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Rudy Rahmaddi and Masaru Ichihashi

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Department of Development Policy
Division of Development Science
Graduate School for International
Development and Cooperation (IDEC)
Hiroshima University
1-5-1 Kagamiyama, Higashi-Hiroshima
739-8529 JAPAN

The impact of foreign direct investment on host country's exports: Sector-based evidence from Indonesian manufacturing

Rudy RAHMADDI* and Masaru ICHIHASHI

Graduate School for International Development and Cooperation, Hiroshima University,
1-5-1 Kagamiyama, Higashi Hiroshima, Hiroshima 739-8529, Japan.

ABSTRACT

This study sought to elucidate the existence of a link between foreign direct investment (FDI) and exports in the manufacturing sectors of Indonesia. It contributes to the literature by investigating the sector-based impact of inward FDI on a host country's exports, using disaggregated data of manufacturing sectors categorized by factor intensity during the 1990–2008 period. So doing enables one to test an FDI-substitute or FDI-complementary effect on sector-based export performance. The FDI theory proposes the possibility of an export-promoting effect in host economies. Employing panel analysis on the full sample and subsamples, and by later applying a differentiated cross-section effect, we found that FDI flows significantly crowd-in manufacturing exports in most panel observations. Interestingly, such an export effect is even stronger in physical capital, human capital, and technology-intensive sectors, without any significant evidence of a crowd-out effect in natural resource-intensive and unskilled labor-intensive industries—sectors in which Indonesia has a comparative advantage. In addition, this study uncovered the importance of other determinants of export performance. The findings draw some main policy implications—namely, the importance of targeted sector-based policy, competitive exchange rate management, and further development of industrialization towards high value-added activities.

Keywords: Exports performance; foreign direct investment; Indonesia; panel analysis
JEL classifications: F14, F21, F23, O53

* Corresponding author.
Email address: rudyrahmaddi@hiroshima-u.ac.jp

1. Introduction

Following the collapse of oil prices in the mid-1980s, Indonesia started to embark on a trade liberalization era featuring an outward-oriented or export promotion (EP) strategy; this strategy replaced its import substitution industrialization (ISI) strategy, which could not be counted on to promote sustainably high growth from the 1990s onward. As Indonesia came to realize that a new growth engine was needed, the policy pendulum swung in favor of export expansion (outward-oriented policy) and non-natural resource-based, private-sector-led growth. The Indonesian economy was later characterized in part by significant increases in foreign direct investment (FDI)[1] and continuous growth among manufacturing exports. A closer look at manufacturing exports from 1991 to 2008 indicates that although commodities under natural resource-intensive (NRI) and unskilled labor-intensive (ULI) sectors—such as wood, textiles, and footwear—still occupy most of the total manufacturing exports value (in real US$), their average annual growth of 2.39% is lower than that of physical capital (PCI), human capital (HCI), and technology-intensive (TI) export commodities (8.24%), which are mainly contributed by export growth in road vehicles and other transport (including components) and electronics goods. Meanwhile, total foreign investment in the manufacturing sector held a dominating share of total realized FDI in Indonesia from 1990 to 2008: more than 75% of total foreign investments, worth US$108.86 billion, were invested in PCI, HCI, and TI sectors. Such growing trends within sector-based exports and FDI imply a changing structure in manufacturing industries towards higher-value-added activities. Thus, a study of the relative impact of FDI on Indonesia's manufacturing exports deserves attention.

FDI nowadays can serve as a facilitator of development and technological "catch up," and even as a source of "leapfrogging technologies" that allow developing countries to "ladder up" development stages in some industries (Petri and Plummer, 1998; Brezis et al., 1993). Kojima (1973, 1975) stresses the role of FDI as a tutor for the technology-related laddering-up process in host economies, since it may transmit a total "package" of capital, management skills, and technology, thus resulting in both improvements in the factor

[1] Foreign investment may take a variety of forms: Greenfield investment, horizontal and vertical merger and acquisition (M&A), and/or portfolio investment via capital market. The data used in present study do not cover the flows of portfolio investment; additionally, the effect of FDI outflows on exports is beyond the scope of the present analysis. In this study, the terms "FDI" and "foreign investment" only represent FDI inflow, and both definitions are used interchangeably.

productivity of local firms and in changes in the comparative cost advantage between products. Such a dynamic change in comparative advantage will inevitably affect international trade, in terms of both structure and direction. Kojima argues, however, that either of two contrasting FDI–export effects (i.e., complementary or substitution) may occur, depending on whether FDI flows into a targeted sector possessing a comparative advantage or disadvantage. Given the importance of sector-based differences in the scale and performance of FDI flows, past studies that have emphasized the overall relationship between FDI and trade at the aggregated level may prove problematic. Although useful, such an approach may fail to capture variations in FDI interaction at the sector-based level (Kawai and Urata, 1998). In addition, a sector-based analysis may have imperative implications in the design of development strategies and in providing guidance for inward FDI to specific sectors—especially when the use of direct and indirect linkages of foreign investment to facilitate a host country's industrial transformation is considered important. Such an analysis could even be expanded upon, in an effort to seek out appropriate policy implications that dovetail from the export-led growth model version 2.0 (Haddad and Shepherd, 2011). Nevertheless, very few empirical studies have examined the sector-based contribution of the linkage between FDI and manufacturing exports in the special case of Indonesia.[2] The current study attempts to close this empirical research gap.

The purpose of this study is to offer a contribution to the literature by carrying out a sector-based analysis of the impact of FDI on a host country's manufacturing exports; it does so by employing data pertaining to realized FDI in the 1990–2008 period. The advantage of realized FDI over approved FDI data in measuring the degree to which FDI affects export performance has been acknowledged; the former more strongly represents the actual inflows of foreign investment toward the domestic economy, after they have actually been implemented into projects. Specifically, this study is devoted to investigating the following issues empirically. First, can the growth of Indonesia's manufacturing exports be attributed to FDI? Second, do FDI have a differential effect on manufacturing exports of a different industry, as classified by factor intensity? In this sense, this consideration enables one to analyze whether FDI may crowd in (out) a host country's exports from a different industry, on account of its comparative advantage (disadvantage)—

[2] The studies of Ramstetter (1999) and van Dijk (2002) are notable exceptions.

something Kojima (1975) predicts. In so doing, this paper may shed light on whether FDI has contributed to the changing structure of manufacturing exports in Indonesia. Finally, this study specifies other important determinants of sector-based exports—namely, private domestic capital investment, growth of gross domestic product (GDP), and exchange rate. The present study focuses on manufacturing sectors, due to their predominance vis-à-vis the total value of Indonesia's merchandise exports: these industries account for over 90% of Indonesia's total FDI.

The rest of this paper is organized as follows. Following a brief overview of FDI and trends in manufacturing exports performance and structure, the paper reviews the theoretical framework and some empirical literature on the FDI–export linkage. It is then followed by a description of methodology and data used in the present study. The penultimate section elucidates the empirical results and provides discussions and some implication thereof. Finally, the paper ends with some concluding remarks.

2. Indonesia: FDI and exports of manufacturing

The era of the EP strategy in Indonesia was marked by rapid increases in FDI, owing to a bold and decisive series of economic reforms introduced from the mid-1980s onward. Those reforms covered exchange rate management, including two large nominal depreciations in 1983 and 1986; prudent fiscal policy; comprehensive tax reform; a more open posture towards foreign investment; and financial deregulation (Hill, 1996; Ishida, 2003). A string of liberalization packages with regard to investment and trade will be briefly discussed.

