2007

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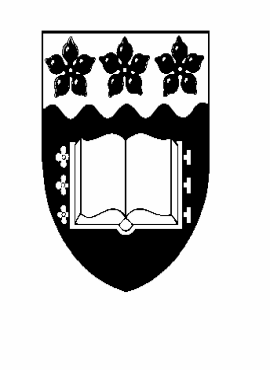
Publication Details

Jayanthakumaran, K and Lee, SW, An initial push for successful transition from import substitution to export-orientation in Taiwan and China: The FDI-led hypothesis, Working Paper 07-03, Department of Economics, University of Wollongong, 2007.



University of Wollongong

Economics Working Paper Series 2007

http://www.uow.edu.au/commerce/econ/wpapers.html

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WP 07-03

May 2007

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Kankesu Jayanthakumaran and Shao-Wei Lee*

Abstract

This paper examines the association between government policy interventions, Foreign Direct Investment (FDI) and exports in Taiwan and China by applying the LP (Lumsdaine and Papell, 1997), approach allowing two endogenous structural breaks. This paper further explores the cointegrating relationship between FDI and exports in Taiwan by using the Johansen and Juselius (1990) approach and causal relationships between FDI and exports in both Taiwan and China by using the Granger causality tests respectively. We found that significant trend breaks in the FDI and export time series detected in both countries coincided with extensive government interventions, mainly in the form of Export Processing Zones (EPZ), encouraging FDI during a transition period from import substitution to export orientation. The results emerging from our research indicate no long-run cointegrating relationship in Taiwan and one-way causal relationship flows from exports to FDI in China and FDI to exports in Taiwan. The growing fear is that the World Trade Organisation's (WTO) involvement in deregulating EPZs may narrow the differences between the zones and the rest of the economy and prevent new firms from entering the zones. The EPZs may no longer be the transitional strategy for poor/developing countries.

JEL: C22, F21, R58
Key words: FDI, Exports, EPZ, structural breaks, causality, East Asia

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1. Introduction

Taiwan's export-led strategy, implemented through its introduction of an Export Processing Zone (EPZs) [1] in Kaohsiung, was aimed at gaining Foreign Direct Investment (FDI) in labour-intensive manufacturing in the 1960s while China sought to achieve similar aims through its foreign direct investment (FDI)-led strategy in the 1980s. The rapid and sustained economic development achieved in Taiwan by promoting a competitive market for factors (transforming from labour-intensive to capital-intensive, and then to knowledge-based industries based on competitiveness) over the past 50 years is another story in its own right. It is well known that during the initial development of Taiwan, labour-intensive manufacturing went through phases such as primary import substitution (1950-62) and primary export substitution (1962-70) (Fei et al., 1985). Inward FDI in Taiwan increased rapidly with the establishment of the Kaohsiung export processing zone (EPZ) in 1966. China has tended to adopt a similar policy by promoting labour-intensive manufacturing with the support of FDI by establishing Special Economic Zones (SEZs) since the economic reforms of 1978. Currently China is the second largest recipient of FDI worldwide. Realising the benefits of FDI, China in 1990 relaxed its emphasis on joint ventures in favour of wholly-owned foreign enterprises.

The purpose of this paper is, firstly, to examine the association between policy interventions and FDI in Taiwan and China, and to present an analysis of government interventions in FDI by promoting exports of labour-intensive manufacturing products; secondly, to test the hypothesis that the introduction of EPZs/SEZs in Taiwan and China has had a positive impact on FDI and exports, and, further, to evaluate cointegration and causal links between inward FDI and exports; and, finally, to conclude with a brief evaluation of the role of FDI in pushing the economies of Taiwan and China initially towards labour-intensive products and then towards competitive capital-intensive products. In section two, the theoretical and empirical aspects of FDI and exports are reviewed. In section three, FDI in Taiwan and China is discussed, while sections four and five deal with methodology and results, respectively. Section six, the final section, presents our conclusions.

2. FDI and Exports

State interventions in trade and investment were widespread among the newly industrialised economies (NIEs) in their early stages of development. Foreign investors in the host country were the beneficiaries of sector-specific fiscal interventions such as tax concessions. Foreign investors in the EPZs received favoured treatment with respect to taxation, infrastructure, import control and industrial regulations. EPZs were known as a gateway for foreign investors into the host country and used as a transitional strategy to shift from import substitution to export orientation and thus represent one of the steps taken towards becoming more efficiently integrated into the world economy. When a host country adopts more

[1] By definition, EPZs allow the creation of an enclave, isolated from the domestic economy, within which export-oriented manufacturing activities can freely operate with favourable treatment afforded to firms by way of tax holidays, streamlined regulations, reduced customs barriers and limited state interference. Contrary to this definition of EPZs, Taiwan used them as a growth centre strategy, allowing greater integration with the rest of the economy. Note that EPZ and Special Economic Zones (SEZ) refer to almost similar concepts.

liberal economic policies, advocating trade and investment liberalisation, EPZs can help transform its products into high value-added products, as evidenced in Taiwan.

The linkage between FDI and exports can be traced by applying the flying-geese model, product life cycle theory and new growth theory. The flying-geese model reveals a country's shifting competitiveness with time lags by paying attention to the dynamic changes in the endowment of factors such as labour, capital and knowledge that countries usually experience during the process of economic development. In Asia, the flying-geese type of FDI played a dominant role in the emergence of new industries and the withering away of old ones with time lags (Kwan, 1996). The dynamic changes of the industrial structure in specific countries (the rise and fall of industries in the light of cost advantages, for example, the shift from the textile industry to the chemical industry and then to the steel and automobile industry) and the shift of industries across countries have well been noticed in Asia. FDI contributed to the emergence of new industries and to the rise of new countries based on their cost advantages. For example, inflows of FDI have resulted in the development of textile and garment industry in the 1960s in Asian Newly Industrialising Economies (ANIEs). Outflows of FDI took place from Japan which helped Japan to reduce the size of its textile and garment industry and release resources for emerging capital-intensive industries. The ANIEs are currently relocating their textile and garment industry to Association of South East Asian Nations (ASEAN) and China (Kwan, 1996).

