E C O N O M I C S B U L L E T I N

Foreign Direct Investment and Electronics Exports: Exploratory Empirical Evidence from Malaysia's Top Five Electronics Exports

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Abstract

The foreign direct investment (FDI) has contributed significantly to Malaysia's electronics exports as well as the growth and development of the electronics industry as a result of the export-oriented industrialization initiatives undertaken since 1970s. The aim of this study is to explore the causation between FDI and electronics exports by using Malaysia's top five electronics exports by SITC (Standard International Trade Classification) product groups. The findings show a bi-directional causality between FDI and exports of semiconductor devices in the short run. The present study provides important policy implications towards the competitiveness of electronics exports and also promoting and targeting FDI inflows into key and priority growth in the electronics sub-sectors.

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1. Introduction

The electronics industry is Malaysia's leading non-resource-based export–oriented industry. A large part of the industry has been dominated by multinational corporations (MNCs), which use Malaysia as a suitable international production base for exports of intermediate or final products to their home countries or affiliates in third markets for assembly or distribution. In fact, the industry is moving towards backward integration i.e. inputs are being imported from abroad or home countries of MNCs for value added in Malaysia. As a result, the foreign direct investment (FDI) inflows are highly concentrated in this industry. The rapid growth of the industry is attributed to the adoption of a series of industrialization programs e.g. import-substituting industrialization policy in the 1960s, export-oriented industrialization policy in the 1970s and the Industrial Master Plans of the 1980s and 1990s. The relative attractiveness of the country as a destination for FDI inflows, especially from the United States (U.S.), Japan, Europe, Taiwan and Republic of Korea, has made Malaysia among the world's largest exporters of semiconductors devices and audio-visual equipment (MIDA 2006). Through its increased integration into the international economy as a result of the continued liberalization of trade and investment, the electronics industry has expanded significantly in terms of exports, employment and output. In 2003, for instance, the Department of Statistics, Malaysia (2004) reported the industry was comprised of more than 900 companies employing 360,000 workers with output and exports amounted to US$38.7 billion and US$48.2 billion respectively. Besides, the industry, which is capital intensive and is the largest within the electrical and electronics sector, had continued to attract high levels of foreign investments between 2001 to 2005, which contributed to total capital investment with 81.4% share (US$9.3 billion) compared with 18.6% (US$2.1 billion) in domestic investment (Malaysia, 2006). Despite it is the major recipient of FDI (accounting for 45.7% of total FDI inflows), the industry is facing growing competition from People's Republic of China (PRC) and India as destinations for electronics manufacturing (see Hussain and Radelet, 2000; Malaysia, 2006). They have become leading production centres for low and medium technology products at competitive prices and have the potential to move up the value chain in future.

Thus, the aim of this study is to examine whether there are short- and long-run relationships between FDI and Malaysia's top five electronics exports by SITC (Standard International Trade Classification) product groups using cointegration and causality analyses. The contributions of the present study are threefold: Firstly, this paper provides additional evidence on the Malaysian experience by examining the causality relationships between FDI and exports given that the available empirical literature on this study is limited until recent years (for examples, see Sahoo, 2004; Pacheco-López, 2005; Hsiao and Hsiao, 2006). Conceptually, the causal relationship between FDI and exports could run in either direction. With regard to export trade, foreign firms may establish a production base in the host country according to the country's comparative cost advantage (Pugel and Lindert, 2000), which suggests FDI inflows promote exports. When the MNCs become competitive and profitable in the exports markets, they will tend to grow from reinvested internal profits and newly borrowed funds along with new technology, superior management and marketing strategies (Pacheco-López, 2005).This implies exports stimulate FDI. Secondly, the findings can provide an analysis of the future growth directions of the electronics industry since it has been identified as one of the key growth sectors in Ninth Malaysia Plan, 2006-2010. Thirdly, the findings can also be used to assist policy makers to design appropriate policies to sustain FDI inflows in order to enhance Malaysia's export competitiveness in the international markets in the light of most Southeast Asian nations have witnessed the bulk of FDI drift towards PRC since the Asian financial crisis in 1997.

The structure of this paper is as follows. Section II provides a description of the data and tests the order of integration of each variable based on unit root tests, which is a prerequisite for Granger causality analyses in Section III. Policy implications and concluding remarks are presented in Section IV.