To attract more foreign investment, foreign proprietary restriction and divestment requirements in Indonesia were relaxed in 1985–86 for export-oriented investment and firms located in the bonded zone. The government of Indonesia (GOI) unleashed Government Regulation No. 17, enacted in 1992, followed later by further investment-facilitation programs that allowed for 100% foreign proprietorships and less stringent divestment requirements for investments targeted in certain regions, bonded zones, and sectors with descending investment-threshold levels. Efforts to attract foreign capital were also made on the fiscal front, and the GOI introduced a set of tax incentives and duty exemptions. Another important incentive offered to foreign investors was the provision of legal protections on foreign investment. All these "pull factors" were

timely, since they coincided with a wave of production relocations to East Asian economies, in search of lower-cost production sites—searches triggered by some "push factors" such as appreciating currencies, the abolition of foreign exchange control, and rising wages at home (Aziz, 1998; Pangestu, 2002; Thee, 2005).

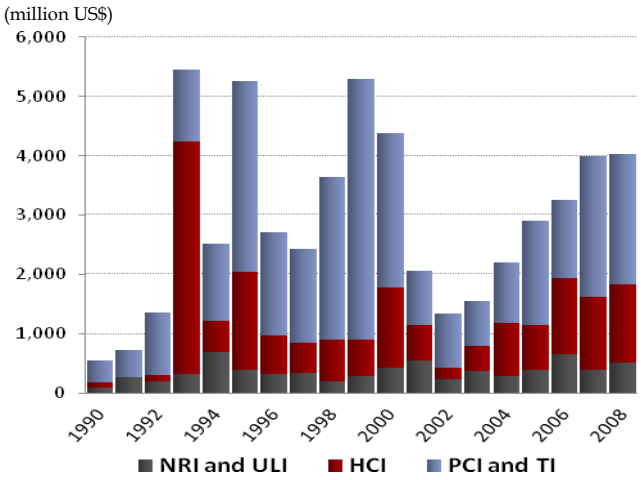
As a result, foreign investment increased significantly during the period. The amount of net FDI as recorded in the balance of payment climbed from US$385 million in 1986 to US$6.2 billion in 1996. After negative net inflows from 1998 until 2003—primarily triggered by the 1997 Asian economic crisis, and later exacerbated by local economic disruptions in some of the years following—the numbers since 2004 have increased. Total realized foreign investments from 1990 to 2011 accounts for 16,038 projects, worth a total of US$145.07 billion (see **Table 1**).

Table 1. Top FDI (realized) by country (1990-2011)

No.	Country	Total	
		Projects	(million US$)
1	Japan	2,458	22,493.5
2	Singapore	1,983	19,279.9
3	United Kingdom	890	10,933.8
4	Mauritius	90	10,703.0
5	USA	618	9,398.0
6	Netherlands	522	6,494.0
7	Seychelles	36	6,010.8
8	South Korea	1,963	5,658.9
9	Hong Kong	459	4,382.5
10	Taiwan	687	4,112.4
11	Malaysia	748	2,006.5
12	Germany	333	1,783.9
13	Australia	485	1,653.6
14	Italy	102	1,374.7
15	France	256	1,323.8
16.	Others (combined)	4,408	37,456.3

Source: Indonesia Capital Investment Coordination Board (BKPM)

Japanese investment has accounted for the largest portion of all realized FDI over the most recent 22 years, with most investments taking place in the higher-value-added sectors (e.g., basic metal and metal goods, machinery and electronics, road vehicles and other transports, and chemicals and pharmaceuticals). During 1990–2008, PCI, HCI, and TI sectors were the main destinations within the manufacturing sectors of foreign investment; most of it targeted the chemicals and pharmaceuticals (CP) and metal, machinery, and electronics (MME) industries (see **Figure 1**).



Note: NRI & ULI comprise of wood, textiles & garments, leather & footwear, other manufacturing industry; HCI are rubber & plastics, road vehicle & other transports, pulp & paper; TI includes chemicals & pharmaceuticals, non ferrous mineral industry, medical & optical, and metal, machineries & electronics.

Figure 1. FDI inflows (realized) by sector (1990-2008)

Source: Indonesia Capital Investment Coordination Board (BKPM)

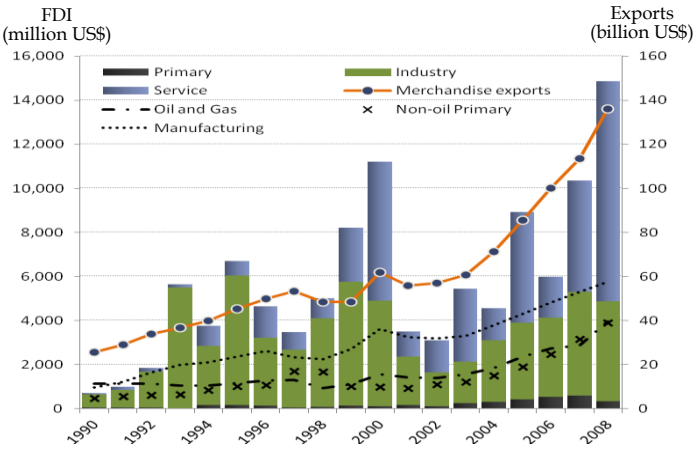


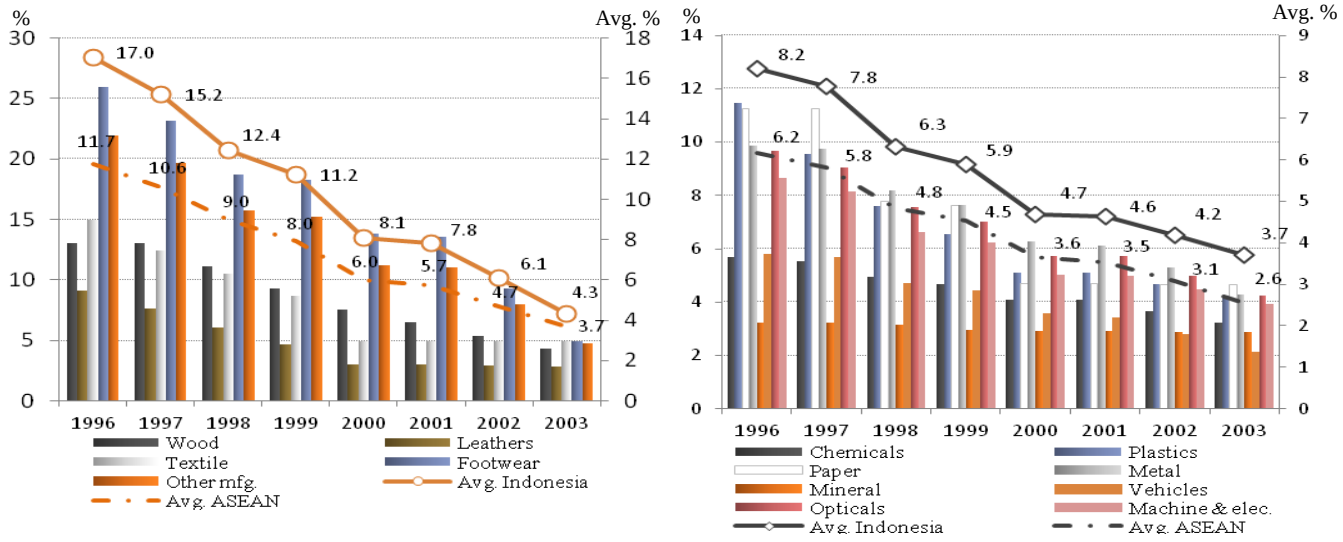
Figure 2. FDI inflows (realized) and exports (1990-2008)

Source: Indonesia Capital Investment Coordination Board (BKPM) and UN Statistics, calculated

To promote manufacturing exports, the GOI has undertaken trade liberalization measures, comprising the relaxation of restrictions on foreign investment in export-oriented industries; the enhancement of efficiencies in bureaucracy, including customs reforms; the abolition of a broad level of protections, including non-tariff barriers (NTBs); and significant reductions to the overall tariff structure. The average (unweighted) tariff rate was cut from 27% in 1986 to 15% by 1995, and the percentage of tariff lines subject to NTBs fell from 32% to 12% (Snodgrass, 2011). Exporters were also provided with a drawback system for import duties, under which tariffs imposed on imported raw materials and parts were refunded when the companies later exported finished products. All these measures led to a boom in exports performance, especially among manufactured commodities. Manufacturing exports (SITC 5–8) grew 24% per annum from the onset of the trade liberalization era until 1996, from US$4.63 billion in 1987 to over US$26.2 billion in 1996—a nearly six-fold increase over 10 years. While the proportion of oil and gas to total merchandise exports was continuously diminishing from the considerably high level of 50% in 1987 to the much lower extent of 25.4% in 2007, manufactured goods as a percentage of total exports increased from 27.5% to 46.7% in that same period (**Figure 2**). From 1987 to 2008, manufacturing exports recorded an annual average growth rate of 15%, the highest among other major commodities of oil and gas and nonoil primary goods.