The flying-geese model is slightly different from the product life cycle theory (Vernon, 1966) by emphasising changes in the production process over time, particularly the combination of factors of production (labour-intensive or capital-intensive). According to product life cycle theory, the same firms that initiate a product for consumption in home markets will undertake FDI to produce a product for consumption in foreign markets. Product life cycle theory explains the phenomenon of an increasing number of US-based multinational corporations (MNCs) in advanced countries, for example, in European countries and Japan, and then in developing countries. Initially, investments shift to advanced countries from the USA when local demand in those countries grows large enough to support local production. Finally, investments shift to developing countries when product standardisation and market saturation give rise to price competition and cost pressures.

New growth theory perceives FDI as catalyst for domestic investment and technological progress and as motivating an increase in productivity in the recipient countries. FDI is expected to augment knowledge transfer by increasing the existing stock of knowledge in the host country through labour training, acquisition of skills, introduction of alternative management practices and organisational arrangements. Innovation by domestic firms is expected to increase due to competitive pressure and knowledge transfer.

According to new growth theory, EPZs can conserve anti-export biases present in the host economy if reforms are not extended to the wider economy. If coupled with a national reform strategy, EPZs can stimulate the emergence of a domestic exporting sector outside the zone by initiating additional trade-oriented reforms. The new growth theory thus perceives foreign investors as promoters of domestic firms in terms of technical, marketing and managerial know-how, international distribution and international business dealings (Johansson and Nilsson, 1997). The drawback of

this theory is that the suggested effects on the host country are hard to measure as they are not tangible in nature.

The experience of ANIEs shows that the inflows of FDI into labour-intensive industries which held comparative advantages in the early stages of development stimulate exports as soon as liberal trade and investment policies are introduced (Dahlman and Sananikone, 1997). This is mainly due to the fact that the technology gap in labour-intensive industries between host and home country is not large and thus easy for indigenous firms to close. Foreign exposure stimulates the competitiveness and efficiency of indigenous firms through 'challenge response' effects and potential 'spillover' effects, the latter being both intra- and inter-industry. Intra-industry spillover occurs when indigenous firms in the same industry as foreign subsidiaries are likely to imitate new technologies, management practices and advanced production processes. Inter-industry spillover occurs when foreign subsidiaries share technology with their suppliers (backward linkage), enabling them to upgrade their products and increase their export potentials. Foreign subsidiaries may also pass on their efficiency to local firms in the form of price reductions (forward linkage), thereby improving the export potential of the local firms. The exports of foreign subsidiaries are considered to be direct effects of FDI, whereas indirect effects are generated by the impact of FDI on the export performance of indigenous firms.

One could also argue that an export growth strategy may lead to FDI inflows initially, before FDI stimulates exports. In the early stages of such a strategy, a higher degree of outward orientation and potential exports attracts FDI, while outward orientation promotes competition. Competition in turn promotes innovation and efficiency and results in an improvement in productivity. Cost reduction due to an increase in productivity lead to a higher rate of return to foreign investors and potentially prepares the ground for further foreign investment. FDI tends to turn export potential into real export growth in the later stages of an export growth strategy.

Recent studies have concentrated on this issue from the perspective of either the determinants of a host country's export performance or the causal relationship between inward FDI and exports. The majority of empirical studies conclude that there is a positive or one-way causal relationship between inward FDI and host countries' export performance, indicating that FDI inflows stimulate exports (Ekanayake et al., 2003; Leichenko and Erickson, 1997; Liu and Shu, 2003; Metwally, 2004; Seo, 1997; Sun, 2001; Vuksic, 2006; Zhang, 2005; Zhang and Song, 2000). Contrary to this, a few studies have found a one-way causal relationship between exports and inward FDI, indicating that exports stimulate FDI (Jun and Singh, 1996; Khan and Leng, 1997; Zhang and Felmingham, 2001). Literature surveys indicate that there may be a bi-directional causal link, i.e. that exports stimulate FDI inflows and FDI inflows promote exports (Baliamoune-Lutz, 2004; Liu et al., 2002; Pacheco-Lopez, 2005; Zhang and Felmingham, 2001). It is also interesting to note that some studies conclude that the positive association between inward FDI and exports is unfounded, indicating that foreign firms are not likely to stimulate exports (Alıcı and Ucal, 2003; Sharma, 2003; Zheng et al., 2004).

The majority of the above empirical studies applied causality tests based on time series data to examine the nature of any causal relationship between FDI and exports. Some studies do not consider the endogenous nature of the export process and are subject to simultaneous bias (Hood and Young, 1979). Several are cross-country

studies which assume a common economic structure and similar production technology across countries, which may in fact not be true (Hejazi and Safarian, 2001; Liu et al., 2001). In those studies the Granger causality technique is widely used. Inconsistency in time and country is an obstacle to the meaningful comparison of available empirical studies, although the majority of studies indicated a one-way causal relationship from inward FDI to host countries' export performance. In brief, the evidence for causal links between FDI and exports is inconclusive.

3. FDI in Taiwan and China[2]

The dramatic increases in FDI inflows into Taiwan and of Taiwanese exports since the introduction of state incentives for foreign investments in export-oriented, labour-intensive industries during the late 1960s have been widely observed (Dahlman and Sananikone, 1997; Fei et al., 1985). This is often referred to as an export-led strategy. The remarkable increases in FDI inflows into China since the economic reforms of 1978 have also been well noted and are often referred as an FDI-led strategy (Figures 1 & 2). Literature surveys recognise that foreign firms have contributed much of the growth in Chinese exports. Several studies have attempted to link the export/FDI-led strategies with the dramatic growth of exports and income of Taiwan and China during their respective periods of promoting FDI.

Fei et al. (1985) noted Taiwan's transition from import substitution to export promotion, particularly in the light manufacturing sector from 1962 to 1970. To stimulate export-oriented activities, incentives were implemented for foreign investment in general and within EPZs in particular. The 1960 'Statute for the Encouragement of Investment' offered a wide range of incentives to both local and foreign firms, including a five-year tax holiday for approved export-oriented enterprises, 100% equity ownership, unhindered repatriation of profits and interest earnings, accelerated depreciation, exemption from import duties and preferential land sites. Local content requirements (maximum of 70% of the product value) were imposed on foreign firms to encourage local firms.

