rd</sup> highest market value in the World at approximately US\$45B. The company is publicly traded on the Taiwanese stock exchange, where it represents approximately 10% of the market's total capitalization and is one of the five most widely traded stocks, and also has ADRs cross-listed on the NYSE with average daily trading volume of nearly 10 million shares. TSMC's scale and reputation for professional management should reduce risk that information asymmetry explains any ADR premium.

### ***Arbitrage in the Taiwanese ADR Market: Two Distinct Markets***

The other interesting aspect of Taiwan and TSMC is that restrictions on ADR conversion have and continue to limit arbitrage opportunities between the two securities. Restrictions on who, when and how much can be converted creates two distinct markets for the company's securities<sup>14</sup>. The company describes the rationale for these restrictions as follows: "the Program has been designed to reduce the potential for disruption to the existing market trading for TSMC's common shares and ADSs. TSMC believes that this is in the best interests of TSMC and its long-term shareholders and other stakeholders."

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<sup>12</sup> Taiwan Stock Exchange Corp [www.tse.com.tw](http://www.tse.com.tw)

<sup>13</sup> TSMC: Initiating Coverage. SG Cowen May 3, 2005

<sup>14</sup> TSMC Investor Relations TSMC Conversion Sale Program FAQ

## *A Brief History of Taiwanese Regulations*

In order to test whether or not Taiwan's history of deregulation helps explain TSMC's ADR premium, it is first necessary to review the history of the major regulations Taiwan placed on foreign investors interested in investing in the domestic market. Taiwan first opened its exchange to foreign investors in 1991. For the next ten years, regulations on foreign investors were relatively strict. All investors were required to register to become Qualified Foreign Investors, foreign ownership in any one company was capped and register investors were given quotas as to how much they could invest in the exchange. Furthermore, Taiwan placed restrictions on currency and capital remittance, prevented hedging practices and established a number of restrictive requirements around settlement and pre-funding that made investing in the Taiwanese domestic market unattractive<sup>15</sup>. The Taiwanese government also placed limits on ADR issuances for fear of draining liquidity from its own market<sup>16</sup>, and on single-day volatility for domestic securities. Collectively, these regulations limited supply of ADRs, limited supply of domestic shares for companies near foreign ownership caps (which included very few companies by 2000) and arguably decreased demand for domestic securities.

From 2000 to 2005, Taiwan has eased these restrictions in an effort that appears to be targeted at gaining inclusion in the MSCI World Index<sup>17</sup>. What makes Taiwan interesting as a case study is that it has deregulated gradually. In 2000, it cancelled foreign ownership restrictions, in 2003 it simplified the registration process for foreigners and lifted investment quotas for investors. And in 2004 and 2005, Taiwan has taken a number of steps to simplify trading and hedging. Eddie Guillemette, an Executive Director at Morgan Stanley Asia, describes the remaining barriers as largely annoyances. Foreign investors still need to register and employ a local tax guarantor, settlement and pre-funding requirements add transaction cost and complexity and the market for securities borrowing and lending is still undeveloped.

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<sup>15</sup> Taiwan Stock Exchange Corp and Securities and Futures Bureau Financial Supervisory Commission, R.O.C.

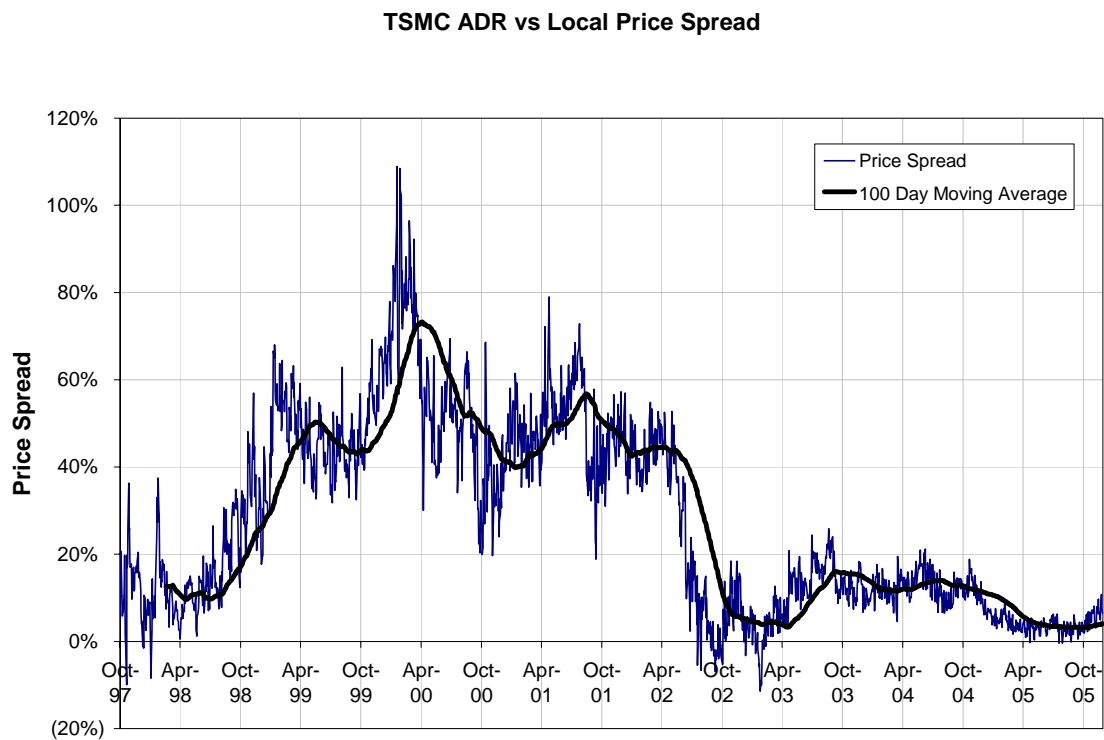
<sup>16</sup> The Economist. "Over the Odds," January 15, 2000

