MONASH University
Business and Economics

Department of Economics

issn 1441-5429

Discussion paper 15/08

FOREIGN DIRECT INVESTMENT AND EMPLOYMENT IN MANUFACTURING AND SERVICES SECTORS: FRESH EMPIRICAL EVIDENCE FROM SINGAPORE

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Abstract: Manufacturing and services have been regarded as the "twin engines" of growth for Singapore economy. As the economy is moving up the value chain from downstream to upstream activities, a significant proportion of FDI (foreign direct investment) has been attracted to the manufacturing and services sectors. This paper examines the causal relationships between inward FDI and the host country's employment in these two sectors using tri-variate VAR (vector autoregressive) framework. The main findings show evidence of unidirectional causality, running from employment in manufacturing and services to FDI inflows. Furthermore, there is evidence showing strong employment linkages, predominantly from the manufacturing to services. The present study provides useful policy implications towards promoting foreign investment in emerging areas of and manpower development in both sectors of the economy.

Keywords: Causality; foreign direct investment; employment; Singapore

JEL classification codes: E24; F21

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1. Introduction

Singapore is one of the most globalised nations in the world as a result of the adoption of open foreign investment policy and liberalised trade regime over a long period of time.[1] In the course of globalisation, a large part of the manufacturing and services sectors have been dominated by multinational corporations (MNCs), which use Singapore as a hub for global operations and international business (Islam and Chowdhury, 1997). Thus, both manufacturing and services sectors are the major recipients of foreign direct investment (FDI). In 2005, out of the total FDI stock, services (which include financial & insurance services, professional & technical, administrative and support services) have the largest share of 41.4% followed by manufacturing (33.3%) compared to 39% and 38.2% respectively in 1995 (Table 1). In recognition of the strategic importance of both sectors in terms FDI promotion, employment generation and contribution to GDP (Gross Domestic Product) growth, the Singapore Economic Development Board (2004) noted manufacturing and services will continue to be the "twin engines" of growth for the nation's economy. In fact, manufacturing and services could mutually reinforce each other. For instance, diversifying the manufacturing sector to high value chain activities could generate intermediate (also known as derived) demand for services ranging from logistics and ports to business and finance. Conversely, a strong complementary services sector could encourage more manufacturing activities; thus creating as mutually reinforcing growth cycle.[2]

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[1] Accessed at: http://www.atkearney.com/shared_res/pdf/Globalization-Index_FP_Nov-Dec-06_S.pdf (date accessed: July 1, 2008).

[2] Accessed at: http://www.edb.gov.sg/edb/sg/en_uk/index/news_room/news/2005/important_to_keep.html?showMode=printable (date accessed: July 1, 2008).

Table 1. Distribution of inward FDI by industry, 1995 & 2005 (stock as at year-end)

	1995 (per cent)	2005 (per cent)
Industry		
Financial & Insurance Services	37.3	38.3
Manufacturing	38.2	33.3
Wholesale & Reyail trade, Hotel & Restaurants	13.2	15.7
Transport & Storage	3.1	5.4
Professional & Technical, Administrative & Support Services	1.7	3.1
Real Estate, Rental & Leasing Services	4.7	2.6
Information & Communications	0.6	1.1
Total	**100**	**100**

Source: Singapore Department of Statistics (2007).

In view of the fact that FDI inflows are highly concentrated in manufacturing and services sectors in Singapore as well as there is evidence supporting interdependence between different sectors of the economy (Greenhalgh and Gregory, 2001; Franke and Kalmbach, 2005; Guerrieri and Maliciani, 2005; Thangavelu and Tan, 2008), the present study empirically explores the causality pattern between inward FDI and the host country's employment in manufacturing and services and, the employment linkages between the two sectors. Thus, using relatively conventional VAR (vector autoregressive) based Granger causality test procedures to study these linkages, we can ascertain the extent of the causal-linkages between the inflows of FDI and Singapore's employment in manufacturing and services since inward FDI can potentially contribute to the nation in terms of technology transfer, usage of local inputs, increased job opportunities and other spill over effects. By the same token, the causality test results can provide inputs for formulating appropriate policies for the development of labour market in Singapore that can help attract foreign firms to locate and grow in emerging areas of manufacturing and services that are relevant to global businesses. By and large, Singapore represents a suitable case study for such an investigation because it is an export-oriented economy that actively court FDI to advance domestic industrialisation and economic development along with manufacturing and services as the key growth drivers of the economy.