2. The data and the unit root tests

2.1 Data

The estimation period spans some 10 years, covering quarterly data from 1991:1 to 2000:4, and has been determined largely by the availability of the unpublished data of electronics exports by SITC product group provided by the Department of Statistics, Malaysia. The following variables represent Malaysia's top five electronics exports: (1) EX776 semiconductor devices e.g. thermionic valves and tubes, photocells etc.; (2) EX752 automatic data processing equipment; (3) EX764 telecommunication equipment, parts and accessories; (4) EX763 sound recorders or reproducers, television image and sound recorders or reproducers; and (5) EX762 radio-broadcast receivers with sound recorders or reproducers. The FDI data used in this study comprises the long-term private capital (LTPC) flows from the Malaysia's balance of payments' capital account. Prior to 2001, all the FDI data was classified as LTPC flows but from 2001 onwards, LTPC flows was named as FDI flows in Malaysia's balance of payments' capital account (see Goh, 2005). The variables are in real terms. The electronics exports are volume of electronic export at 3- and 4-digit SITC level, while the LTPC variable is deflated by Consumer Price Index (CPI). All the raw data are transformed into indices at 1995 prices (i.e.1995 = 100) to ensure all variables are unit free.

2.2 Unit root tests

Most macroeconomic series are found to have unit roots i.e. they are not stationary or their variances increase with time (Nelson and Plosser, 1992). If unit roots are present in each time-series variable, spurious correlation may arise if we regress levels of these time-series variables that contain trend components. Hence, before testing for cointegration and implementing the Granger causality test, it is essential to test each individual series for unit roots using the augmented Dickey-Fuller (ADF), which allows for serial correlation in residual and still tests for unit roots. In addition, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS, 1992) test will also be used to test for unit roots. It differs from ADF test described earlier in that the series is assumed to be (trend-) stationary under the null. As pointed out by Perron (1989) that conventional unit root tests are inappropriate for variables that have undergone structural changes, and the power to reject the unit root null declines if the data contains a structural break that is ignored. Hence, this study also applies the recently developed unit root test with an unknown level shift proposed by Lanne *et al*. (2002).

Table 1. Testing for Stationarity

	ADF (H_o: a unit root)	KPSS (H_o: trend stationary)	Lanne, *et al*. (2002) (H_o: a unit root)
FDI	-3.4983 (0)**	0.0732	-6.9070 (0)*** [break date: 1998q3]
EX752	-4.529 (0)***	0.1255*	-4.8935 (0)*** [break date: 1991q4]
EX762	-3.0227(5)	0.1335*	2.7162 (5) [break date: 1994q3]
EX763	-2.2913 (0)	0.1658**	-2.2752 (1) [break date: 1994q4]
EX764	-2.8047 (0)	0.1641**	-2.5313 (5) [break date: 1995q4]
EX776	-5.1613 (9)***	0.1154	-2.4472 (4) [break date: 1996q4]
Critical values			
1%***	-3.96	0.216	-3.81
5%**	-3.41	0.146	-3.15
10%*	-3.13	0.119	-2.86

Notes: The data are in levels. A time trend is included in these tests. (.) denotes the optimum lag length suggested by AIC (Akaike's information criterion). [.] is the suggested break date. The critical values for the ADF test are from Davidson and MacKinnon (1993, page 708, Table 20.1), while the critical values for unit root test with structural break are from Lanne et al. (2002, page 678, Table II, with 50 observations). While the critical values for KPSS test is from Kwiatkowski, *et al*. (1992). A four-quarter lags are included for KPSS test.

The unit root test statistics are reported in Table 1. It is clear from ADF, KPSS (1992) and Lane *et al*. (2002) test statistics that a unit root is unlikely for the FDI variable i.e. it is stationary in levels or integrated of order zero, *I*(0). On the other hand, the test results for the order of integration of all the electronics export variables do not seem to be clear cut. For instance, the evidence seems firmly in favor of the hypothesis of *I*(1) for EX762, EX763 and EX764, while the test results are inconclusive for EX752 and EX776 e.g. the former is only *I*(1) as assessed by KPSS test at 1% level of significance but we reject the null hypothesis of *I*(1) at one per cent level of significance as indicated by both ADF and Lanne *et al*. (2002) tests, while we are strongly against the hypothesis of *I*(1) for the latter according to both ADF and KPSS (1992) tests even though Lanne *et al*. (2002) test suggests otherwise.