<sup>17</sup> Team Interview w/ Eddie Guillemette, Executive Director at Morgan Stanley Asia. November 23, 2005

### ***Does Deregulation of Market-Based Barriers Help Explain TSMC's ADR Premium?***

As one would expect, ADR trading premiums for TSMC have declined since 1998. But, if deregulation is really a significant driver of premium trends, specific regulatory changes should help explain distinct changes in premium behavior, not just gradual trends. If theories of market efficiency hold, even the absence of pure arbitrage opportunities, one would expect that by the date of regulatory change, ADR premiums should reflect the new realities of the market from that point forward.

#### Exhibit: TSMC ADR Spread



Surprisingly, it is difficult to directly attribute movements in the ADR premium to significant regulatory changes on foreign investment controls.

- Foreign ownership in TSMC did not increase significantly above the previous cap of 50% after the removal of foreign ownership restrictions in December 30, 2000. According to the company's 2001 annual report, foreign ownership was only 52% in March 2002, suggesting that ownership

controls had little to do with investor preference for the domestic security and ADR<sup>18</sup>.

- Mid-2003 steps to eliminate institutional investment quotas and ease registration requirements on foreign investors also do not appear to explain the behavior of premium trends during this period.
- The only steps that appear to help explain ADR premium trends are those taken in 2004 and 2005 to simplify settlement, stock borrowing and lending and hedging.

The one clear trend that seems to explain the gradual decline in the ADR premium is increased supply of TSMC ADRs. Although data on the specific relaxation of ADR issuance limitations is difficult to obtain, it is clear that premiums have declined as the supply of ADRs has increased.

Two key insights emerge from these findings. First, the fact that deregulation increasing supply of domestic securities and releasing some restrictions on foreign investor demand for those securities does not explain specific movements in ADR premiums suggests demand for both securities is not uniform. Second, reaction to deregulation is gradual. As Guillemette states, “institutional investors are slow to react to changes in market regulations.” Both of these insights suggest that different forces and players drive demand in each market.

### ***Implications for ADR Premiums in Emerging Economies***

Extrapolating this study to other developing economies seeking to liberalize their domestic securities markets, we suggest the following hypotheses:

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<sup>18</sup> Taiwan Stock Exchange Corp Foreign Ownership Market Data

- ADR deviations from local market prices will continue to exist as long as pure arbitrage is not possible.
- Reactions to deregulation in domestic markets may be inefficient, creating short-term opportunities for those willing to trade in the domestic security.
- Liquidity of ADRs is an important explanatory variable for the magnitude of premiums and surprise announcements can have a strong impact on premiums.
- Opportunities may exist to offer services such as synthetic ADRs. If TSMC and Taiwan restrict the number of ADRs available, perhaps a financial institution could offer similar services to those provided by a depository bank, list a “rogue” ADR and in return earn part of the margin.

### ***Conclusions***

While ADR premiums represent a deviation from the law of one price, there appear to be legitimate market inefficiencies that explain their existence. Through analysis, we have been able to partially quantify some of these inefficiencies. At the same time, it is clear that there is no single driver of these premiums and therefore it is difficult to project the magnitude and movements of premia for any ADR/home-stock combination.

From our research, it is apparent that the long-term trend is towards increased market efficiency with the expectation that most of the current barriers or frictions will be eliminated over time. The case of Taiwan, and the corresponding long-term movement in the ADR spreads for TSMC, is a prime example of that trend. However, given the multitude of factors that determine the spread, the short-term magnitude and movement is nearly impossible to predict. In our view, although Taiwan may be a prolonged example, it is unlikely that any market will be able to remove all impediments to market efficient pricing of ADR/domestic security pairs at once. Since short positions are not possible in the long-term, it is difficult to conduct riskless arbitrage of ADR spreads, especially in the case of Infosys and TSMC.

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