In principle, causality can run in either or both directions i.e. from FDI inflows to employment in manufacturing and/or services and, conversely, from employment in

manufacturing and/or services to FDI inflows. For example, if there is a boost in inward FDI in manufacturing sector, this could directly create employment in the sector itself due to higher capital investment by MNCs. The total employment effect of inward FDI could be greater given multinational trade and investment activities also involve backward and forward integrations.[3] If the manufacturing and services sectors are mutually supporting, this could also lead to increased employment in services too. However, if inward FDI is seen as a substitute for domestic investment, it is expected to have little and sometimes negative effects on employment owing to the displacement of local firms by relatively more efficient foreign firms. As pointed out by Bellak (2004), the crowding out of weak domestic firms by foreign entry could lead to some short run job losses as a result of competition effect. Eventually, Dunning (1994) argued that the engagement in backward linkages by MNCs in the host economy could result in some job losses in domestic supporting industries due to low local sourcing by MNCs. For the range of potential effects including empirical studies of the impacts of inward FDI on employment, see Baldwin (1994), UNCTAD (1994), Ernst (2005), Jayaraman and Singh (2006) and Jenkins (2006).

On the other hand, an increase in employment in manufacturing or and services could also encourage inward FDI. A rapid growth of skilled workforce[4] in the host country is instrumental in attracting foreign firms to set up their bases there as high-tech start-ups or to perform some of the core activities (e.g. research and development, production, marketing, delivery, and provision of after-sale services), or supporting activities (e.g. procurement of inputs, technology, human resources, and other infrastructure, like management and finance)[5]. Dunning (1993) noted that some of these activities can readily be performed cheaper or better by suppliers located elsewhere, which can lead to

[3] Backward integration is achieved when inputs are being imported from abroad or home countries of MNCs for value added in the host country while forward integration is achieved when the intermediate or final outputs are being produced and exported back to their home countries or affiliates elsewhere for assembly and distribution (Sieh-Lee, 2000).
[4] Other pull factors that attract FDI may include strategic location, sophisticated infrastructure, attractive investment incentives etc.
[5] According to Porter's (1985) generic value chain model, it is unusual that one single firm performs all the core and supporting activities by itself.

the determination of cross-border transaction flows in intermediate goods and services by multinational hierarchies.

The rest of this paper is organised as follows. Section 2 describes the data and methodology – determination of the stationarity of each variable based on unit root tests and the Granger causality (Granger, 1969, 1988) test procedure. Results are reported in Section 3. Concluding remarks and policy discussions are documented in Section 4.

2. Data, Unit Root and Granger Causality Tests

Data

The data for FDI inflows is obtained from *International Financial Statistics*, International Monetary Fund while the source of the time-series on employment in manufacturing (EM) and services (ES) is from *CEIC* Asia Economic Database. All the raw data are transformed into natural logarithm (*ln*) with the exception of FDI inflows, which is converted into real terms before the logarithmic transformation occurs[6]. The estimation period starts from the second quarter of 1997 to the fourth quarter of 2005. The choice of this sample period is based on the availability of the data especially the series for EM and ES.

Unit Root Tests

Conventionally speaking, macroeconomic time series tend to have unit roots, i.e. they are not stationary or their variances increase with time (Nelson and Plosser, 1992). In this relation, the OLS (ordinary least squares) estimator may generate spurious regression estimates when regressing levels of non-stationary time-series variables that contain trend components and are not cointegrated i.e. the estimated residual series is non-stationary. In such situations, VAR based Granger causality test results may be misleading. In practice, the endogenous variables entering the VAR model are assumed stationary, $I(0)$; if the variables are non-stationary ($I(1)$) and are not cointegrated, VAR model in first differences is an appropriate specification. Since we are interested in identifying

[6] The price index used to deflate the FDI variable into real terms is CPI (Consumer Price Index).

causality relationships, it is essential to test each individual time series viz. foreign direct investment (FDI), employment in manufacturing sector (EM) and services sector (ES) to ensure stationary ($I(0)$) before implementing the Granger causality test in a VAR framework (Granger, 1969, 1988). For this reason, we perform the Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979) and Phillips and Perron (PP) (Phillips and Perron, 1988) tests to determine whether the various time series are stationary or $I(0)$. The former test statistic allows for serial correlation in residuals and still tests for unit root while the latter can be used to test the residuals of a unit root process that are heterogeneous (i.e. residuals have different variances) or weakly dependent (Phillips and Perron, 1988).

