LABOR COSTS AND CAPITAL PRODUCTIVITY: SOME RECENT EVIDENCE FROM A GROUP OF EMERGING ECONOMIES

Mehdi Salehizadeh, San Diego State University
Feraidoon (Fred) Raafat, San Diego State University

In recent years an increasing number of multinational corporations based in the U.S. (and elsewhere) have been attracted to emerging countries primarily due to lower labor costs and higher returns to capital existing between these economies and that of the U.S. This paper examines a set of data for Mexico, Hong Kong, Korea, Singapore and Taiwan, by considering the method of cointegration, for the period of 1970-1998. The data consists of spreads between labor costs, a measure of capital productivity, currency values against the U.S. dollar, and net flows of long-term capital. The analysis provides a further confirmation of the long-term equilibrium linkage between global capital flows, labor-cost spreads, marginal productivity of capital, and exchange rates.

An increasing number of multinational corporations (MNCs) have been attracted to emerging economies partly due to lower level of labor costs and expected higher capital returns prevailing in those countries. An additional contributing factor has been a precipitous decline in the value of many of these countries' currencies vis-a-vis the U.S. dollar in the recent past. The combined effect has led to a substantial increase in the amounts of long-term capital flows, i.e., foreign direct investments (FDI), to these countries by MNCs based in the U.S. and elsewhere. This paper examines a number of economic indicators for a selected group of emerging countries: Mexico, Hong Kong, Korea, Singapore, and Taiwan. Specifically, data on labor-cost spreads, a measure of capital productivity, currency values against the U.S. dollar, and net flows of FDI for 1970-1998 are analyzed. The method of cointegration is used to investigate the existence of long-term equilibrium between the FDI and each of the other factors.

The remainder of the study is organized as follows. The next section presents a review of literature intended to provide the necessary theoretical and empirical foundations for the key variables in this paper. This is followed by details on the methodology and data, with the results and some concluding remarks discussed in the final two sections.

BACKGROUND INFORMATION AND LITERATURE REVIEW

Differences in Labor Costs

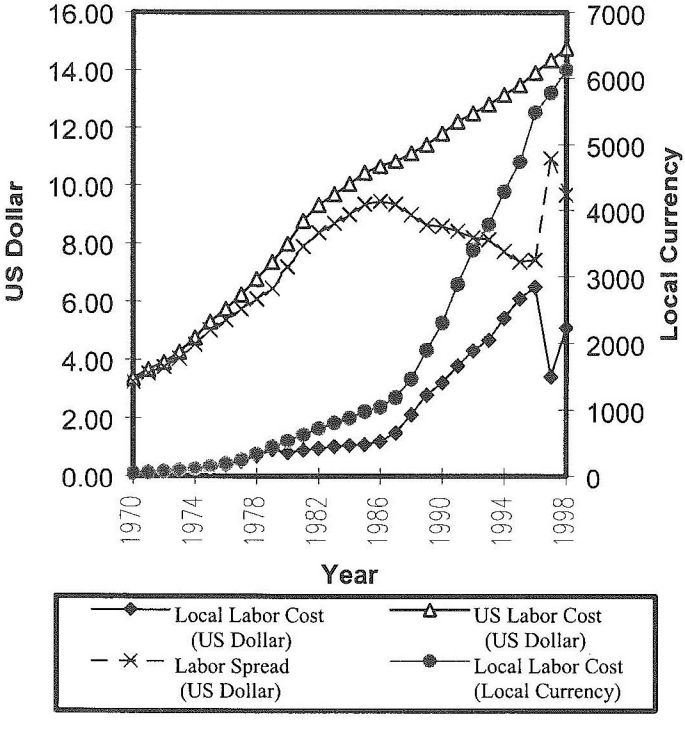
Economic as well as political variations do contribute to labor-cost differentials among nations. Rodrik (1999), in analyzing the role of political system, finds that after differences in labor productivity, income levels, and other variables are controlled for, "there is a robust and statistically significant association between the extent of democracy and the level of

manufacturing wages in a country." The results hold both across countries and over time within countries, with factors related to political competition and participation being the driving force behind the results.