The composition of manufactured exports also underwent dramatic change. Historically, as it is

endowed primarily with natural-resource and labor abundance, Indonesia's comparative advantage lies in NRI and ULI products. Nevertheless, from 1987 to 2005, the share of NRI exports—most of which were wood and cork products (mainly plywood)—fell from 44% to 8.0%, whereas those of ULI (e.g., textiles and garments) and TI (metal goods, machinery, and electronics) exports increased from 26.1% to 32.2% and from 5.4% to 27.2%, respectively. Pangestu (2002) argues that such a shift in Indonesia's export structure from NRI to TI products may explain the dramatic performance of manufactured exports in that country. Within 19 years, total manufacturing exports have increased considerably, from a small base of US$4.63 billion in 1987 to over US$42.9 billion in 2005—an average growth rate of 48.7% per annum. Interestingly, ongoing tariff liberalization in Indonesia under the ASEAN Common Effective Preferential Tariff (CEPT) went hand-in-hand with these impressive rates of growth in ULI and TI exports (see **Figures 3a** and **3b**).



(a) NRI and ULI

(b) PCI, HCI and TI

Figure 3. Indonesia Tariff under ASEAN-Common Effective Preferential Tariff (1996-2003)
Source: ASEAN Secretariat (www.asean.org.10101.htm), calculated.

Natural resource-based exports were dominated by wood and cork products (mainly plywood). The rise in ULI and TI exports can be attributed to the rise in exports of textiles, garments, and electronics. While the value of textile and garment exports increased more than six-fold during 1987–96 and accounted for slightly more than 24.8% of total manufactured exports during that period, the growth of electronics exports increased from negligible amounts to US$3.89 billion in 1996, accounting for close to 14.8% of all manufactured exports. Most of the growth in electronics exports occurred between 1990 and 1996, and it was related to the

realization of foreign investment in technologically complex, higher-value-added sectors, as previously discussed. Fascinatingly, the upward trend of exports growth among PCI, HCI, and TI exports commodities went hand-in-hand with an increase in the competitiveness of such industries, whereas during 1993–2002, NRI and ULI commodities had inflicted a recurrent negative competitiveness effect on total manufacturing exports growth (Rahmaddi and Ichihashi, 2012).

The above discussions suggest that a linkage between FDI and a host country's manufacturing exports may exist. Such an issue will be explored in greater detail, using sector-level data.

3. Theoretical and empirical reviews

3.1. Theoretical issues

The linkage between inward FDI and a host country's export performance has been long recognized in the literature. Yet, theories on the linkage between FDI and trade do not always provide clear predictions of whether foreign production is a substitute for, or a complement to, international trade. Hill and Athukorala (1998) argue that such a linkage may involve substitutes or complements, depending in part on an investor's motive and the nature of the host country's investment and trade regimes. Such a failure at theoretical prediction also partially reflects the separate development of macroeconomic general equilibrium models of trade and the microeconomic approach of foreign investment, the latter of which is based on the behavior of individual firms (Pain and Wakelin, 1998).

Under a restrictive trade model based on the Heckscher–Ohlin–Samuelson (H–O–S) framework, the equalization of factor prices across countries can be brought about either via an international trade channel or by means of an international mobility of production factors. Mundell (1957) argues that factor mobility may serve as a substitute for trade under restrictive assumptions of identical production functions for each good in two countries. In contrast, Purvis (1972), by emphasizing the effect of different production functions between country A (capital-abundant investing country) and country B (labor-abundant host country), explains that foreign investment can, in fact, expand trade if it creates and/or expands the opportunity to import one product and export the other. Nevertheless, the author does not clearly explain how and why such different production functions between the two countries become critical elements in the factor mobility–trade linkage, and under

what conditions foreign investment may serve as a trade complement.

Later, Kojima (1975) played a seminal role in developing a systematic macroeconomic approach to the FDI–trade linkage by further developing the models of both Mundell and Purvis, and by specifying the conditions under which foreign investment can be complementary to, or substitute for, commodity trade. He first clarifies that FDI, being distinct from international money capital movements, is in essence the transmission of a set of capital, managerial skills, and technology to the host country. In this sense, Kojima stresses the role of FDI as a "tutor" in the technological laddering-up process in host economies, since it may not only transfer capital but also convey superior production technology through the training of labor, the transfer of management, and the marketing of know-how, from advanced industrial, investing countries to developing, host countries—all of which lead to improvements in the productivity of local firms. To discern the types of industry in which FDI may easily transfer technology and improve production functions in the host country—and eventually create more trade opportunities—Kojima proposes a different perspective vis-à-vis comparative advantages/disadvantages between the investing and host countries.

Kojima (1975) argues that if FDI flows into industries in which the host country has a comparative advantage rather than a comparative disadvantage, it tends to improve the productivity of the host economy and thus stimulates more exports—not only among their foreign affiliates, but also among indigenous export-oriented firms. Haddad and Harrison (1993) point out that the exports of those indigenous firms can be stimulated by observing the export behavior of multinational enterprises (MNEs). In a less direct manner, Kojima argues that transfers of technology, management know-how, entrepreneurial skills, and productivity spillovers from MNEs to indigenous firms can occur much more readily in circumstances involving a smaller technological gap between the investing and host countries. Such an indirect effect works through product and factor markets. From the trade-disequilibrium perspective, Kojima asserts that FDI into the host country's comparative-advantage industry will create harmonious trade between the two countries, since each country has excess demands and supplies in different areas of trade, and yet they can trade effectively in a *quid pro quo* arrangement. Thus, FDI into the ULI industries of developing host countries are largely trade-creating. On the other hand, inward FDI towards PCI industries where the host country is comparatively disadvantaged is

trade-replacing or trade-destroying as such investment is essentially import-substituted or perhaps involves oligopolistic competition, resulting in trade reductions between the investing and host countries.

In a vein similar to Kojima's hypothesis of FDI complementarity to trade, Markusen (1983) proposes that FDI may expand exports when exports are induced by non H–O–S factors such as differences in technologies. An important determinant of this relationship in Markusen's framework is whether FDI is undertaken in an export-oriented or import-competing industry in the host country. FDI undertaken in an import-competing industry tends to reduce exports, since most products are intended to serve the domestic market. Meanwhile, FDI conducted in an effort to utilize the host country's comparative advantage in a natural-resource, low labor cost, export-oriented sector is likely to stimulate exports to home or third countries' markets. This proximity-concentration trade-off could be the case in Indonesia, due to its mixed advantages of low labor cost, natural resource abundance, and huge domestic market for foreign companies.