Table 2 reports the results of ADF and PP tests. Both tests consistently suggest that the employment variables (EM and ES) are non-stationary or $I(1)$ but that FDI is stationary in levels ($I(0)$).

Table 2. Results of unit root tests for stationarity

	ADF	PP	I(d)
lnFDI	-4.426971 [1]	-4.884826 [5]	lnFDI ~ $I(0)$
	(0.0067)	(0.0020)	
lnES	-1.861177 [10]	-1.851293 [3]	
	(0.6428)	(0.6573)	
ΔlnES	-2.551784 [8]	-4.802364 [3]	lnES ~ $I(1)$
	(0.1161)[#]	(0.0005)	
lnEM	-2.118626 [6]	-0.817778 [2]	
	(0.5137)	(0.9539)	
ΔlnEM	-3.130351 [1]	-1.995321 [5]	lnEM ~ $I(1)$
	(0.0342)	(0.2874)[##]	

Notes: FDI = Foreign Direct Investment; ES = Employment for services; and EM = Employment in manufacturing. Unit root equation for the variable in levels includes a constant and a trend while for the variable in first-differenced, only a constant is included. The optimum lag order is in [.] which is based on AIC from a maximum of 12 lags. The value in (.) is p-value.

[#] the p-value is 0.0018 for the case without constant and trend.

[##] the p-value is 0.0467 for the case without constant and trend.

Granger Causality Test

In order to perform the Granger causality test (Granger, 1969, 1988), specification of the possible causal linkages between the endogenous variables i.e. inward *ln*FDI, *ln*EM and *ln*ES can be tested in terms of a VAR system framework. To ensure all the variables included in the system are stationary, the non-stationary *I*(1) variables are differenced once such as ΔlnES, and ΔlnEM with the exception of the *ln*FDI variable, which was confirmed by ADF and PP tests that it is stationary in levels, *I*(0). Therefore, the potential causality patterns can be represented by the tri-variate VAR specification as follows:

$$lnFDI_t = a_0 + \sum_{j=1}^{j} a_j lnFDI_{t-j} + \sum_{j=1}^{j} a_{2j} \Delta lnES_{t-j} + \sum_{j=1}^{j} a_{3j} \Delta lnEM_{t-j} + u_t \quad (1)$$

$$\Delta lnES_t = b_0 + \sum_{j=1}^{j} b_j lnFDI_{t-j} + \sum_{j=1}^{j} b_{2j} \Delta lnES_{t-j} + \sum_{j=1}^{j} b_{3j} \Delta lnEM_{t-j} + u_t' \quad (2)$$

$$\Delta lnEM_t = c_0 + \sum_{j=1}^{j} c_j lnFDI_{t-j} + \sum_{j=1}^{j} c_{2j} \Delta lnES_{t-j} + \sum_{j=1}^{j} c_{3j} \Delta lnEM_{t-j} + u_t'' \quad (3)$$

The Wald test, which follows the chi-square distribution, is computed to test the causal relations among *ln*FDI, ΔlnES, and ΔlnEM based on the tri-variate VAR framework.

3. Results

Before the Granger causality tests are undertaken, the order of lag length for the unrestricted VAR has to be identified. The optimal lag length is chosen based on a set of statistical selection information criterions viz. Likelihood ratio (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz criterion (SC) and Hannan-Quinn information criterion (HQ). Table 3 provides the appropriate lag length for the estimated VAR models. The optimal lag length for the chosen VAR models is one and seven lags as indicated by LR, FPE and SC, and AIC and HQ, respectively.

Table 3. Lag length selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	229.0523	NA	1.07E-11	-16.74462	-16.60063	-16.7018
1	247.1607	30.85139*	5.50E-12*	-17.41931	-16.844*	-17.2481

2	252.2543	7.546066	7.57E-12	-17.12995	-16.122	-16.8303
3	262.4481	12.8366	7.46E-12	-17.21838	-15.779	-16.7902
4	274.7711	12.77938	6.78E-12	-17.46452	-15.593	-16.908
5	278.1237	2.731746	1.35E-11	-17.0462	-14.742	-16.3612
6	300.9959	13.55389	7.92E-12	-18.07377	-15.338	-17.2603
7	325.3275	9.011717	6.46E-12	-19.20944*	-16.04184	-8.26755*

Notes * indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error. AIC: Akaike information criterion. SC: Schwarz information criterion. HQ: Hannan-Quinn information criterion. A maximum lag length of seven is considered due to insufficient observations for higher lag in the analysis.