The gap in hourly compensation costs for manufacturing production workers between the United States and our group of emerging countries widened in 1997 and during the first half of 1998,[1] reflecting, among other factors, the U.S. dollar's appreciation against many foreign currencies. Hourly compensation costs for manufacturing production workers in the United States increased 3.1 percent from the 1996 level to $18.24 in 1997. By comparison, Mexico's increased to $1.75, while the trade-weighted average level for similar workers in the Asian NIEs (Hong Kong, Korea, Singapore, and Taiwan) actually declined in 1996-1997 to 36 percent of the U.S. level, the lowest since 1975. A major factor contributing to this decline was a 10.8 percent drop in the U.S. dollar-based hourly compensation costs in Korea. Figure 1 highlights the changes for Korea.

Total compensation costs include pay for time worked, other direct pay (including holiday and vacation pay, bonuses, and the cost of pay-in-kind), employer expenditures for legally-required insurance programs and contractual and private benefit plans, and for some countries, other labor taxes. In this paper, the compensation measures are computed in national currency units and are converted into U.S. dollars at prevailing commercial market currency exchange (nominal) rates.[2]

Figure 1. Korea: Labor Cost



Measures of Productivity

BLS [1999] defines and measures labor productivity in terms of output per hour of labor employed. An increase in productivity represents a decrease in the amount of labor input needed to produce a unit of output; thus, an increase in productivity may offset an increase in compensation per hour in its effects on unit labor costs.[3] Output per worker varies significantly across countries. Hall and Jones (1999) argue in a recent study that the differences in physical capital and educational attainment only partially explain the variation in output per worker. According to their analysis, "differences in capital accumulation, productivity, and therefore output per worker are driven by differences in institutions and government policies."

Many studies have focused on the "traditional" variables, the impacts of which can be captured through the use of the *total factor productivity* (TFP) measure. Harrigan's (1999) research has documented industry TFP differences across advanced economies.[4] For emerging countries, however, conducting a similar cross-country empirical analysis over time is nearly impossible primarily due to the unavailability of comparable data. Instead, the well-known Cobb-Douglas production function may be utilized in order to derive an alternative measure of productivity. The function can be expressed as:[5]

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha},$$

where Y is the amount of output, A is a technological constant, K and L represent the amount of capital and labor inputs, respectively, t is a time subscript, and α ($0 < \alpha < 1$) designates the aggregate capital share in an economy. The empirical evidence presented by Sarel (1997), and supported by a number of other studies cited therein, indicate that for many economies, including the U.S. and our selected emerging countries, α has an approximate value of 0.33 and is relatively stable over time.

A surrogate measure of productivity is the marginal product of capital (*MPK*). For the Cobb-Douglas production function, ***MPK*** is equal to the partial derivative of Y with respect to K, and can be expressed as:

$$MPK = \alpha\, Y / K.$$

While ***MPK*** is not directly related to either labor or total factor productivity, it is, nonetheless, a useful variable in determining (capital) productivity and thus the attractiveness of rates of return on investments, which in turn influence MNCs' FDI flows across countries and over time.[6] *A priori*, we would expect to observe cross-country variations in ***MPK*** values (*see* Figures 2A and 2B), reflecting, among other factors, the level of development of an economy and the output-capital ratio. Indeed, as a country moves through various stages of development, higher levels of income tend to be associated with lower ***MPK*** values.

Figure 2A. Marginal Product of Capital (MPK)