It is worth noting, however, that Kojima's hypothesis may fail to explain the complexity of the relationship between FDI and trade. This complexity exists because international investments made by multinational corporations may be diversified in various industries depending on firms' competitive advantages in the host country's market. As a result, the net impact of such FDI on foreign trade will be uncertain (Arndt, 1974 and Lee, 1984, among others).[3] Despite this limitation, Kojima's proposition may have some validity in explaining international investments that flow from industrialized countries to developing countries (Sun, 1999). Given the theoretical possibilities of the two contrasting links between FDI and exports, the question of which connection type actually exists is a matter of empirical examination.

3.2. Selected empirical reviews

Just as there are conflicting theoretical views on the role of FDI, the available empirical evidence in this area is inconclusive. In more aggregate analysis, Horst (1972) analyzes the effect of US FDI on US manufacturing exports to Canada, using three-digit SITC cross-sectional data from 1963; he found FDI to have a negative impact on US exports to Canada, and that Canadian tariffs positively affect US FDI (i.e., tariff-

[3] Many studies have been devoted to the elucidation the complexity of relationship between FDI and trade shifting from less macro- to more micro-level perspectives. The product lifecycle hypothesis (Vernon, 1966) and the eclectic theory of the OLI paradigm (Dunning, 1979) are found among influential studies.

jumping motive). In an attempt to investigate the impact of FDI on Indian exports using annual data from 1970–98, Sharma (2003) found no statistically significant evidence of the impact of FDI on exports. In contrast, other studies indicate that FDI actually has a positive effect on host countries' export performance, as found by O'Sullivan (1993) in Ireland and Blake and Pain (1994) in the United Kingdom.

In addition to single-country studies, some cross-country literature employing more disaggregated data indicate that the effect of FDI on host countries' export performance may differ by country, region, or industry. Employing cross-country data from the 1971–92 period, Pain and Wakelin (1998) found some supporting evidence of the significant impact of inward FDI on exports in 10 of 11 OECD economies, where seven countries sustained a positive FDI impact and three countries (i.e., Japan, Italy, and Denmark) sustained a negative effect. Regarding this latter result, the authors argue that such foreign investments have been aimed at the relatively closed domestic market, rather than using the country as an export base. Investigating the impact of inward FDI on regional export performance in China for the 1984–97 period, Sun (2001) shows evidence that the FDI effect was higher in coastal regions than in inland ones. Taking into account the difference of factor proportion (i.e., comparative advantage) within manufacturing industries in China, Wang et al. (2007), using 1983–2002 data, found that the effect of FDI on the manufacturing exports of ULI industries was higher than that of PCI industries.

Recent advances in the literature vis-à-vis the linkage between international trade and investment have emphasized the trade impact of dynamic changes in the comparative advantages that result from foreign investment (Sun, 2001). As FDI plays an important role in facilitating an international division of labor and increases the mobility of production factors—i.e., not only capital, but also and more importantly technology, management skills, and other know-how—it may globally reallocate economic resources and productive capacities according to the relative cost of production in various countries. This is expected to bring about dynamic changes in comparative advantages, leading to shifts in the structure and pattern of international trade. Sun (2001) suggests examining sector-based differences in the FDI–export effect as a plausible channel for studying the industrial distribution of FDI and the industrial structure of exports.

Nevertheless, empirical studies examining the sector-based contribution of the linkage between FDI and

manufacturing exports in the special case of Indonesia have been limited. The studies of Ramstetter (1999) and van Dijk (2002), both of which consider the effect of MNE activities on export propensity by using manufacturing firm-level data from Indonesia, are some notable exceptions. Using rigorous survey data at the firm level, both studies found the positive contribution of foreign investment on export expansion, in general. More specifically, Ramstetter (1999), investigating the impact of foreign ownership level on the export propensity of 15,949 firms in 1990, 1992, and 1994, found evidence of a high export proportion per output in firms with high proportions of foreign proprietorship. Van Dijk (2002), using data from Indonesia's 1995 industrial census, shows evidence that MNEs mostly exhibited a significant positive effect on sector-based exports, except in beverages, footwear, and instruments. A recent study by Jongwanich (2010) on the determinants of the export performance of eight Asian economies (including Indonesia) indicates that FDI becomes an important factor of export performance. Employing quarterly data from 1993–2008, Jongwanich classifies exports into three categories: merchandise, exports (SITC 5–8), and machinery and transport equipment (SITC 7). The third of these categories is thought to capture the increasing importance of international product fragmentation and trade in parts and components. Further, Jongwanich concludes that the impact of FDI tends to be higher in the case of manufacturing exports, particularly for exports of SITC 7 products. Nevertheless, none of these studies' models explicitly account for sector-based differences in the effect of FDI on manufacturing exports, as classified by factor intensity in their model. This classification enables one to investigate the FDI–export impact, based on an industry's comparative advantage. The current study attempts to make empirical contributions to this research area.

In summary, there seems to be strong theoretical justification for the positive impact of FDI on exports. Given the ambiguous link between inward FDI and a host country's exports, it is not clear whether FDI has an effect on the export performance of industries bearing different comparative advantages. Sector-based analysis is perhaps most appropriate for elucidating the true scale and performance of FDI–export links in manufacturing industries. These issues are explored empirically using Indonesian manufacturing data.

4. Methodology and data

4.1. Methodology

The preceding discussions of general theories and some empirical literature touching on the role of FDI on export performance suggest that FDI may contribute substantially to manufacturing-export expansion. In addition to FDI–trade theory, other factors may explain the export performance of host countries. Based on a reduced form of the export equation (Goldstein and Khan, 1978; Rose, 1990; Athukorala, 2004; Jongwanich, 2010), real manufacturing exports are determined by some factors—namely, real exchange rate, real world income, and a country's production capacity represented by GDP growth. While real world income is treated as a demand-shifter, production capacity is a supply-shifter. Nevertheless, a small-country assumption implies that the world market would absorb as many exports as a country could offer. Thus, exports should be supply-driven in this sense (Athukorala and Riedel, 1996, among others). In other words, the coefficient attached to real world income should be insignificant. Such an assumption allows us to estimate some determinants of exports (including FDI) in the presence of data unavailability with respect to sector-based export price indices.

Since FDI is expected to affect exports from the supply-side channel through direct and indirect effects, i.e., exports spillover (Markusen and Venables, 1989), we specify FDI and other export determinants, namely, domestic capital investment, GDP growth, and the exchange rate including economic shocks, by modifying a export model used by Goldberg and Klein (1997), Zhang and Song (2000), and Sun (2001), as follows:

$$X_{it} = \alpha_i + \beta_1 FDIF_{it-1} + \beta_2 DCIF_{it-1} + \beta_3 GDPG_t + \beta_4 REER_t + \beta_5 Dcrisis_t + \varepsilon_{it} \quad (1)$$

where the subscripts i and t denote cross-sectional unit and time, respectively; ε is the disturbance term; β_1 through β_4 are the parameters to be empirically estimated; X_{it} is the level of manufacturing export value of industry i in year t; $FDIF_{it-1}$ and $DCIF_{it-1}$ account for levels of FDI and domestic capital investment flows to industry i in year t, respectively; $GDPG_t$ is the growth rate (as a percentage) of GDP in year t; and $REER_t$ is the index level of the real effective exchange rate (export-weighted) in US$ in year t. The binary/dummy variable of $Dcrisis_t$ is also included to capture the effect of the Asian 1997 economic crisis and other supply disruptions on manufacturing exports (the value of unity for 1997 to 2003, and 0 otherwise). All variables,

except GDP growth and the dummy variable, are in natural logarithms.