Table 4 reports the results of causality tests based on tri-variate VAR(1) i.e. lag length of one. The test results indicate that inward FDI does not promote EM and ES because the time horizon of a 3-month lag is too short for inward FDI to have any impact on EM or and ES, practically. There is also no evidence of causation running the other way that is from EM and ES to inward FDI for similar reason. However, the results suggest that an employment linkage running from the manufacturing to services but not in the reverse direction. This implies that as the manufacturing sector is moving up the value chain from downstream to upstream activities, an expansion of skilled workforce in this sector can potentially create employment in the services ranging from logistics and information technology to business and finance. This empirical observation is well supported by Thangavelu and Tan's (2008) findings, who ascertained the employment linkages in the Singapore economy using input-output framework for 18 industrial sectors at 2-digit industrial classification.

Table 4. Granger causality tests using tri-variate VAR(1)

VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable: *ln*FDI	Chi-sq	df	*p*-value
Δ*ln*ES	1.582173	1	0.2084
Δ*ln*EM	0.012578	1	0.9107
All[#]	1.908067	2	0.3852
Dependent variable: Δ*ln*ES			
*ln*FDI	0.167035	1	0.6828
Δ*ln*EM	12.06859	1	**0.0005**
All[#]	12.07252	2	0.0024
Dependent variable: Δ*ln*EM			
*ln*FDI	2.255937	1	0.1331
Δ*ln*ES	0.214926	1	0.6429
All[#]	2.323396	2	0.3130

# denotes the Wald statistic for the joint significance of all lagged endogenous variables (excluding lags of the dependent variable) in the j-th equation. df denotes degree of freedom.

Table 5 provides the results of the Granger causality tests in tri-variate VAR(7) i.e. lag length of seven. The test results suggest that there is strong evidence of a unidirectional causal linkage that runs from EM to ES[7] and then from ES to inward FDI (see Figure 1). This unique causality pattern advocates the argument that the high value-added manufacturing sector is capable of creating demand for employment in services sector in view of the fact that these two sectors could form the "twin-engines" of growth for Singapore economy. In turn, the expansion of the skilled workforce in domestic services sector tends to attract a significant proportion of FDI to Singapore. The empirical evidence of services employment-FDI linkage would be consistent with multinational trade and investment activity that involves in forward linkages. As a result of her continued heavy investment on human resource development (Islam and Chowdhury, 1997), on the whole, the causality findings show that an increase in highly educated and well-trained labour force (i.e. in both manufacturing and services) is capable of drawing FDI inflows into the country (see Table 5 and Figure 2) to undertake high value-added manufacturing activities and provide professional and technology services locally and internationally.

Table 5. Granger causality tests using tri-variate VAR(7)

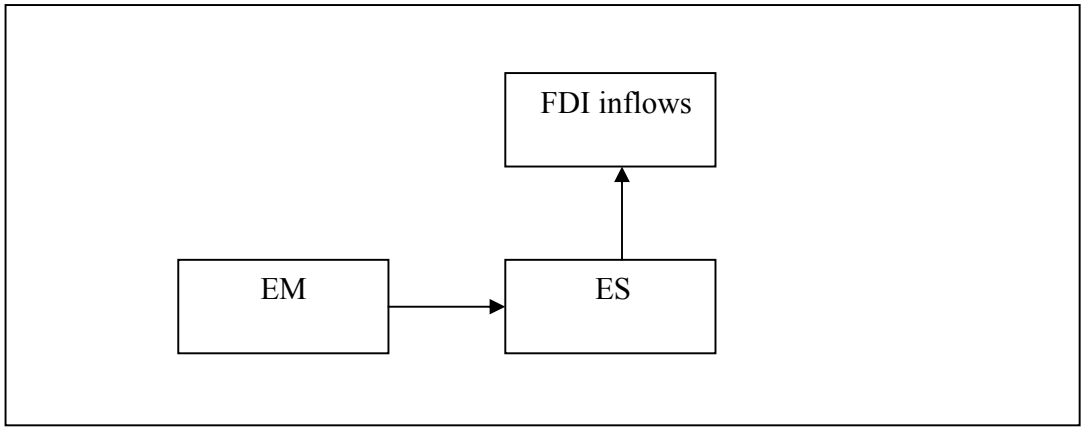
VAR Granger Causality/Block Exogeneity Wald Tests			
	Chi-sq	df	*p*-value
Dependent variable*: ln*FDI			
Δ*ln*ES	17.29524	7	**0.0156**
Δ*ln*EM	5.100862	7	0.6477
All[#]	34.46625	14	**0.0018**
Dependent variable: Δ*ln*ES			
*ln*FDI	9.326501	7	0.2301
Δ*ln*EM	14.34364	7	**0.0454**
All[#]	27.02426	14	0.0191
Dependent variable: ΔlnEM			
*ln*FDI	9.047849	7	0.2492
Δ*ln*ES	5.176694	7	0.6384
All[#]	13.11105	14	0.5178