The 1965 Statute for the Establishment and Management of EPZ targeted foreign investment in export-oriented, labour-intensive industries. EPZs offered complete exemption from customs duties and sales taxes in addition to other incentives. EPZs became operative by receiving approved Japanese investments from 1968 onward. EPZs in Taiwan not only performed as an economic transformer that turned Taiwan's excess manpower on the farms into skilled blue-collar workers in the factories, but it also successfully transformed labour-intensive industries into more technological and capital-intensive enterprises (Wu et al., 2006). By 1970 exports had grown almost thirteen-fold compared with 1967 (Lee, 2007)[3].

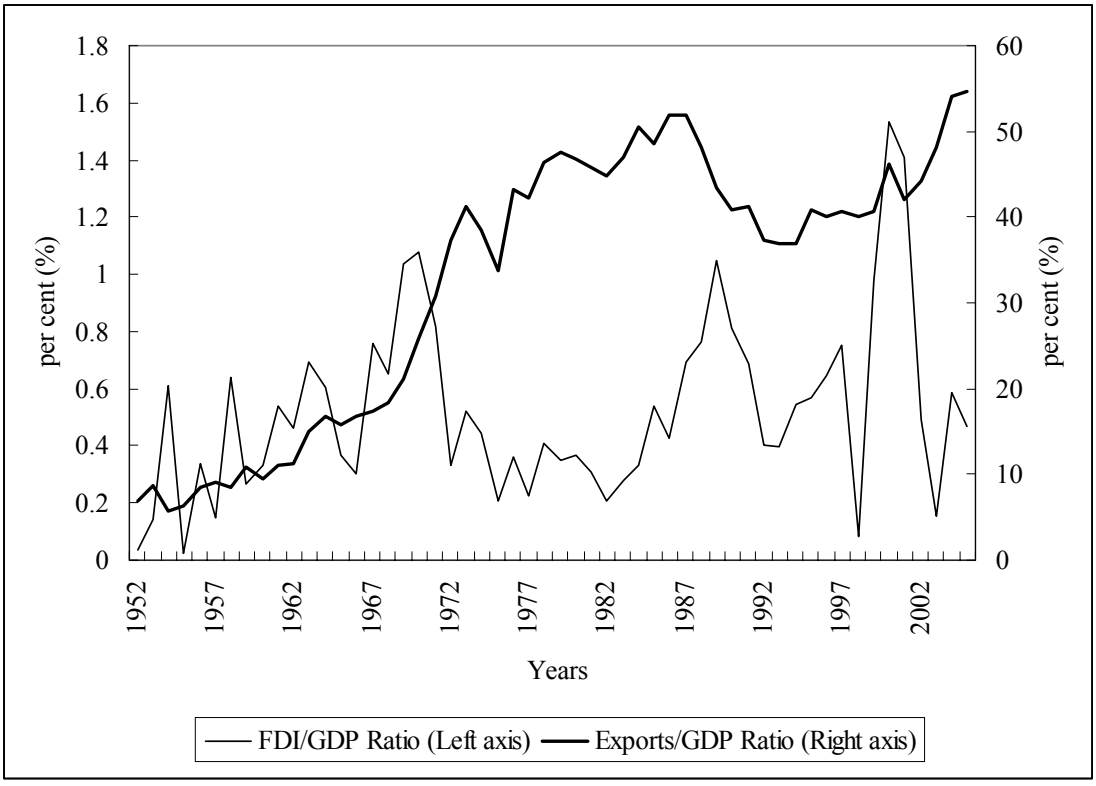
FDI was part of Taiwan's overall development strategy, playing the role of a catalyst in Taiwan's industrialisation and export growth. The majority of FDI was in export-

[2] Because all forms of links between Mainland China and Taiwan had been frozen for the past half century, Hong Kong played an intermediary role in trade and investment links between Mainland China and Taiwan. However, China's economic reforms in 1978 paved the way for direct Taiwanese investment in Mainland China, and currently Taiwan contributes around 7% of the total investment in Mainland China.

[3] The results and data for Taiwan presented in this paper are from Lee (2007).

oriented light industries such as textiles, clothing and footwear products during the 1960s. The government promoted labour-intensive industries to take advantage of the growing population, excess agricultural labour and low wages. In the 1970s, as wages rose and the supply of unskilled labour diminished, the government shifted to an industrial strategy that called for the development of capital-intensive industries. The government targeted several specific industries for exports by offering selective incentives and promoting export-oriented FDI. More than 80% of total FDI went into the manufacturing sector, thus contributing to the growth of manufacturing by creating linkage effects through technology and skill transfers.

Following the second oil shock in the early 1980s, Taiwan initiated a trade and investment liberalisation and internationalisation. Howe (1996) noted that between 1983/84 and 1991/1992 (a) a reduction of the average tariffs from 31 to 9 per cent; (b) a reduction of the number of commodities subject to non-tariff barriers from 26,768 to 9,053 and (c) an increase in FDI and associated spill over effects. The establishment of an Executive Committee to Develop Strategic industries in 1982 and the Development of New Industrial Products in 1984 were considered as the domestic process of upgrading Taiwan industry.



Sources: AREMOS (2005); DGBAS (2005); MOEA/IC (various issues); Seo (1997).

Figure 1 FDI/GDP and Exports/GDP for Taiwan (1952-2005)

A visual inspection of Figure 1 indicates a substantial acceleration in Taiwan's FDI/GDP ratio and exports/GDP ratio. The FDI/GDP ratio increased from 0.36% in 1965 to 1.03% in 1969. By 1970, EPZs contributed about 10% of total exports (Dahlman and Sananikone, 1997). Concerning exports by Foreign-invested

enterprises (FIEs)[4] in Taiwan, the establishment of EPZs from 1966 on directly contributed to this increased ratio, increasing rapidly from 37% in 1950-1966 to 76% in 1967-1971, and reaching its highest point of 91% in 1971-1973. This outstanding export performance was mainly due to the Taiwanese government's strict selection of export-oriented FIEs, particularly during 1967-1971 (Schive, 1978). This ratio fluctuated over the decades; however, exports by FIEs maintained their growth, increasing from a low of 22% in 1993 to 53% in 2003. FDI inflows into China can be grouped into three phases: The first phase (1979 to 1983) coincided with the establishment of 'special economic zones' (s); the second phase (1984 to 1992) coincided with the expansion of s, for example, the 'open coastal cities' in 1984[5] and the three 'open economic zones' in 1985[6]; while the final phase (since 1992) shows a distinct upward trend in inflows of FDI. Measures were introduced to promote technically advanced export-oriented investment in the final phase (Zheng et al., 2004). The regional distribution of FDI has been exceptionally uneven. About 88% of FDI targeted the coastal provinces, taking advantage of duty-free arrangements, seaport facilities and proximity to overseas markets. The Chinese government has continuously committed to invest in infrastructure projects, pursued a stable macroeconomic policy by maintaining steady economic growth, low inflation and a stable currency, and has offered preferential tax breaks to firms that invest in special regions.