The beta coefficients of β_1 through β_4 are the elasticity of exports with respect to FDI, domestic capital investment, GDP growth, and the export-weighted foreign exchange rate, respectively. The value of the coefficient on $FDIF_{it}$ (β_1) is of particular interest in this study, since this coefficient depicts changes in the percentage of manufacturing exports in response to a percentage change in FDI. The use of a lag structure on the explanatory variables of FDI and domestic capital investment is justified, based on three particular rationales: (a) following Leichenko and Erickson (1997), the effects of investments on export performance are not likely to take place immediately, since any effect of investments (i.e., modernization of production facilities, adjustments in production structure, dissemination of new technology, and so forth) requires a certain time to take effect on exports production; (b) such a procedure will alleviate a potential endogeneity problem between exports and FDI (Zhang and Song, 2000; Sun, 2001); the lag specification represents an appropriate sequence whereby investment proceeds ahead of production and production proceeds ahead of exports; and (c) although the simple first-order lag structure may not be appropriate in fully capturing potential feedback between investments and exports, the relatively short time period for the study (i.e., 19 years) requires the use of the simple lag approach.

In addition to FDI, we also specify other variables that may play important roles as determinants of manufacturing exports performance. First, the inclusion of domestic investment in exports analysis is intended to hold constant the effect of other investments in general. We expect the coefficient of β_2 to bear a positive sign, since increases in domestic capital formation will augment productive capacity, thus enabling producers to expand their output. Some previous studies (Leichenko and Erickson, 1997; Zhang and Song, 2000; Sun, 2001) indicate the importance of domestic investment on export performance. Second, the GDP growth rate ($GDPG_t$)—which indicates the overall economic performance of a host country economy in year t—is included, to capture the export-enhancing effect in supply capacity due to increased economic performance. Thus, we expect the coefficient β_3 to be positive. We deliberately use GDP growth rather than its level, in order to alleviate plausible direct simultaneity between GDP and investment. Ideally, we should use growth of gross sector-based product to capture the impact of sector-based economic performance on manufacturing

exports. Nevertheless, the unavailability of sector-based GDP matched appropriately with the existing data of sector-based FDI limits our methodology. Third, the exchange rate variable is another typical trade-related variable that may influence exports, since it represents the competitive factor (price effect) of export commodities. Sugema (2005) found evidence of the positive effect of exchange rate depreciation on Indonesian nonoil exports. In our model, $REER_t$ represents the consumer price index (CPI)-based index of real effective exchange rate (2000 = 100), weighted by Indonesia's 15 export partners' currencies in US$. It is constructed in such a way that an increase in the REER index denotes the real depreciation of the currency. As conventional export demand theory predicts, the depreciation of a country's currency may give impetus for further export expansion. The depreciation (appreciation) of a currency makes that country's exports commodities more (less) competitive, leading to more (less) demand thrust in the world market. Thus, we expect the coefficient β_4 to be positive. Finally, we include a dummy variable of economic crisis, $Dcrises_t$, to capture the impact of the Asian 1997 economic crisis and other export supply disruptions, which lasted until 2003.[4] We use a dummy structure similar to that found in the study of Adiningsih et al. (2009). The effects of such crises might be ambiguous. On one hand, the Asian 1997 economic crisis may have increased exports via significant exchange rate depreciation. On the other hand, such depreciation may have hampered the import of intermediate goods required by the export sector. Later, more expensive imported inputs would be transmitted at an increased domestic price level (exchange rate pass-through) that may hamper the investment needed to increase the production of tradable goods.

Panel data involves different models that can be used in estimations. These are the ordinary least squares (OLS) method, the fixed effect, and the random effect. The main problems inherent in the pooled OLS model are that it does not allow for sector-based heterogeneity and it assumes that all sectors are homogeneous. The fixed-effect model, on the other hand, is able to capture the sector-based effect of FDI on manufacturing exports, since it models each effect explicitly. Like the fixed-effect model, the random-effect model can also acknowledge heterogeneity in the cross-section. Nevertheless, rather than explicitly model the predetermined

[4] A detailed explanation of the impacts on exports and investment of the Asian 1997 economic crisis and other economic disruptions following such a crisis are thoroughly provided in many studies, including Pangestu (2002) and Thee (2006), among others.

heterogeneous effect using a sector-based dummy, the random-effect model assumes that the effects are random, independent, and identically distributed over the error term, so that $u_{it} = v_i + \varepsilon_{it}$, where v_{it} denotes the *i*th sector's year-invariant unobserved heterogeneity. Such a random effect can be estimated using a generalized least squares (GLS) model. Hsiao (1986) argues that even though its results might be inconsistent when the number of observations is small and if the initial values correlate with the effects, the asymptotic bias of a GLS estimator is smaller than that of OLS. In order to obtain the most appropriate inferences based on the fixed-effect or random-effect model, Hausman statistics are used to test the null hypothesis that the regressors and individual effects are not correlated. A failure to reject the null hypothesis implies that the random-effect model is preferable to the fixed-effect model. In contrast, if the null hypothesis is rejected, the fixed effect is then considered appropriate.

We first estimate Equation (1) using the full sample of manufacturing industries (N = 11) to investigate whether the growth of Indonesia's manufacturing exports in general can be attributed to inward FDI. To analyze the scale and performance of such an FDI–export effect at the sector level, Equation (1) is later employed on two subsamples of manufacturing sectors classified by factor intensity, namely: (a) NRI and ULI sectors, consisting of five industries, which represent the comparative advantage in natural resources- and labor-abundance industries, and (b) PCI, HCI, and TI sectors comprising six industries, which account for capital-intensive (physical and human) and technology-intensive sectors. This method enables one to analyze whether FDI can crowd in (out) a host country's exports from different industries by virtue of its comparative advantage (disadvantage), as Kojima (1975) predicts.

Later, to further elucidate the effect of FDI on each individual industry, our analytical model can be expanded by relaxing the restriction of equal effect on each observed sector. The results may have imperative implications for the design of development strategy and the provision of guidance for inward FDI to specific industries. Thus, we now assume such an effect varies across 11 sectors.

$$X_{it} = \alpha_1 + \alpha_2 D_{2i} + ... + \alpha_{11} D_{11i} + \beta_1 FDIF_{it} + \gamma_1 (D_{2i} FDIF_{it}) + ... + \gamma_{11} (D_{11i} FDIF_{it}) + \beta_2 DCIF_{it} + \beta_3 GDPG_t + \beta_4 REER_t + \beta_5 Dcrisis_t + u_{it}$$

More succinctly, the above equation can be expressed as follows:

$$X_{it} = \alpha_1 + \sum_{n=2}^{11} \alpha_i D_{ni} + \beta_1 FDIF_{it} + \sum_{n=2}^{11} \gamma_i (D_{ni} FDIF_{it}) + \beta_2 DCIF_{it} + \beta_3 GDPG_t + \beta_4 REER_t + \beta_5 Dcrisis_t + u_{it} \quad (2)$$

where D is a sector dummy, n is a dummy number, *i* is the sector (say, D_{2i} is 1 for TEX [the textiles and garments sector, and 0 otherwise], and so forth), and γ_is are differential slope coefficients, just as α_is are differential intercepts that capture a sector's specific effect. If one or more of the γ_i coefficients is statistically significant, it will tell us that one or more slope coefficients is different from the base group (e.g., if β_1 and γ_2 are statistically significant, then (β_1 + γ_2) will give the value of the FDI coefficient for sector 2) (Gujarati, 2004). Equation (2) is estimated on the full sample using the fixed-effect model. In the following subsection, we describe further the data details and provide a list of the sectors in the two main categories.