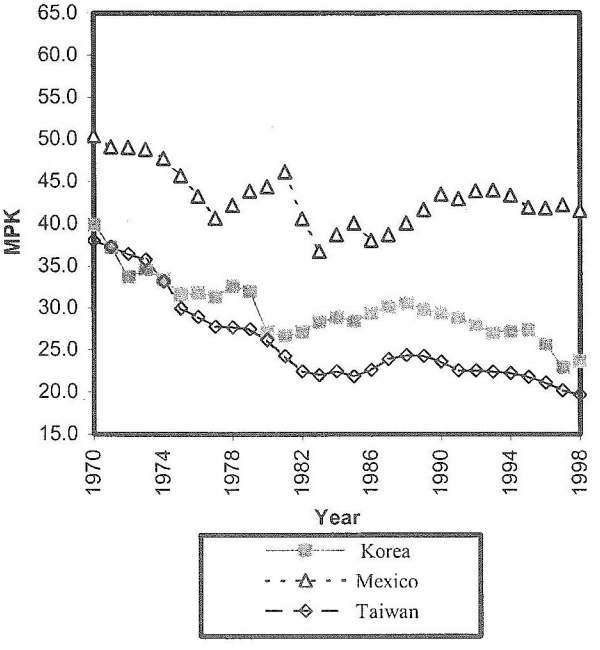
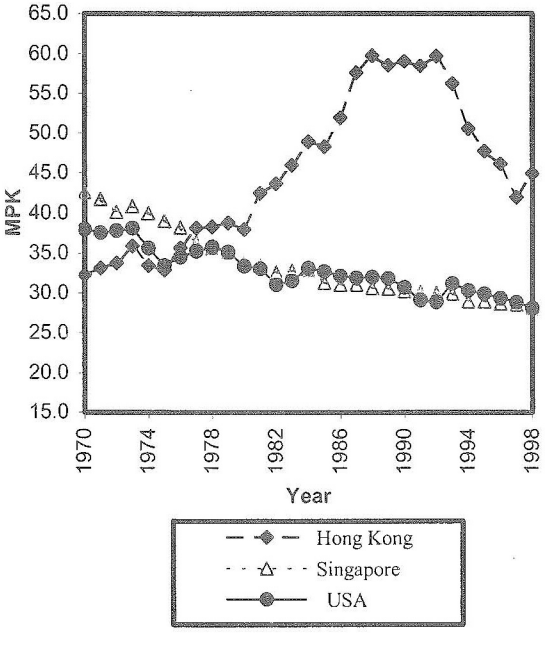


Figure 2B. Marginal Product of Capital (MPK)



Currency Values

Currency movements impact our analysis in two ways. First, there is interaction between exchange rate fluctuations and the various measures of productivity. Asea and Mendoza (1994) state that "... cross-country differences in long-run domestic relative prices of non-tradable are determined by differences in the ratio of long-run sectoral marginal products of labor," but that "... long-run relative prices (as measured in the data or as predicted by regressions) are of little help in explaining long-run, cross-country differences in the level of real exchange rates based on CPIs or GDP deflators." On the other hand, Chinn and Johnston (1997) argue that "... the most empirically successful models include traded and non-traded sector productivity measures, government spending ratios, and either the terms of trade or the real price of oil." Moreover, they present estimates that indicate "... a 1 percent innovation in U.S. traded sector productivity induces between a 0.2 to 0.5 percent appreciation in the U.S. dollar." Further evidence is found in Canzoneri et al. (1999), which provide an explanation of real exchange rate movements in terms of sectoral productivities. For a group of OECD countries, the authors show that "relative prices generally reflect relative labor productivities in the long run," but the "evidence on purchasing power parity in traded goods is less favorable." Meanwhile, De Gregorio and Wolf (1994) conclude that "faster productivity growth in the tradable relative to the non-tradable sector and an improvement in the terms of trade induce a real appreciation." Overall, the underlying long-run relationship between exchange rates and a measure of productivity is examined in our study.

Second, currency movements impact U.S. dollar-based measures of foreign labor costs. Data from the Federal Reserve show that the currencies of the emerging economies being examined here, with the exception of the Hong Kong dollar (which is pegged to the U.S. dollar), experienced sharp depreciations during 1997-1998 as compared to 1996 (owing almost entirely to the Asian financial crisis, which also exerted pressures on the Latin currencies). While individual fluctuations have varied greatly over the 1970-1998 period, the general trend has been for these currencies to decline against the U.S. dollar, thus offsetting some of the increases in hourly compensation costs measured in national currencies. For example, the trade-weighted hourly compensation costs for the 28 foreign economies studied by BLS increased 4.4 percent during 1996-1997 in terms of national currency, but decreased 2.4 percent when measured in U.S. dollars; Korean compensation costs increased 5.5 percent in national currency, but, as previously noted, fell 10.8 percent in U.S. dollars. Figure 3 shows the movements of Korean Won against the U.S. dollar over the sample period.

Flows of Long-Term Foreign Capital

Available data[7] confirm recent increases in MNCs' long-term capital investments in the emerging economies. During this past decade, many countries accelerated economic reforms and opened "closed" sectors of their economy to foreign ownership. These policy reversals have allowed massive amounts of private foreign capital inflows to take place (*see* Figure 4).