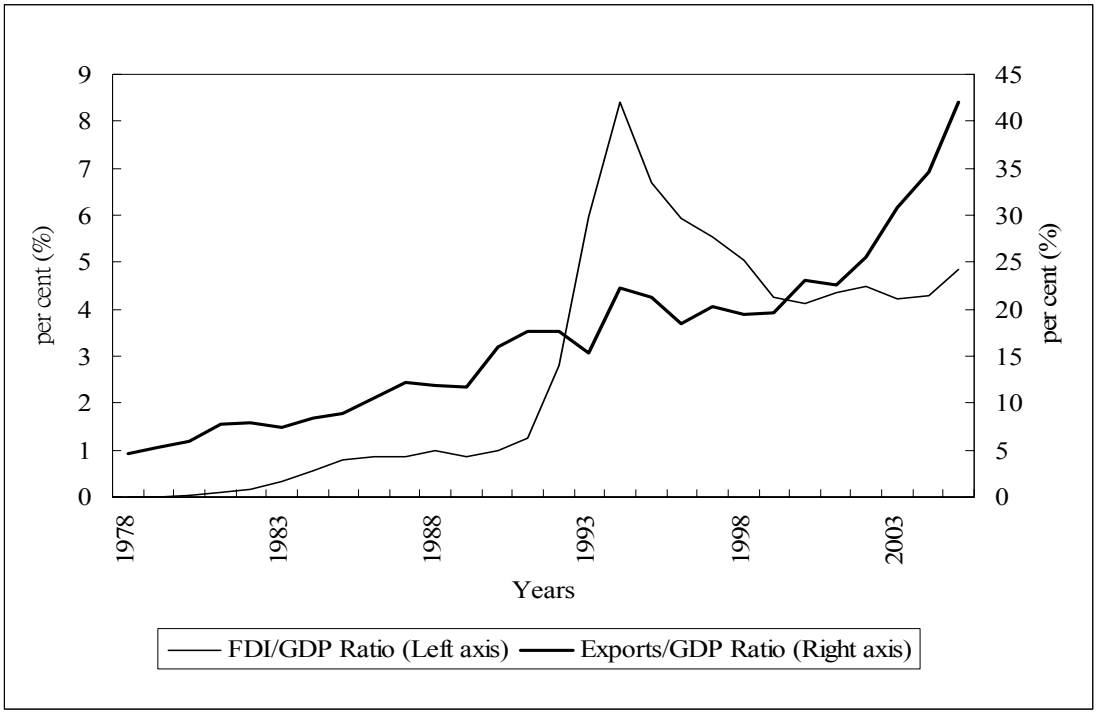
The SEZs accounted for half of all exports and about 90% of the exports of foreign-owned enterprises. China adopted a policy of 'open coastal cities' and 'open economic zones' in the expectation that this would promote linkages with indigenous firms. In 1999, the proportion of firms receiving FDI in the textiles and electronic industries was around 57% (around 20% in the textile industry and 37% in the electronics industry). Hu and Jefferson (2002) noted that the proportion of firms receiving FDI in the electronics industry was nearly twice that of the textile industry.

A visual inspection of Figure 2 indicates a substantial acceleration in China's FDI/GDP ratio and exports/GDP ratio. The FDI/GDP ratio increased from 0.02% in 1980 to 0.80% in 1985. By 1995, this ratio has reached around 8%. By 2005, exports by Foreign-invested enterprises in China had reached a high of nearly 58% of all exports compared with 0.1% in the early stage of its policy of opening-up the economy.

[4] The term 'exports by FIEs' in this study is defined as the percentage of exports by foreign-invested enterprises.

[5] In 1984, 14 major cities such as Dalian, Qinhuangdao, Tianjin, Yantai, Qingdao, Lianyungang, Nantong, Shanghai, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang and Beihai were opened up to foreign investment.

[6] Open areas were extended to the Pearl River and Yangzi River deltas, South Fujian, and the Liaoning and Jiaodong peninsulas.



Sources: UNCTAD (on-line)

Figure 2 FDI/GDP and Exports/GDP for China (1979-2005)

Huang (2001) observed that China's internal reforms had lagged behind its external reforms and argue that the benefits of undertaking internal reforms (focusing on domestic private firms) may be far greater than any policy measures designed to attract FDI. Huang (2001, p. 62) further say that "there have been huge losers in the Chinese reform process, notably private entrepreneurs who have foregone business growth opportunities and lost control over their businesses because of the systematic legal and financial discrimination against them". By contrast, in Taiwan FDI was part of an overall development strategy which accommodated spillovers, knowledge transfer and labour training.

4. Methodology

The objective of the study is to test the hypothesis that the introduction of EPZs/SEZs in Taiwan and China has had a positive impact on FDI and exports, and, further, to evaluate cointegration and causal links between inward FDI and exports. To find out the possible government interventions on FDI and exports, this paper investigates the unit root analysis in the presence of multiple endogenously determined structural breaks, which is built upon the spirit of the "intervention analysis", by applying Lumsdaine and Papell's (LP, 1997) approach.[7] Historical time series data of FDI and

[7] In empirical studies, a single endogenously determined structural break in the time series data can be detected by using different models such as Zivot and Andrew (ZA) model, the Additive Outlier (AO) model and the Innovational Outlier (IO) model. These models allow either gradual change (in slope) or immediate change (in intercept) or allow both a change in the slope and intercept of the trend function. However, those models fail to detect the multiple structural breaks in the time series. Inappropriate measurement of the number of the structural break leads to bias judgement of the stationarity of the

export for Taiwan covered from 1952 to 2005 and 1979 to 2005 for China. Importantly, another advantage of using the LP approach in the unit root analysis is that the LP approach reduces the incorrect judgement of stationarity of the time series, which will lead to model misspecification in the Granger causality test. The Granger (1969) causality test is a simple test of causality. The Granger causality techniques are performed in a framework of vector autoregression (VAR) model or error correction model (ECM).