4.2. Data

The sector-based datasets used in this study are obtained from the Capital Investment Coordination Board of Indonesia (BKPM). The datasets are published but are not publicly available; access to the datasets and permission to use them were granted to the authors by BKPM. Initially, we categorized industries based on factor intensity, thus deriving five main category-classes: NRI, ULI, PCI, HCI, and eventually TI; this typology is in line with that of Aswicahyono and Pangestu (2000). We take such categorization in order to maintain consistency with national statistics (BPS). However, to synchronize with BKPM's existing data pertaining to realized FDI and domestic fixed capital investment by industry, we regrouped the datasets into two main categories: the NRI and ULI sectors, and the PCI, HCI, and TI sectors. The former grouping represents Indonesia's comparative advantage (NRI, low labor cost, and low technology) industries, while the latter represents its comparative disadvantage (capital intensive and technologically complex) industries. The NRI and ULI sectors consist of five industries, while the PCI, HCI, and TI sectors comprise six industries, providing us with 11 manufacturing sectors in total.

We match the realized FDI and domestic fixed capital investment data by industry with the export value (in US$) of each commodity, by SITC (rev. 2), obtained from the UN Statistics Database of Commodity Trade

(COMTRADE).[5] The panel datasets cover 11 cross-sections of manufacturing sectors in a series from 1990 to 2008, thus providing us with 182 observations within the full sample (unbalanced), and 87 and 95 observations for the NRI/ULI sectors and PCI/HCI/TI sectors, respectively. Details of industry classifications based on factor intensity and export commodity—the latter of which is based on SITC, under two main category classes—are provided in **Table 2**. Indonesia's data of real-GDP growth in US$ (2000 = 100) are obtained from the *World Development Indicator*, while data of Indonesia's and its trading partners' currencies in US$, as well as their CPI values, are obtained from the International Monetary Fund's (IMF) *International Financial Statistics*. Finally, export values (in US$) of Indonesia's 15 main trading partners are used to construct effective exchange rate are obtained from COMTRADE.

Table 2. Commodity classification based on factor Intensity

No	Manufacturing industry (BKPM)	Abbreviation	SITC (rev. 2)
A	**NRI and ULI sector**		
1	Wood and cork manufactures	W	63
2	Non-metallic mineral	NMM	68
3	Textiles and garments	TEX	65, 84
4	Leather and footwear	LF	61
5	Other manufacturing commodity	OI	89
B	**PCI, HCI and TI sector**		
1	Chemicals and pharmaceuticals	CP	51, 52, 54, 59
2	Rubber and plastics	RP	62, 57, 58, 893
3	Pulp and paper/paperboard	P	64
4	Metal goods, machineries and electronics	MME	69, 72 to 74, 751, 752, 759, 76, 77
5	Road vehicle and other transports	RV	78, 79
6	Medicals, instruments and optics	MO	87, 88

Note: Initial categorization following Aswicahyono & Pangestu (2000) is reclassified to suit with sector-based data of FDI & domestic investment available from BKPM.

5. Empirical results and discussion

5.1. FDI and other export determinants

To investigate the impact of FDI and other variables on Indonesian manufacturing export performance, the set of regression analyses that use panel estimation models and that were discussed in the previous section

[5] Export price indices for disaggregated sector are not available. We thus employ Indonesia's GDP deflator (US$ index) as a proxy for export price. This is justified, since merchandise exports represent the largest share of total exports (Kee and Hoon, 2004). The use of a GDP deflator with an international tradable price index can be found in the literature (Heien, 1968; Goldstein and Khan, 1976). Our experimentation in using CPI and producer price index (PPI) as export price deflators did not provide good results, and the IFS export price index is available only up to 2005. In addition, we use the gross capital formation (GCF) price index—calculated by dividing the current GCF value of Indonesia in US$ over its constant value, as a proxy for the investment deflator. Both values are obtained from the *World Development Indicator*.

were undertaken on the full sample and subsamples, under two main categories of manufacturing exports classified by factor intensity. We provide results using pooled OLS, random-effect, fixed-effect, and heterogeneous fixed-effect models in **Tables 3** and **4**. As previously mentioned, the pooled model may pose problems as a result of its homogeneity assumption. Nonetheless, we do present the results of pooled least squares, to see whether the signs of estimation are robust for different estimation models and stable in all observations. Later, interpretations will be made based on the most appropriate model, as suggested by a Hausman or likelihood ratio (LR) test. The results for the full sample and subsample using Equation (1), along with their estimation properties, are provided in **Table 3**, whereas the results and estimation properties with Equation (2) and using the heterogeneous fixed-effect model on the full sample are presented in **Table 4**.

Table 3. Determinants of Indonesian manufacturing exports (dependent variable: exports)

Variable	All sectors		NRI and ULI		PCI, HCI and TI	
	PLS	REM	PLS	FEM	PLS	REM
Constant	6.528 ***	10.735 *** (1.826)	8.002 ***	14.807 *** (0.881)	3.454	8.655 ** (3.630)
GDP growth	3.591	2.894 * (1.639)	2.772 **	1.765 *** (0.514)	3.664	3.181 * (1.827)
FDI	0.176 ***	0.092 *** (0.037)	0.247 **	0.045 (0.055)	0.255 ***	0.102 ** (0.052)
Domestic investment	0.145 ***	0.046 * (0.027)	0.156 ***	0.072 *** (0.024)	0.125 *	–0.013 (0.04)
Exchange rate	2.030 ***	1.793 *** (0.344)	1.422 ***	0.984 *** (0.155)	2.460 ***	2.446 *** (0.558)
Economic crisis	– 0.518 ***	– 0.330 ** (0.159)	–0.403 ***	–0.098 * (0.057)	–0.674 **	– 0.521 * (0.278)
Estimation Properties						
Estimation model	REM		FEM		REM	
Adjusted R^2	0.419		0.928		0.562	
Hausman test	4.626 (0.46)		n.a.		1.506 (0.91)	
LR test (χ^2)	303.88 (0.00)***		207.183 (0.00)***		125.20 (0.00)***	
Number of observation	182		87		95	

Notes: ***, **, and * represent significant at the 1%, 5%, and 10% level of significance, respectively; numbers in parentheses are robust standard errors (heteroskedasticity corrected); PLS, REM, and FEM denote pooled least squares, Random Effects model and Fixed Effects model respectively.

The coefficient estimates presented herein are the elasticity coefficients of exports in response to a 1% change in the explanatory variables. In general, the signs of all the coefficient estimates are as expected. They are robust under four different estimation models and stable in both the full sample and subsample estimations. For the full-sample, the Hausman test ($\chi^2 = 4.63$, $p < 0.46$) indicates that the random effect model is the most

appropriate estimation model as shown in lower side, first column of **Table 3**. On the other hand, the fixed effect model is preferred to only pooled least squares model for sub-sample estimation of NRI and ULI sector based on LR statistics ($\chi^2 = 207.2$, $p < 0.00$). This is because the number of cross-section under such sub-sample is less than number of regressors so that the random effect model cannot be performed. The results are provided in second column. Estimation results for sub-sample PCI, HCI and TI are generated using the random effect model as indicated by result of Hausman test ($\chi^2 = 1.51$, $p < 0.91$) in lower part, third column of **Table 3**, while results in **Table 4** are in favor of the heterogeneous fixed effect model compared to pooled least squares as shown by χ^2 statistics of LR test therein ($\chi^2 = 16.6$, $p < 0.08$)**.**

As shown in **Table 3**, our study finds significant evidence of the importance of FDI in the expansion of manufacturing exports. The positive effect of FDI on exports is significant in two of three observations. In the full sample, we find a significant FDI export-enhancing effect at the 1% significance level; its value of 0.099 implies that a 1% increase in FDI in the previous year is associated with a 0.092% increase in manufacturing exports in the next year, and *vice versa*. For the subsamples, we support evidence of the positive effect of FDI on the sector-based PCI, HCI, and TI exports at the 1% significance level. The magnitude scale of 0.102 indicates that a 1% increase (decrease) in FDI in the previous year is associated with a 0.102% expansion (reduction) in manufacturing exports of PCI, HCI, and TI commodities in the next year. Nevertheless, we find no significant evidence of an FDI effect on manufacturing exports of a comparative advantage industry in the NRI or ULI sector, even though it bears a positive sign.