Figure 3. Korea Exchange Value (Won/US$)

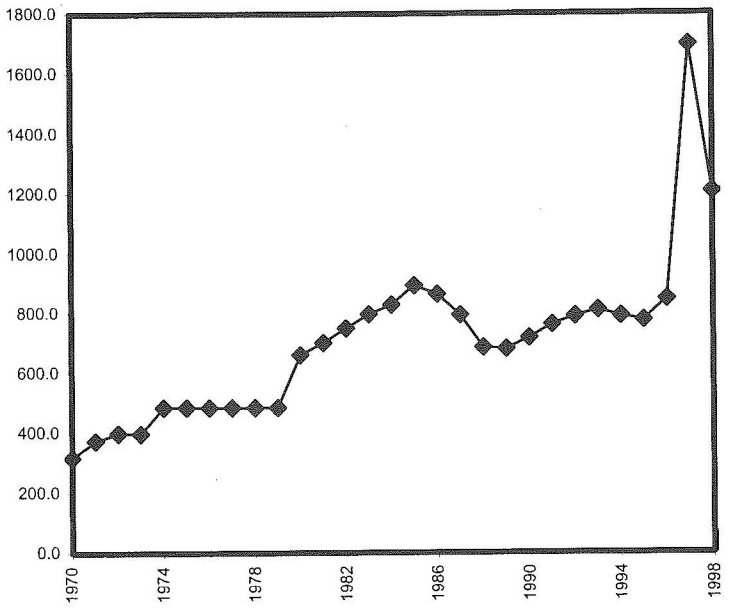
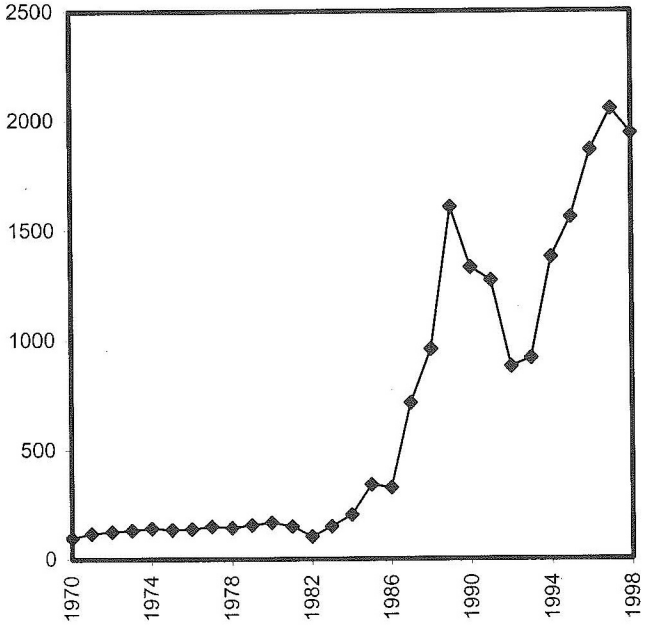


Figure 4. Foreign Direct Investment Inflows (US$ Million)



Private capital flows to emerging economies are generally explained in terms of the theories of international diversification (see, for example, Heston and Rouwenhorst, 1994; Ibbotson and Brinson, 1993; Jorion and Rossenberg, 1993; Speidell and Sappenfield, 1992; and Solnik, 1996). Long-term capital flows (FDI), which entail managerial control and are primarily designed for long-run, sustained operations, take place due to a variety of political, corporate, economic, and financial factors.[8] Thus, it will be difficult to establish precise links – including any cause and effect – between FDI and the other variables identified in this paper. Instead, our empirical analysis will examine the long-term relationship between FDI and the other key variables using the cointegration method.

METHODOLOGY AND DATA

The technique of cointegration is used on 1970-1998 data to identify long-term links between net flows of foreign capital, and each of the following variables: spreads in labor costs, a measure of productivity, and exchange rates. Cointegration analysis consists of the following steps.