According to Engle and Granger (1987), the hypothesis testing of cointegration consists of two parts: test for *I*(1) of the individual series, and *I*(0) of a linear combination. The term cointegration refers only to the second part of the hypothesis i.e. the test is performed conditional on the fact that each individual series is *I*(1). Based on the unit root tests, we have found the FDI variable is *I*(0) and the electronics exports variables are either *I*(0) or *I*(1) depending on the particular unit root test procedure(s). This suggests that it would be infeasible to consider a cointegration analysis, which implies a long-run relationship does not exist between FDI inflows and anyone of the five electronics exports.

3. Empirical Results

Since the previous section concludes no cointegration between FDI and anyone of the five electronics exports, conventional Granger causality approach applies. The conventional Granger causality test (Granger, 1969 and 1988) is based on a bivariate, p^{th} order vector autoregressive (VAR(p)) representation in which FDI_t depends upon lags of itself and lags of EX_{SITCt} (if EX_{SITCt} is $I(0)$) or ΔEX_{SITCt} (if EX_{SITCt} is $I(1)$) and symmetrically EX_{SITCt} or ΔEX_{SITCt} depends upon lags of itself and lags of FDI_t. For example, equations (1a) and (2a) represent the case of both FDI_t and EX_{SITCt} are I(0) whereas equations (1b) and (2b) show status quo for FDI_t but EX_{SITCt} is $I(1)$.

$$FDI_t = a_0 + \sum_{j=1}^{p} b_1\, FDI_{t-j} + \sum_{j=1}^{p} b_{2j}\, EX_{SITC\,t-j} + u_t \qquad (1a)$$

$$FDI_t = a'_0 + \sum_{j=1}^{p} b'_1\, FDI_{t-j} + \sum_{j=1}^{p} b'_{2j}\, \Delta EX_{SITC\,t-j} + u'_t \qquad (1b)$$

$$EX_{SITCt} = \alpha_0 + \sum_{j=1}^{p} \beta_1 EX_{SITCt-j} + \sum_{j=1}^{p} \beta_{2j} FDI_{t-j} + e_t \qquad (2a)$$

$$\Delta EX_{SITCt} = \alpha'_0 + \sum_{j=1}^{p} \beta'_1 \Delta EX_{SITCt-j} + \sum_{j=1}^{p} \beta'_{2j} FDI_{t-j} + e'_t \qquad (2b)$$

The symbol Δ denotes the first-differenced operator e.g. $\Delta EX_{SITCt} = EX_{SITCt} - EX_{SITCt-1}$ and EX_{SITCt} represents electronics exports by SITC product groups. The random disturbances u_t, u'_t, e_t, and e'_t in each equation are assumed to have zero mean, constant variance and are uncorrelated. In addition, there is assumed to be no serial correlation between equations. Since the number of regressors is the same in each equation and they are predetermined e.g. past values of FDI_t, EX_{SITCt} and ΔEX_{SITCt}, estimation by ordinary least squares (OLS) yields asymptotically efficient parameter estimates.

We use Akaike (1974) Information Criterion (AIC) to choose the order of the VAR. The model with the smallest AIC value is selected when it minimizes the residual sum of squares. For completeness, the F statistics for Granger causation with lags 4, 8 and 12, are reported in Table 2. The results of some cases are found to be sensitive to the lag length assigned. Consequently, the results with lag length of 12, which suggested by AIC are preferred. Clearly, the test statistics show that there is only an evidence of bidirectional Granger causality between semiconductor exports (EX776) and FDI in the short run. This evidence corroborates the theory and is consistent with previous studies by Alguacil *et al*. (2002) and Pacheco-López (2005). With lag length of 12, the null hypothesis that FDI is Granger-noncausal for EX776 is rejected at the 5% level of significance. From the same set of regressions, the reverse causality from EX776 to FDI is also significant. This implies that FDI inflows to Malaysia can promote the exports of semiconductor devices, which accounted for US$20.7 billion or 42.8% of the country's total electronics exports in 2003 (MIDA, 2006), which in turn attracted 97.1% foreign investment in 2001 (MIDA, 2002). And also if the semiconductor exports are competitive and profitable, they can also stimulate more FDI inflows to the country.