As a first step for Granger causality test, the property of stationarity of time series data should be identified. Two widely used conventional unit root tests such as ADF and Phillip Perron (PP) tests are applied. However, these two tests fail to consider the possible breaks in the time series. If the existence of structural break(s) in the series is not considered carefully, the conventional ADF test statistics may have been biased towards the non-rejection of a unit root when the series is trend stationary within each of the sub-periods (Perron, 1997). Therefore, Lumsdaine and Papell's (LP) model is applied to detect two-time structural breaks in the unit root analysis, and the result of stationarity of each time series by using the LP approach replaces the result from ADF and PP tests. The structural break may occur by reflecting, for example, a country's policy reforms or slowdown in growth (Perron, 1997). If the break date(s) is/are located in the same year as the occurrence of the incident, then we may conclude that the time series was affected immediately by this structural break. Similarly, if the break date(s) is/are located in the year after the incident occurred, we may interpret this that the time series was affected gradually by this structural break (Pahlavani et al., 2005).

LP approach adapts a revised version of the ADF test, which is augmented by two endogenous breaks, the null hypothesis is unit root against stationary with two endogenously determined breaks alternative. The LP's model is considered as:

$$\Delta y_t = \mu + \beta t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \varphi DT2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \qquad (1)$$

where Δ represents the first difference operator. y_t is the time series being tested and t is a time trend variable. t =1, ….,T, where $c(L)$ is a lag polynomial of known order k. This model includes enough numbers of lags k, to ensure the residual term ε_t is white noise, and the optimal lag length k is selected based on the general to specific approach suggested by Ng and Perron (1995). $DU1_t$ and $DU2_t$ are dummy variables for a mean shift occurring at times $TB1$ and $TB2$ ($1<TB<T$, TB is the break date), respectively. $DT1_t$ and $DT2_t$ are the corresponding trend shift variables. $DU1_t$ = 1 if $t > TB1$ and zero otherwise; $DU2_t$ =1 if $t > TB2$ and zero otherwise; $DT1_t = t - TB1$ if $t > TB1$ and $DT2_t = t - TB2$ if $t > TB2$ and zero otherwise. This model allows for two breaks in both intercept and slope term of the trend function. The break dates are determined, depending on the minimum value of the t statistics for α. Using annual time series in this study, followed Lumsdaine and Papell (1997), we assume k_{max} is up to 8. The decision rule is that: if the t-statistic of α is higher than 5 per cent critical value, then the unit root of null hypothesis can not be rejected.

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time series. Therefore, this study adopts the newest available method to detect the multiple structural breaks in the time series data by using LP model in stead of using any one of the above models.

As a second step, cointegration tests are applied. If series are linked to form an equilibrium relationship in the long run, then even though the series themselves may contain stochastic trends (i.e. be non-stationary, *I*(1)), they will move closely together over time. Therefore, the existence of cointegration implies a long-run equilibrium with an economic system converges over time (Harries, 1995, p. 22).

In this study, Johansen and Juselius's (1990) approach to the number of cointegrating vectors is achieved if two variables are *I*(1). The cointegration test of maximum likelihood based on the Johansen-Juselius test is developed based on a VAR approach initiated by Johansen (1988). According to Johansen (1988), a *p*-dimensional VAR model involving up to *k*-lags can be specified as follows:

$$Z_t = \alpha + \prod_1 Z_{t-1} + \prod_2 Z_{t-2} + ... + \prod_k Z_{t-k} + \varepsilon_t \qquad (2)$$

where Z_t is a (p x 1) vector of p potential endogenous variables and each of the $\prod_i$ is an (p x p) matrix of parameters and ε_t is the white noise term.
Equation (2) can be formulated into an ECM form:

$$\Delta Z_t = \alpha + \prod_k Z_{t-k} + \sum_{i=1}^{k-1} \theta_i \Delta Z_{t-i} + \varepsilon_t \qquad (3)$$

where Δ is the first difference operator, and $\prod$ and θ are p by p matrices of unknown parameters and k is the order of the VAR which translated into a lag of k-1 in the ECM. ε_t is the white noise term. Johansen and Juselius (1990) developed two likelihood ratio tests: The first test is the likelihood ratio test based on the maximal eigenvalue which evaluates the null hypothesis of 'r' cointegrating vector(s) against the alternative of 'r+1' cointegrating vectors; the second test is the likelihood ratio test based on the trace test which evaluates the null hypothesis of, at most, 'r' cointegrating vector(s) versus the general null of p cointegrating vectors. If the two variables are *I*(1) but co-integrated, the Granger causality test will be applied in the framework of ECM which is shown as equations (6) and (7).

The Granger causality test is applied based on a stationary dataset. Hence, it is necessary to establish the stationarity properties of the data and unit root analysis is conducted for this purpose. The stationary basis of a logarithm set of two variables for the Granger causality model in a bivariate VAR can be carried out as the following regressions (4) and (5):

$$LFDI_t = \sum_{j=1}^{p} \alpha_{11,j} LFDI_{t-j} + \sum_{j=1}^{p} \alpha_{12,j} LEXPORT_{t-j} + \varepsilon_{t1} \qquad (4)$$

$$LEXPORT_t = \sum_{j=1}^{p} \alpha_{21,j} LEXPORT_{t-j} + \sum_{j=1}^{p} \alpha_{22,j} LFDI_{t-j} + \varepsilon_{t2} \qquad (5)$$

where ε_{t1} and ε_{t2} are white noise, and p is the lag length. A test of joint significance of these lagged terms ($\alpha_{12,j} = 0, j = 1, \ldots p$ and $\alpha_{22,j} = 0, j = 1, \ldots p$) constitutes a short-run Granger causality test. Four possible situations showing whether two variables have any causal relationship are as follows:

a) One-way causality from FDI to exports if $\sum_{j=1}^{p} \alpha_{22,j} \neq 0$ and $\sum_{j=1}^{p} \alpha_{21,j} = 0$

b) One-way causality from exports to FDI if $\sum_{j=1}^{p} \alpha_{12} \neq 0$ and $\sum_{j=1}^{p} \alpha_{11,j} = 0$

c) Bi-directional causality between FDI and exports if $\sum_{j=1}^{p} \alpha_{12} \neq 0$ and $\sum_{j=1}^{p} \alpha_{22,j} \neq 0$

d) No causal relationship if $\sum_{j=1}^{p} \alpha_{12}$ and $\sum_{j=1}^{p} \alpha_{22,j}$ are not statistically significant.