An (n x 1) vector time series y_t (e.g., of capital flows or labor cost spreads) is said to be *cointegrated* if each of its elements individually is integrated of order 1 (denoted $I(1)$), i.e., non-stationary with a unit root, and there exists a nonzero (n x 1) vector **a** such that $\mathbf{a}'y_t$ is stationary. Cointegration means that one or more linear combinations of the variables is stationary even though individually they are not. There are two steps involved in applying the cointegration method. In the **first step**, appropriate tests must be conducted to ensure that the variables are non-stationary in levels and have the same order of integration. In the **second step**, Johansen's likelihood ratio test must be conducted, which is based on estimating the following regression equation (in vector form):

$$\Delta y_t = \pi + \Pi_1 \Delta y_{t-1} + \cdots + \Pi_{k-1} \Delta y_{t-(k-1)} + \Gamma y_{t-k} + u_t,$$

where k is the number of lags assumed for the VAR (vector auto-regression) in levels, π is a vector of constant terms, Π_t and Γ represent the (n x n) matrices of OLS (ordinary least square) coefficients, and u_t denotes the (n x 1) vector of OLS residuals. The likelihood ratio test is of the null hypothesis of zero cointegrating relations against the alternative hypothesis of n cointegrating relations (where n is the number of elements of y_t).

Due to the lack of availability of quarterly data, annual data from 1970-1998 were used in this analysis. Originally Argentina and Brazil were also included in our sample; however, a detailed review of the available data revealed two major difficulties: (1) there were significant variations in these two countries' exchange values – including the introduction of new currencies, new exchange regimes, and the re-denomination of existing units; and (2) data on labor costs that were available belonged to differing and incompatible databases, resulting in a lack of comparability over time. Therefore, Argentina and Brazil were dropped from further consideration.

The data used for cointegration tests consisted of the natural logs of the base figures. Spreads in labor costs were calculated based on data from the U.S. Bureau of Labor Statistics (BLS, 1998) and the UN's International Labor Organization (as well as the authors' estimates for 1970-1974 and 1998). The ***MPK***s were determined based on the

values for α[9], Y (output) and K (capital). Data for the latter two variables, on a per capita basis and covering 1970-1992, were downloaded from the Penn World Tables (1999, available through the NBER Web site),[10] with Y represented by "real GDP per capita in constant dollars, base 1985" and K reflecting "capital stock per worker, base 1985" (the numbers for 1993-1998 are authors' estimates).[11] The exchange rates were obtained from the Federal Reserve. Finally, the data for long-term capital flows (with *total* FDI flows used as a proxy for U.S. MNCs' investments) were collected from the IMF, the U.S. Department of Commerce, the UN, and national central banks. (*See* Table 1 for an example of the data used here).

Table 1
Hong Kong Statistics

Year	FDI US$	LLC HK$	HK$/ US$	LLC US$	USLC US$	LCSP US$	GDP	MPK
1970	85	1.44	6.06	0.23	3.35	3.11	4502	32.2
1971	90	1.85	5.69	0.32	3.65	3.32	4844	33.1
1972	115	2.20	5.65	0.39	3.90	3.51	5207	33.7
1973	152	2.68	5.08	0.52	4.25	3.72	5758	35.8
1974	192	3.12	4.91	0.63	4.75	4.11	5675	33.5
1975	188	3.61	5.03	0.71	5.30	4.58	5629	32.9
1976	228	4.15	4.67	0.88	5.73	4.84	6312	35.6
1977	256	4.66	4.61	1.00	6.24	5.23	7059	38.1
1978	347	5.36	4.80	1.11	6.77	5.65	7737	38.3
1979	488	6.36	4.94	1.28	7.35	6.06	7941	38.7
1980	627	7.26	5.13	1.41	7.98	6.56	8719	38.0
1981	814	8.38	5.67	1.47	8.77	7.29	9341	42.5
1982	854	9.73	6.49	1.49	9.32	7.82	9493	43.7
1983	1140	10.61	7.78	1.36	9.69	8.32	9956	46.0
1984	1368	11.95	7.82	1.52	10.04	8.51	10609	49.0
1985	1640	13.03	7.81	1.66	10.43	8.76	10599	48.4
1986	1737	14.17	7.79	1.81	10.65	8.83	11520	52.0
1987	2260	15.78	7.76	2.03	10.83	8.79	12961	57.6
1988	3080	18.13	7.80	2.32	11.12	8.79	13969	59.7
1989	4168	21.08	7.80	2.70	11.41	8.70	14260	58.6
1990	4750	24.10	7.70	3.08	11.80	8.71	14849	59.0
1991	5430	26.91	7.78	3.45	12.21	8.75	15601	58.5
1992	7720	29.33	7.74	3.78	12.50	8.71	16471	59.7
1993	8210	32.11	7.72	4.15	12.80	8.64	17129	56.3
1994	9135	34.50	7.73	4.45	13.14	8.68	17550	50.6
1995	11305	36.09	7.73	4.66	13.47	8.80	17945	47.8
1996	10970	38.45	7.73	4.97	13.91	8.93	18448	46.2
1997	10600	40.63	7.74	5.24	14.34	9.09	18125	42.0
1998	9870	42.93	7.74	5.54	14.75	9.20	18250	44.9