Table 2. Testing for Causality (*F*-statistic)

Null hypothesis	Lags: 4	8	12 (AIC)
FDI =/=>EX776	0.8964 (0.4726)	1.3134 (0.2747)	1.2474 (0.4129)
EX776 =/=> FDI	**3.5881 (0.0115)**	1.6128 (0.1629)	1.1850 (0.4399)
FDI =/=>ΔEX776	0.8762 (0.4846)	1.4966 (0.2031)	**19.3509 (0.0057)**
ΔEX776 =/=> FDI	**2.6787 (0.0417)**	1.0737 (0.4090)	**14.5337 (0.0098)**
FDI =/=>EX752	1.6362 (0.1785)	0.5436 (0.8142)	0.1906 (0.9928)
EX752 =/=> FDI	**2.0652 (0.0982)**	**2.8053 (0.0190)**	2.5853 (0.1263)
FDI =/=>ΔEX752	1.4671 (0.2256)	0.5322 (0.8221)	0.2268 (0.9798)
ΔEX752 =/=> FDI	1.3168 (0.2760)	**2.1473 (0.0645)**	1.1218 (0.5015)
FDI =/=>ΔEX764	0.4394 (0.7796)	1.4823 (0.2081)	1.6698 (0.3295)
ΔEX764 =/=> FDI	1.6937 (0.1655)	**2.5747 (0.0304)**	1.5068 (0.3709)
FDI =/=>ΔEX763	1.1226 (0.3560)	0.5692 (0.7939)	0.3367 (0.9358)
ΔEX763 =/=>FDI	0.7282 (0.5767)	**2.1958 (0.0592)**	1.0475 (0.5334)
FDI =/=>ΔEX762	0.6965 (0.5978)	1.0213 (0.4433)	1.4283 (0.3934)
ΔEX762 =/=>FDI	0.9581 (0.4383)	1.8156 (0.1162)	1.3696 (0.4115)

Note: =/=> denotes 'do not Granger-cause'. Maximum lag length of 12 – AIC (.) is p-value

4. Conclusions

This paper provides new empirical evidence on the causality relation between FDI inflows and exports using Malaysia's top five electronics exports by SITC product groups as a case. This study covers an important area of applied work in international trade, which has relatively few studies until recently. The findings show that the FDI variable is stationary, *I*(0) while the electronics export variables are inconclusive either *I*(0) or *I*(1) depending on the specific unit root test procedures. These findings do suggest that there is no long-run relationship between FDI and anyone of the top five electronics exports. Furthermore, based on the Granger-causation tests via a bivariate VAR approach, this study finds that there is a bi-directional causality between FDI inflows and semiconductor exports.

In addition, the implications from these findings can be drawn, briefly as follows. Firstly, the evidence of the positive impact of FDI inflows to Malaysia on semiconductor exports and the reverse causation from semiconductor exports to FDI inflows to the country strongly support the recent empirical studies that FDI promotes exports and export stimulates FDI. Secondly, since the exports of semiconductors devices are the largest export earner in the electronics industry, it also happens to be the major recipients of FDI accounting for 71.1% of the total foreign investment received in electronics projects (MIDA, 2002a). Hence, the semiconductor subsector continues to attract significant foreign capital investments (US$830 million) in new and expansion projects e.g. the subsector received a total of 73 projects of which 22 were new projects and 51 were expansion projects (MIDA, 2002b). Finally, with the emergence of cheaper destinations for electronics manufacturing such as PRC and India, the Malaysian government should continue to promote the increase in the use of technology and move the semiconductor subsector further up the value chain to produce the latest generation of integrated circuit (IC) and the state-of-the-art product design and development, which are in line with the policies and strategies recently recommended by Ninth Malaysia Plan (Malaysia, 2006). At the present stage, the government has been effective in providing important infrastructure and the necessary support system for industrial development. However, the skills of the workforce are inadequate to meet the technological needs for higher value added activities. Thus, manpower training programs for high-end industrial development should be implemented.

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