Further, if two variables are I(1) but cointegrated, then equation (4) and (5) can be formulated into ECM as follows:

$$\Delta LFDI_t = \sum_{j=1}^{p-1} \beta_{11,j} \Delta LFDI_{t-j} + \sum_{j=1}^{p-1} \beta_{12,j} \Delta LEXPORT_{t-j} + \alpha_1 EC_{t-1} + \varepsilon_{1t} \quad (6)$$

$$\Delta LEXPORT_t = \sum_{j=1}^{p-1} \beta_{21,j} \Delta LFDI_{t-j} + \sum_{j=1}^{p-1} \beta_{22,j} \Delta LEXPORT_{t-j} + \alpha_2 EC_{t-1} + \varepsilon_{2t} \quad (7)$$

where Δ is the first difference operator, and ε_{1t} and ε_{2t} are white noise. EC is the error correction term, and p is the order of the VAR which translated into a lag of p-1 in the ECM. α_1 and α_2 represent the speed of adjustment after FDI or exports deviate from the long-run equilibrium in period t-1. The coefficients of lagged value, $\beta_{12,j}$ for j = 1,…, p-1, in equation (4) represent short-run effects of export performance on FDI and $\beta_{21,j}$ for j = 1,… p-1, and in equation (5) represent short-run effects of FDI on export performance. A test of the joint significance of these lagged terms constitutes a short-run Granger causality test.

The Granger causality test is straightforward: If *X* 'Granger cause' *Y*, but *Y* does not 'Granger cause' *X*, then one may conclude that past values of *X* should be helpful in predicting the future value of *Y*, but the past value of *Y* is not helpful in forecasting *X*. It is worth noting that this model does not imply any 'cause and effect' relationship but only the predictability between two variables.

Our analysis covers some 27 years (1979-2005) for China and some 54 years (1952-2005) for Taiwan. All variables are in natural log and are expressed in real terms. We obtained the data for FDI and exports for China from the UNCTAD database (online), National Bureau of Statistics of China and Zheng et.al. (2004) for Taiwan from the Ministry of Economic Affairs /Investment Commission (MOEA/IC) and the National Statistics of Taiwan (on line).

5. Results

The results of the ADF and PP tests are displayed in Table 1. The ADF test shows that LTWFDI is stationary, *I*(0), while the null hypothesis for the unit root can not be rejected for the remaining variables. On the other hand, the PP test suggests that LTWFDI and LCNFDI are *I*(0), whereas LTWEXP and LCNEXP became stationary after first differencing *I*(1). Importantly, both LCNFDI and LCNEXP will be considered *I*(0) in this study as suggested by the LP approach (see Table 2). Similarly, LTWFDI and LTWEXP will be considered *I*(1) due to the null hypothesis of a unit root can not be rejected on the basis of the result from the LP approach.[8] Most of t-

[8] The essential of LP approach is devoted to find the structural breaks in the time series. If the null hypothesis of unit root can not be rejected in this study by using the LP approach, then we suggest the

statistics in Table 1 for μ, β, θ, γ, ω, and φ are statistically significant and this strengthen our results.

Table 1 The results of the ADF and PP tests

		LTWFDI	ΔLTWFDI
		γ_{ct} *(constant and trend)*	γ_{ct} *(constant and trend)*
ADF test statistics		-3.**69[1]***	-6.41**[3]***
5% critical value		-3.50	-3.50
PP test statistics		-6.39*	-29.85*
5% critical value		-3.50	-3.50

* Significance at 5 per cent level

		LTWEXP	ΔLTWEXP
		γ_{ct} *(constant and trend)*	γ_{ct} *(constant and trend)*
ADF test statistics		-0.48**[1]**	-4.86**[1]***
5% critical value		-3.50	-3.50
PP test statistics		-0.58	-7.52*
5% critical value		-3.50	-3.50

* Significance at 5 per cent level

		LCNFDI	ΔLCNFDI	Δ^2LCNFDI
		γ_{ct} *(constant)*	γ_{ct} *(constant)*	γ_{ct} *(constant)*
ADF test statistics		-1.39[2]	-2.92[1]	-3.74[3]*
5% critical value		-3.00	-3.01	-3.01
PP test statistics		-6.57*	-15.72*	-17.88*
5% critical value		-2.98	-2.99	-2.99

* Significance at 5 per cent level

		LCNEXP	ΔLCNEXP
		γ_{ct} *(constant and trend)*	γ_{ct} *(constant and trend)*
ADF test statistics		-2.38[1]	-4.93[1]*
5% critical value		-3.59	-3.60
PP test statistics		-2.65	-6.24*
5% critical value		-3.60	-3.60

* Significance at 5 per cent level. Δ and Δ^2 denote first and second differencing of the time series, respectively. The figures in **[ ]** are the order of augmentation determined by Akaike's information criterion (AIC). Critical values are computed based on Mackinnon (1996); L = log, CN = China and TW = Taiwan.

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time series contains a unit root and further consider the order of integration of the time series by using ADF test.

In order to judge the property of the stationarity of the series properly, we considered the existence of trend break(s) on all variables by using the LP approach. Table 2 presents the results from the LP approach, and the plotting of the structural breaks for each variable is shown in Figure 3. The test detected breakpoints in China's FDI in 1984 and 1992. These breakpoints coincide with the expansion of SEZs and an upward trend in FDI inflows following the April 1990 amendments to the joint venture law of 1979 respectively. The test also detected breakpoints in China's exports in 1993 and 1996. These breakpoints coincide with the gradual effects of the trade and investment reforms made since 1979. The expansion of SEZs through the creation of 'open coastal cities' in 1984 and 'open economic zones' in 1985, and the implementation of a more liberal approach through amending the 'joint venture law' in 1990 and through substantially devaluing the RMB (Yuan) in 1994 could have gradually contributed to these trend breaks.