# denotes the Wald statistic for the joint significance of all lagged endogenous variables (excluding lags

[7] The unidirectional finding is consistent with the previous case using tri-variate VAR(1).

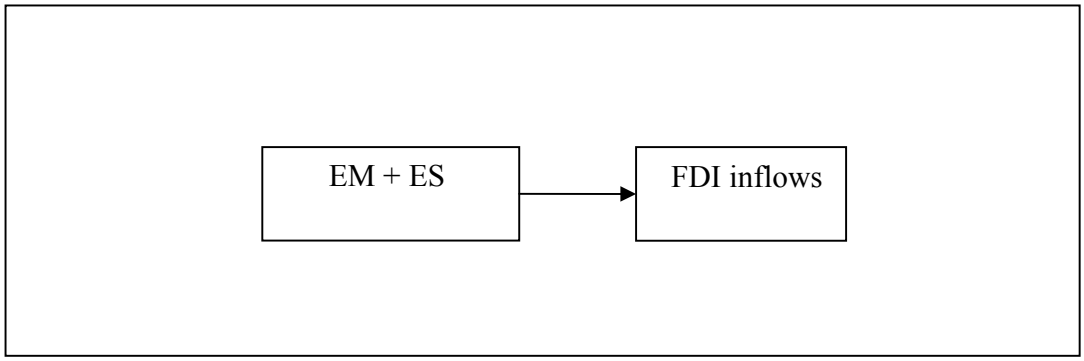
of the dependent variable) in the j-th equation.

Figure 1: Inter-linkage between inward FDI, manufacturing employment and services employment



Note: EM denotes employment in manufacturing while ES is employment in services

Figure 2: Inter-linkage between inward FDI and employment in both manufacturing and services



Note: EM denotes employment in manufacturing while ES is employment in services

4. Conclusions

The present study empirically investigates the inter-linkages between FDI inflows, manufacturing and services employment for a small open economy – Singapore, which is well endowed with human resources, offers attractive environments and incentives for foreign investors and, both manufacturing and services sectors are seen as future engines of growth. The basis for such an investigation is that an increase in FDI inflows could lead to higher employment in the host country if it complements with domestic investment. The employment effect of FDI inflows is greater if it is concentrated in labour-intensive industries (Jenkins, 2006). Conversely, the growth in the skilled workforce in emerging industries could attract FDI, which can potentially lead to technology transfer.

The findings indicate that there is unidirectional causation that runs from employment in manufacturing and services to FDI inflows, implying apart from her strategic location in the region, sophisticated infrastructure, and attractive investment incentives, an expansion of skilled workforce in these sectors is instrumental in drawing FDI inflows into the country, thus, opening up a channel for important source of technology and better international business network. On the other, there is no evidence of causation running the other way, from FDI inflows to employment in manufacturing or and services, suggesting the presence of MNCs has lower propensity to establish linkages with local industries. The possible explanations for low local sourcing by MNCs are MNCs have massive resources and international network and local firms' business methods and are not suited to global markets. To forge linkages between MNCs and domestic firms, the government should assist local companies to tie up with foreign partners (e.g. forming strategic alliances with MNCs), which can increase the transnationality of domestic frims. Furthermore, the government should continue to develop programmes for manpower development focusing on critical skills needed by the wholly owned subsidiaries of foreign corporations in order to increase local sourcing.

The findings also provide robust evident that employment linkage is running from manufacturing to services, which supports the view that as the manufacturing industries

move up the value chain, they tend to generate employment spill-over effects to the services sector. Hence, in light of both the manufacturing and services are regarded as the "twin engines" of growth for Singapore economy and these two sectors are interlinked, the appropriate strategy to increase the job opportunities in the services sector is to diversify the manufacturing base and increase high value-added activities in emerging manufacturing industries.

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