Notes: FDI: Foreign Direct Investment; LLC: Local Labor Cost; HK$: Hong Kong Dollar; USLC: United States Labor Cost; LCSp.: Labor Cost Spread; GDP: Gross Domestic Product per capita (US$); MPK: Marginal Product of Capital (%).

THE RESULTS

The theory behind ARMA (autoregressive moving average) applies only to stationary or cointegrated time series. If the data is non-stationary, it is said to contain an integrated component and it should be differenced. The augmented Dickey-Fuller (ADF) test provides a formal test of stationarity. We used EViews (1998) software to process the data. The ADF unit root test (with the number of lags, k, set equal to 1) was applied to each series. The results, reported in Table 2, indicate that all the series are non-stationary in levels, i.e., each is integrated of order 1 (non-stationary with a unit root), and thus can be subjected to cointegration tests. If cointegrated, then a linear combination of the variables is stationary even though individually they are not.

Table 2
Unit Root Test For The Four Series

Country	Data Series	ADF Test Stat., Level
Mexico	• Labor Cost Spreads	-0.96
	• Currency Values	-2.39
	• MPK	-2.38
	• FDI	-2.62
Hong Kong	• Labor Cost Spreads	-1.70
	• Currency Values	-2.07
	• MPK	-0.66
	• FDI	+0.14
Korea	• Labor Cost Spreads	-1.70
	• Currency Values	-2.19
	• MPK	-2.79
	• FDI	-2.13
Singapore	• Labor Cost Spreads	-1.50
	• Currency Values	-2.61
	• MPK	-1.16
	• FDI	-3.65
Taiwan	• Labor Cost Spreads	-1.96
	• Currency Values	-1.64
	• MPK	-2.42
	• FDI	-2.05

Notes: The tests were conducted on regressions containing a constant and a trend, with the number of lags, k, set equal to 1. All the ADF test statistics are found to be "significant" (at either the 1, the 5, or the 10 % level based on MacKinnon critical values), suggesting that each of the series is non-stationary.

Next, for each of the 5 economies, the Johansen likelihood ratio test for cointegration were applied to the vector y_t consisting of the natural log of labor cost spreads, ***MPK***, exchange rates, and flows of FDI. There were no *a priori* restrictions imposed upon the cointegrating vectors and a lag length of $k = 1$ was used. The results obtained are quite

robust and are summarized in Table 3. The findings indicate that in all the cases there is a strong evidence (at either the 1 or the 5% level) of the existence of a long run "equilibrium relationship" (co-movement) among the capital flows and the other variables in this study, i.e., the hypothesis of no cointegration is strongly rejected. The evidence confirms the existence, for each country, of a linear combination of the variables that is stationary.

It is important to note that the results do not imply any cause and effect; rather, cointegration signifies a long-term equilibrium condition. For each economy, we observe variations (non-stationarity) in labor-cost spreads relative to the U.S., bilateral exchange rates, a measure of capital productivity, and foreign capital inflows during our selected time period. Our empirical results show that the annual figures obtained for these four measures demonstrate a long-term equilibrium relationship, implying a consistent pattern of (stationary) movements vis-à-vis each other over the period 1970-1998.

Table 3
Tests for Cointegration

Country	Johansen's Cointegration: Likelihood Ratio Test
Mexico	58.66*
Hong Kong	55.69**
Korea	49.58**
Singapore	59.04*
Taiwan	62.98**

Notes: The Johansen's cointegration tests involved $k = 1$.
* (**) Cointegration is found to be significant at the 5 (or 1) percent level.
Mexico: the test involved a constant.
Hong Kong: the test did not have a constant or a trend.
Korea: the test had no constant or a trend, with the lag, k, set at 2.
Singapore: the test involved a constant.
Taiwan: the test involved a constant.