Table 2 Lumsdaine and Papell (LP) test results

Variables	TB1 TB2	μ	β	θ	γ	ω	φ	α	k
LCNFDI	1984 1992	0.0000 (-1.5292)	1.5609 (-3.187)	0.8118 (-5.5511)	-1.4682 (-3.0514)	0.7122 (-6.6181)	-0.0601 (-3.8170)	-0.4617 (-9.3112)*	1
LCNEXP	1993 1996	3.8306 (-19.2988)	0.4977 (-5.4834)	-2.2782 (-9.9121)	-0.4082 (-2.1961)	-0.8640 (-3.4670)	0.3205 (-1.8735)	-1.7017 (-9.9215)*	7
LTWFDI	1968 1979	-1.4269 (-3.0270)	-0.4142 (-4.3227)	-1.5710 (-2.2211)	0.3828 (-3.2900)	0.0813 (-0.1416)	0.1587 (-1.7695)	-0.9852 (-6.0469)	2
LTWEXP	1970 1984	3.2770 (-4.4963)	-0.2452 (-3.2453)	-2.2023 (-2.6325)	0.4191 (-3.9416)	-1.7667 (-2.8035)	-0.0211 (-0.3284)	-1.0909 (-5.5597)	5

* Critical value at 5% level of significance is -6.82. *t*-statistics for α are in parentheses. The LP approach is applied using GAUSS software; see equation 1 for details of notations.

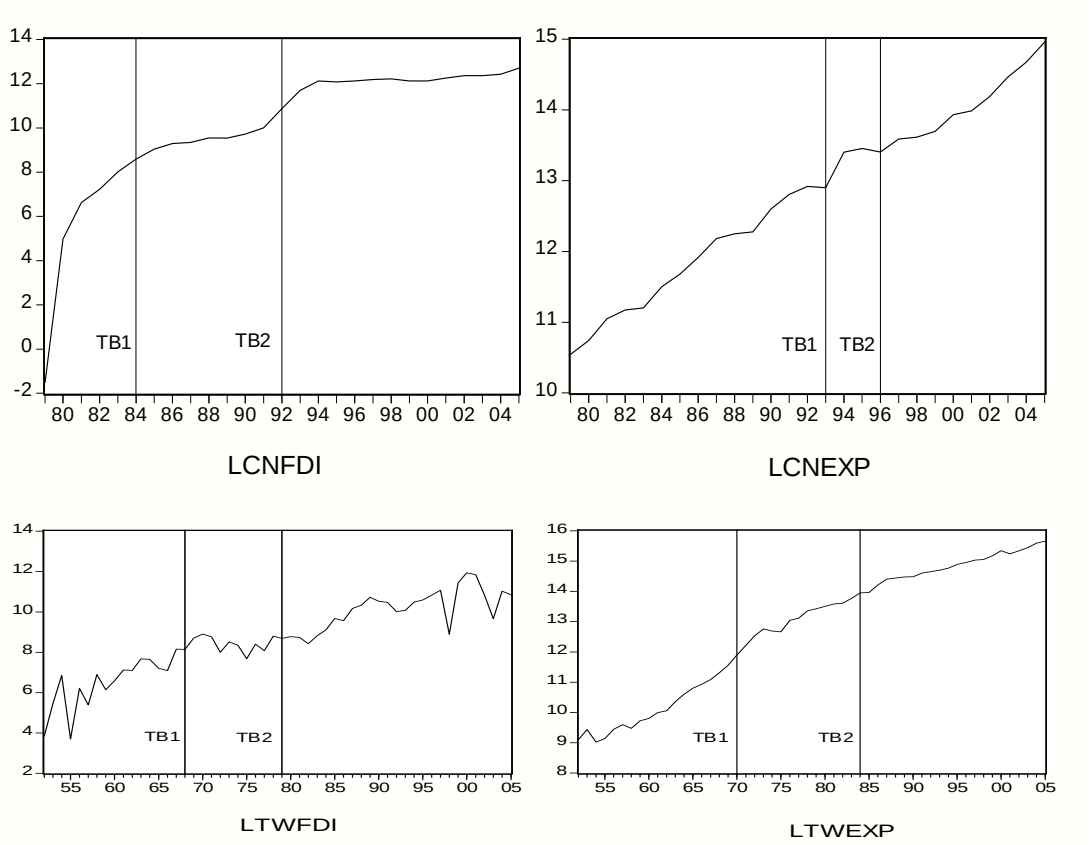

Figure 3 Plots of the estimated timing of structural breaks by LP approach allowing two endogenous breaks.

The trend break found in Taiwan's FDI in 1968 coincided with the effective operation of EPZs in the same year. The second break occurred in 1979, coinciding with deterioration in the growth rate of FDI as a result of Taiwan's unstable political environment, highlighted by a break in formal diplomatic relations between the USA and Taiwan in 1978 (Schive and Tu, 1991). The test also detected breakpoints in Taiwan's exports in 1970 and 1984. The breakpoint in 1970 coincides with the implementation of EPZs. The breakpoint in 1984 was partly due to the Taiwanese government's accelerated trade and investment liberalisation to encourage exports in 1983/84 following the second oil shock in the early 1980s and partly due to the successful achievement of FDI policies on attracting FDI. Many American companies increased their investment in Taiwan during the late1980s by establishing manufacturing subsidiaries which then exported their production back to their parent companies in the USA. The appreciation of the Japanese Yen from mid-1980s was an important incentive for Japanese investment in Taiwanese manufacturing with the purpose of exporting Taiwanese manufactured goods back to Japan.

Table 3 Results of cointegration test

Variable		Max-Eigen Statistic	Trace Statistic	Result
LTWFDI & LTWEXP	r = 0	10.60 [14.88]	15.05 [17.86]	Not cointegrated
	r = 1	4.45 [8.07]	4.50 [8.07]	

Note: Figure in [ ] represents the 5 per cent critical value for Max-Eigen and Trace statistics. The prerequisite for cointegration test it that two variables should be I(1), therefore, cointegration test is not applied to the case of China.