There are some plausible explanations regarding this evidence. First, the traditional comparative advantage in ULI sectors has started to be exhausted, while FDI towards technologically complex sectors may suggest that Indonesia is being used intensively as an export platform to third countries' markets. Rahmaddi and Ichihashi (2012), using Constant Market Share (CMS) analysis and Revealed Comparative Advantage (RCA) indicator, found that there has been a recurrent deteriorating competitiveness effect and a continuous decline in the comparative advantage indicator in NRI and ULI export commodities from 1990 to 2008; nonetheless, manufacturing exports enjoyed growth, mostly from the persistent positive contribution of the competitiveness effect among PCI, HCI, and TI commodities. Thee (2006) argues that certain industries

within the NRI and ULI sectors in Indonesia—e.g., textiles and garments—have moved up the technology ladder since 1992. Meanwhile, there have still been weak and narrow domestic capabilities in absorbing and improving upon complex technologies. As a result, expansions in the manufacture of technologically complex commodities are likely to rely upon imported capital and technology. Second, lower tariffs for products within the PCI/HCI/TI category (see **Figure 2**) might have induced more FDI toward such sectors, eventually generating a stronger export effect. Ito (2010) and Ekholm et al. (2007) each argue that reduced trade costs—e.g., declines in tariffs—induce firms to conduct export-platform FDI. Third, low tariffs might have also facilitated greater imported capital-good inflows toward these sectors. Okamoto and Sjöholm (2001) argue that the extensive use of imported capital and intermediate goods may partially explain high labor productivity, which leads to more export expansion. Data from the OECD-Structural Analysis I–O database indicates that Indonesia's medium to high and highly technological manufacturing exports, on average, require more imported inputs than low-technology ones. During the mid-1990s and 2000s, highly technological manufactured exports utilized 36.5% of the imported inputs, compared to 21.7% among those in the NRI and ULI sectors.

Table 4. Individual effect of FDI on manufacturing export (dependent variable: exports)

Variables	Coefficient	*t*-statistics	Estimation Properties
Constant	10.983 ***	(5.285)	
GDP growth	2.994 ***	(2.656)	
Domestic cap. Investment	0.029	(0.947)	
REER	1.740 ***	(5.473)	
Economic crisis	–0.329 **	(-2.270)	
FDI Wood manufactures	–0.116	(-0.897)	
Non-metallic mineral	0.072	(1.480)	Adjusted R^2: 0.851
Textile and garment	0.011	(0.313)	LR Test ($\chi 2$): 16.59*
Leather and footwear	0.198 ***	(3.435)	FEM
Other manufacturing industry	0.117 *	(1.809)	182 observations
Rubber and plastics	0.105	(0.713)	
Road vehicle & other transports	0.192 **	(2.341)	
Paper/paperboard	0.050	(0.943)	
Chemical and pharmaceutical	0.188	(1.092)	
Medical, instruments, and optical	0.188 **	(1.991)	
Metal, machineries, and electronics	**0.247** **	(2.022)	

Note: *, **, and *** indicate the 10%, 5% and 1% level of significance, respectively; numbers in parentheses are robust *t*-statistics

Similar to the findings in **Table 3**, the results of Equation (2) in **Table 4** provide some supporting evidence. We find significant evidence of the FDI–export-enhancing effect—at the 10% significance level, at least—for five of the 11 industries; two of those industries (i.e., leather and footwear, and other manufacturing industries) are in the NRI and ULI sectors, and three industries (i.e., road vehicle and other transport; medical, instrument and optics; and metal goods, machinery and electronics) are in the PCI, HCI and TI sectors. While the highest FDI–export enhancing effect (0.247) is found in metal goods, machinery and electronics commodities, the lowest value (0.117) is found in exports of other manufacturing industries. This highest value suggests that the exports of metal goods, machinery and electronics benefit most from the FDI received, where a 1% increase in FDI will induce a 0.247% increase in metal goods, machinery and electronics exports. This result implies the importance of foreign investment on industrial development in such sectors, through MNEs' global production network activities—particularly in the electronics industry. On average, the positive effect of FDI on manufacturing exports was relatively higher for technologically complex, higher-value-added commodities from the PCI, HCI, and TI sectors, compared to those from leather and footwear, and other manufacturing industries within the NRI and ULI sectors. This implies that FDI facilitates export performance in both labor-intensive/low-technology and technologically complex, higher-value-added industries, without there being any significant evidence of a crowding-out effect on the manufacturing exports of any sector.

Our empirical evidence is also consistent with the previous findings of Ramstetter (1999), van Dijk (2002), and Jongwanich (2010). In the full sample, our findings support widely held beliefs vis-à-vis the positive contribution of foreign investment to host-country exports. Among evidence derived from the subsamples, our finding of a high FDI–export-enhancing effect among the PCI, HCI, and TI sectors compared to that of the NRI and ULI sectors is in accordance with the finding of Jongwanich (2010), that there was a high FDI–export effect in machinery and transport commodities compared to those of exports of total merchandise and manufacturing commodities (SITC 5–8). At the industry level, our findings generally accord with those of van Dijk (2002), who found significant evidence of the FDI effect in most Indonesian manufacturing sectors; this effect, however, partially contrasts with his findings for the footwear and instrument industries. We also share with Pangestu (2002) a similar viewpoint regarding the importance of

road vehicles and other transport and metal goods, and machinery and electronics commodities. A summary comparison of the current study's findings with those of previous studies on the importance of FDI on Indonesian exports is provided in **Table 5**. Our findings also suggest that FDI play a more significant role in promoting export development among highly technological, higher-value-added sectors than among low-technology, ULI sectors.[6] This may be an important reason for the impressive growth of real exports among manufacturing commodities in Indonesia's PCI, HCI, and ULI sectors in the 1990–2008 period. Lall (2000) points out that rapid and sustained manufactured export growth requires structural shifts, moving from easy to complex products and processes within activities, and from easy to complex technology across industries' activities. In this way, foreign investment may serve as both a tutor and catalyst in promoting technological upgrading activities via technology transfer and diffusion. Overall, our empirical findings support the widely held belief that increased levels of FDI positively affect (i.e., crowd in) manufacturing export performance. The FDI–export-enhancing effect is especially higher for the highly technological, higher-value-added PCI, HCI, and TI sectors, and there is no significant evidence of a crowding-out effect in the NRI and ULI sectors, in which Indonesia has comparative advantages.

Domestic investment bears a positive sign on exports performance. It plays an important role in determining performance of overall manufactured exports at the 10% level of significance. The magnitude of 0.046 implies that a 1% increase of domestic investment will expand exports by 0.046 percent, *vice versa*. Nevertheless, we find statistically significant evidence at only the 1% significance level of the positive influence of domestic investment on export expansion in the NRI/ULI subsample. The scale magnitude of 0.072% suggests that a 1% increase in domestic investment will promote an expansion in NRI and ULI exports by 0.072%, and *vice versa*. This indicates the relative importance of domestic investment on manufacturing exports among comparative-advantage sectors. This evidence seems reasonable, since Indonesia's comparative advantage traditionally lies in the NRI and ULI sectors, as previously argued; this

[6] This part, however, should be interpreted with caution, since export figures do not perfectly measure an industry's technological development. For instance, industrial classifications based on level of technological intensity may be misleading when low-technology products can use relatively complex technological processes, or when high-technology exports include assembled products with low value-added (Okamoto and Sjoholm, 2001). Nevertheless, such export figures can still act as rough indicators of technological competence (Thee, 2006).

therefore implies that the expansion of such low-technology exports in manufacturing—in contrast with those among PCI, HCI, and ULI sectors—may in fact be facilitated by any increase in domestic capital formation.