CONCLUSION

A rising number of MNCs have in recent years committed increasing amounts of FDI capital to emerging economies, with lower level of labor costs and expected higher capital returns prevailing in many of these countries. Data for five emerging countries with differing exchange arrangements, labor and capital markets, and attractiveness to foreign MNCs, help us confirm the existence of a long-term equilibrium linkage between global capital flows, a measure of capital productivity, labor costs, and exchange rates. Pending the availability of more detailed data (encompassing a larger sample of countries and a higher time frequency), additional tests can be conducted leading to more evidence of the long-term relationship between global capital flows and other selected economic variables.

ENDNOTES

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1. It should be noted that wage differences referred to in our study are in the aggregate and do not provide any measure of wage inequalities which exist within a country. Butler and Dueker (1999) show, with data for 11 OECD countries, that "foreign and domestic innovation rates affect domestic wage inequality by equal and opposite magnitudes". The results indicate that "the estimated elasticities imply that a 10% increase in the domestic (foreign) innovation rate leads to a 3% increase (decrease) in the high-tech wage rate, relative to the low-tech wage".

2. It must be emphasized that prices of goods and services vary greatly among countries and that nominal exchange rates do not reliably indicate relative differences in prices. Thus, while the compensation measures are appropriate for comparing levels of employer labor costs, they are not necessarily indicative of relative living standards of workers or their purchasing power.

3. Although the productivity measure relates output to the hours of persons employed in a particular economic sector or activity (e.g., manufacturing), it does not measure the specific contributions of labor as a single factor of production, but rather, it reflects the confluence of other factors such as new technology, capital investment, capacity utilization, energy use, and managerial skills, as well as the skills and efforts of the work force. Golub (1995) concludes, "low wages are a symptoms of low productivity, not an independent source of international competitiveness".

4. Harrigan (1999) finds large and persistent TFP differences across a group of industrialized countries in the 1980s. Two hypotheses were examined: constant returns to scale production with country-specific technological differences, and industry-level scale economies with identical technology in each country. The data support the constant returns/different technology hypothesis.

5. In an indirect analysis of certain aspects of this function, Rowthorn (1999) states that many economists believe that capital accumulation, technical progress and labor force expansion have no lasting effect on unemployment. The study points out: "this view rests on the empirically doubtful assumption that the elasticity of substitution between labor and capital is equal to unity (i.e., production is Cobb-Douglas)." The paper demonstrates that, with a lower elasticity of substitution, the equilibrium unemployment rate is affected by all of the above factors.

6. Robertson (1999), in discussing economic growth, provides further explanation for the long-held view that the rate of return to capital is relatively constant across countries and over time.

7. The latest as well as historical data are available from the IMF, the World Bank, the U.S. Department of Commerce, the UN, and national central banks.

8. De Mello (1999) estimates the impact of FDI on capital accumulation, output and TFP growth for a sample of OECD and non-OECD countries in the period 1970-90. The results show that "the extent to which FDI is growth-enhancing depends on the degree of complementarity and substitution between FDI and domestic investment." Also, see Larudee and Koechlin (1999) on the impact of wage differentials on the flows of FDI.

9. Following the findings reported by Sarel (1997), the value for ? was set at 0.29 for USA, 0.34 for Singapore, and 0.33 for the other countries in our study.

10. Sarel (1997) argues that the use of the Penn World Tables has distinct advantages stemming from

the fact that the database contains capital stocks and output series which are measured in a common currency and in common prices. This makes it possible to estimate growth rates in total factor productivity, calculate *Y/K* ratios, and derive *MPK*s, which provide meaningful comparisons across countries and over time.

11. In arriving at our estimates, two steps were followed. First, data on GDP and "gross capital investment" were obtained from the IMF (in the case of Taiwan, the sources included the country's central bank, several independent databases, and the Economist Intelligence Unit). This provided us with a base with which the Penn data could be compared and contrasted. Second, the existence of various economic "levels" in our selected nations and the attendant growth rates made it necessary to apply differing numerical procedures in order to estimate the required figures. More specifically, the data-fitting capabilities of Excel were used to find the best fit on some data and then interpolations and extrapolations were implemented in order to generate the approximate values wherever data were lacking. Among the "tools" utilized were linear and polynomial functions (Korea, Singapore and Taiwan), power and exponential functions (Hong Kong), and log function (Taiwan).

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