Table 3 reports the result of Trace statistic (λ_{trace}) and Max-Eigen statistic (λ_{max}) tests for a cointegration relationship between the variables LTWFDI and LTWEXP. It can be seen that both Trace statistics and Max-Eigen statistics show a consistent result, such that there is no cointegrating relationship between LTWFDI and LTWEXP. Based on the result of no cointegration relationship between LTWFDI and LTWEXP, the Granger causality test for Taiwan can be performed in a bivariate VAR framework. Further, the Granger causality test for China can be performed in a bivariate VAR framework due to our findings that two variables are I(0). The prerequisite for cointegration test is that the given two variables should be 1(1). In the absence of above prerequisite in China's data series we omit cointegration test for China. The result of the Granger causality test is shown in Table 4.

Table 4 Results of Granger causality test

H_0	*p*	chi-sq	d.f	prob.
LCNFDI does not cause LCNEXP	3	1.9174	3	0.7250
LCNEXP does not cause LCNFDI	3	9.3551	3	0.0249*
ΔLTWFDI does not cause ΔLTWEXP	4	3.3149	4	0.0194*
ΔLTWEXP does not cause ΔLTWFDI	4	0.5392	4	0.7078

* Significance at 5 per cent level. The lag length selection, *p*, is very important to the Granger causality test because it affects the test results significantly (Khan and Leng, 1997; Seo, 1997). In this study, we will select the lag length, *p*, for each variable by Akaike's information criterion (AIC).

The result of the above Granger causality test for China indicates that the null hypothesis that LCNFDI does not "Granger cause" LCNEXP can not be rejected at the 5% level (*p*-value: 0.7250), which leads to a rejection of our hypothesis. This result is consistent with Zheng (2004) and Jun and Singh (1996) but shows the reverse of much other empirical evidence. As the null hypothesis that LCNEXP does not "Granger cause" LCNFDI can be rejected at the 5% level (*p* -value: 0.0249), we conclude that there is a one-way causal relationship flows from exports to FDI in China.

The result of the above Granger causality test for Taiwan indicates that the null hypothesis that ΔLTWFDI does not "Granger cause" ΔLTWEXP can be rejected at the 5% level (*p*-value: 0.0194), which leads to rejection of the null hypothesis, whereas the null hypothesis that ΔLTWEXP does not "Granger cause" LTWFDI can not be rejected at the 5% level (*p*-value: 0.7078). Therefore, we conclude that there is a one-way causal relationship between the flows from FDI to exports in Taiwan.

6. Conclusions

This study has attempted to demonstrate the historical effect of FDI on exports in Taiwan and China. In the light of the foregoing, it is hypothesised that government intervention in the form of EPZs/SEZs in Taiwan and China has had a positive impact on FDI and exports. Applying the Lumsdaine and Papell's (1997) model for detecting breaks in the trend function of univariate FDI time series data, we found significant trend breaks for China in 1984 and Taiwan in 1968. The above breaks coincided with government interventions in the form of establishing EPZs/SEZs to attract mainly foreign investors. These initial breaks are associated with the encouragement of investments in labour-intensive, light manufacturing to exploit China's and Taiwan's abundant workforces. Initial trend breaks occurred in the export time series data for China in 1993 and for Taiwan in 1970. While there are other factors that may have influenced the exports time series over the sample period, it is likely that a gradual structural change occurred in the two countries due to an increase in FDI as a result of the introduction of EPZs and other policy measures encouraging FDI.

In addition to the findings that there is a lack of long-run relationships between FDI and exports in Taiwan, this study further evaluated the causal links between inward FDI and exports in China and Taiwan by using the Granger causality test. For China we found one-way causal relationship flows from exports to FDI. This indicates that countries with export potential attract FDI. Zhang and Felmingham (2001) argue that if causality is assessed at an early stage of the process, then exports or potential exports could appear to be leading to inward FDI. This could be reversed at a later stage when the FDI's exploitation of export potential had led to real export growth. Even though a few studies have indicated similar results (Jun and Singh, 1996; Zheng et al., 2004)[9], our sample for China is relatively small and one should be cautious in interpreting the results. For Taiwan we found a one-way causal relationship from FDI to exports, which is consistent with the majority of empirical work in general.

This type of analysis rarely gives conclusive results, but our results offer support for the hypothesis that government intervention in the form of EPZs/SEZs in Taiwan and China has had a positive impact on FDI and exports, and thus that FDI has tended to perform better in the initial transition of China and Taiwan. In Taiwan the second trend break for exports occurred in 1984, coinciding with more investments and

[9] Zheng et al. (2004) suggest that there is no evidence to support the assumption of a positive relationship with flows from FDI to exports in China, and argue that a possible reason for this result may be the uneven distribution of FDI throughout China's provinces. Jun and Singh (1996) argue that it may not only be the size of the domestic market in the host country that is an important force in attracting FDI but also its export orientation. In addition, they found that exports (particularly manufacturing exports) are the strongest explanatory variable for inward FDI and that this is especially true in high FDI-recipient countries.

exports in capital-intensive industries under a more liberal regime. Taiwan transformed their EPZs into a strategic hub for industries concentrating on higher-level and more value-added production. In China the second trend breaks for FDI and exports occurred in 1992 and 1996, respectively. Even though these breaks are associated with reforms in trade and investment as Huang (2001) indicated, China's internal reforms lagged behind its FDI reforms so domestic firms did not exploit the spillover benefits of FDI. The link between a more liberal economic regime, the learning curve for foreign/domestic investors and exports deserves future investigation.

Our results clearly show some policy implications for other poor developing countries. The EPZs/SEZs have provided an efficient means of absorbing surplus labour (Warr, 1989) in the initial stages of China's and Taiwan's economic development, and have functioned as a transitional strategy that encouraged FDI and helped bring about the shift from import substitution to export orientation. The World Trade Organisation (WTO) is currently involved with the elimination of the Multi Fibre Arrangement (MFA), and the removal of the exploitation of child and female workers in developing countries and of a number of incentives in EPZs. The Uruguay Round negotiations established that preferential incentives provided to EPZs, such as tax breaks and utility subsidies, that are not applied nationwide, can be construed as export subsidies and are thus subject to countervailing duties (from which the least developed countries exempted). The expectation is that the above policies narrow the differences between the zones and the rest of the economy and prevent or discourage new firms from entering the zones (Jayanthakumaran, 2003). In future, it is likely that poor/developing countries may not be able to use EPZs (as a gateway for inviting FDI) as a transition strategy from import substitution to export promotion as did Taiwan and China.

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