GDP growth carries a positive sign in all observations, as expected and significant in all observations. We find significant evidence only at the 10% significance level of the effect of GDP growth on exports performance in the full sample and the PCI, HCI and TI subsample, while it is significant at the 1% significance level in the NRI and ULI subsample, and with the heterogeneous fixed-effect model. Its high level of magnitude implies the importance of Indonesia's economic performance on the production of exportable commodities. High economic growth suggests advancements in the country's productive capacity through supply-side channels such as infrastructure, logistics, and production capabilities, all of which can be utilized to enhance exports production. The value of 2.894 indicates that a 1% increase in GDP growth would facilitate, overall, a 2.894% growth in manufacturing exports. Any improvement in GDP growth will generate higher manufactured exports growth of PCI, HCI and TI than that of NRI and ULI commodities. GDP growth coefficients are as 1.764% and 3.18% for NRI and ULI, and PCI, HCI and ULI exports commodities, respectively. This is as evidence that more advanced technology, higher value-added exports commodities are more responsive to any improvement in production capacity compared to those of low technology, unskilled labor-intensive commodities.

Following economic rationale, manufacturing export performance is influenced positively by an exchange rate (REER) depreciation, at the 1% significance level in all observations. Its value of 1.793 indicates that a 1% currency depreciation will facilitate a 1.793% growth in manufacturing exports overall, implying that any depreciation (appreciation) will induce an increase (decrease) in manufacturing exports, above what which would be considered proportionate. The REER impact on exports also exhibits sector-based differences across the two sector groupings; its figures of 0.984 and 2.445 suggest that 1% depreciation (appreciation) would induce 0.984% and 2.445% increase (decrease) in manufacturing exports for NRI and ULI commodities and PCI, HCI, and TI products, respectively. Our findings suggest that more highly technological products tend to be less susceptible to exchange-rate changes; this seems reasonable in the case of Indonesia, since the technology capital- and TI sectors are still at the bottom of the technology ladder

compared to NRI and ULI—sectors in which Indonesia's traditional comparative advantage lies. Thee (2006) argues that the technological capabilities of high-technology industries in Indonesia are still weak. In addition, export products within such sectors, as previously discussed, are more import-content-intensive than those in NRI or ULI sectors. All these factors make such manufactured exports more responsive to any exchange-rate swing. Our overall findings are comparable to those of Jongwanich (2010) and Sugema (2005). **Table 5** provides comparisons of the current study's findings and those of previous studies vis-à-vis exchange-rate elasticity, and FDI. In addition to other export determinants previously discussed, we also provide significant evidence of the negative effect of an economic crisis in all observations, except in the NRI/ULI subsample. Export commodities of the PCI, HCI, and TI sectors are more vulnerable to any economic shock; this is partly explained by their more responsive inclination to exchange-rate movement and the high proportion of imported inputs required in the production of technologically complex, higher-value-added commodities.

Table 5. Comparison of estimated FDI and exchange rate elasticities of Indonesia exports

Exports determinants	This study			Jongwanich (2010)			Sugema (2005)	van Dijk (2002)
	Mfg. 3 digit	NRI&ULI	PCI, HCI & TI	Total exports	Mfg. SITC 5-8	SITC 7		
FDI	0.09	n.s	0.10	0.03	0.02	0.06	-	(+)
Exchange rate	1.79	0.98	2.45	4.52	2.15	0.97	1.33	-
Data span	1990-2008			1994:1-2007:4			1984:1-1997:2	1995
Observations	182	87	95	56			54	20,161
Model	REM and FEM			GSM model			FMOLS	Tobit model
Export type	Manufacturing			Total, manufacturing & SITC 7			Non-oil	Non-oil

Notes: n.s. denotes not significant result; GSM is general to specific model; FMOLS denotes for fully modified OLS.

5.2. Policy implications

The aforementioned empirical findings bear some implications. First, apart from FDI, the importance of other export determinants on exports—namely, domestic investment, growth of economic performance, and the exchange rate—suggest the GOI should maintain a sound domestic supply condition and adopt competitive exchange-rate management in order to sustain impressive manufacturing exports performance in general. Particularly, increases in domestic capital formation are essential to the promotion of exports of NRI and ULI commodities. Second, since FDI exhibits not only a positive export-enhancing effect on exports, but since its

effect also varies across industries, focused FDI promotion measures and targeted sector-based policy are worth pursuing. Third, a higher FDI effect on technologically complex and higher-value-added commodities suggests that it may play a significant role in contributing to changes in Indonesia's export structure, from natural-resource, low-technology commodities and toward technologically complex and higher-value-added products. Such a structural shift is considered essential to maintaining rapid and sustained growth in manufactured exports. The current study thus proposes an impetus for the GOI, to more readily facilitate FDI to and further development in such sectors. Such FDI-promotion measures should be accompanied by supplementary efforts such as the provision of excellent R&D infrastructure, the elimination of unnecessary trade costs, the deliverance of an efficient logistic system, and so forth. Fourth, promoting further development among technologically complex and higher-value-added industries will also expand and deepen diversification among manufactured goods to maintain rapid and sustained export growth—especially given that industrial development in certain of Indonesia's traditional comparative advantage industries (e.g., textiles and garments) has already been fully exploited and such commodities are facing severe competition from other low labor cost competitors like China. Fifth, the GOI can also deliver an incentive system for firms to upgrade their technological capabilities and to promote higher-quality education, training, and R&D infrastructures—especially in human capital-based technology (i.e., sectors with a high FDI–export effect), to optimize technology transfer and diffusion from MNEs to indigenous firms' export-oriented sectors. Such technology transfers and spillovers eventually result in increased productivity and innovation in the domestic economy, leading to higher growth not only among exports but also in terms of overall economic performance. Further, research analyzing the effect of sector-based variations in FDI linkages on productivity and spillover, as well as whether FDI induces further export diversification and innovation, are worth pursuing.

6. Concluding remarks

In this study, we reviewed the importance of FDI on sector-based manufacturing export performance, using panel estimation. The findings support the widely held belief that increased levels of FDI positively affect manufacturing export performance, and that it is an important factor determining the rapid growth of manufacturing exports. The study also reveals an FDI–export-enhancing effect that varies across the various

Indonesian manufacturing sectors according to their factor intensity and technological capabilities—both of which represent either an industrial comparative advantage or a disadvantage. Such an export effect is even higher among PCI, HCI, and TI sectors, but there is no significant evidence of a deteriorating effect on the NRI and ULI sectors, in which comparative advantages lie. The empirical results imply that FDI play some significant roles in shifting Indonesia's export structure from natural-resource, low-technology commodities towards technologically complex and higher-value-added commodities. In addition, the study indicates the importance of other determinants of export performance—namely, domestic investment, GDP growth, and exchange-rate depreciation. While domestic investment is more effective in generating export performance within the NRI and ULI sectors, the current study's findings indicate that any exchange-rate depreciation would facilitate the export growth of technologically complex, higher-value-added commodities, over and above what would be considered proportionate. We also find that the export commodities of such sectors suffer the most from any economic shock. Thus, this study's findings suggest the importance of some macro and micro-level economic measures to sustain manufacturing export growth, as well as to promote further industrialization towards technologically complex, higher-value-added manufacturing industries. These measures range from competitive exchange-rate management and sound supervision vis-à-vis the domestic supply condition, to more sector-based, targeted, and industry-based policy that facilitates the "laddering up" of technological capabilities and other productivity improvements, especially among high value-added sectors.

Finally, we anticipate future research that explicitly analyzes the sector-based impact of FDI on industrial productivity-spillover, and whether such FDI may promote export diversification and innovation.

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