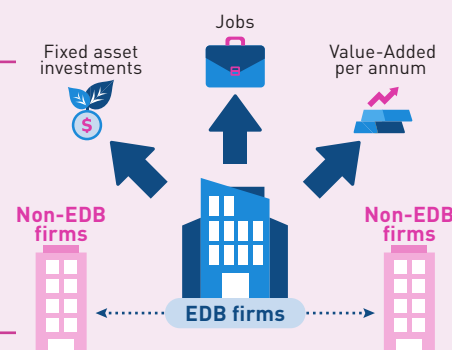


Feature Article

ESTIMATING THE SPILLOVER EFFECTS FROM EDB-SUPPORTED FIRMS

OVERVIEW

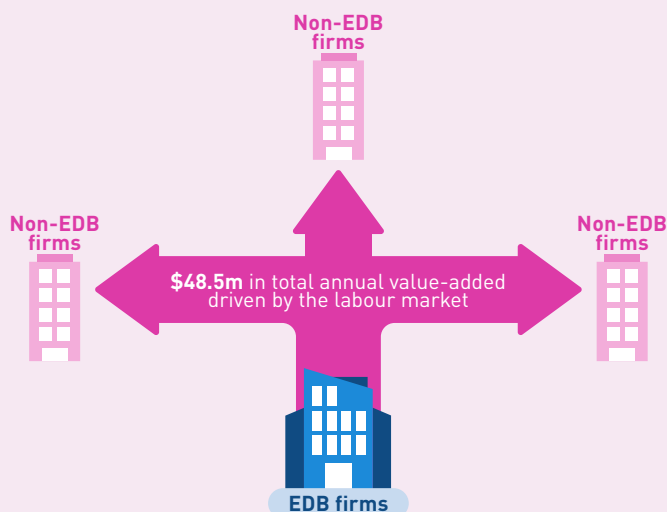
Singapore's Economic Development Board (EDB) was set up to undertake investment promotion and industry development. In 2024, EDB attracted \$13.5 billion in fixed asset investments, which are expected to create 18,700 jobs over the next five years and generate \$23.5 billion in value-added per annum (3.2% of nominal GDP in 2024). In addition to their direct contributions, EDB firms also have indirect spillover effects to the broader economy.



FINDINGS

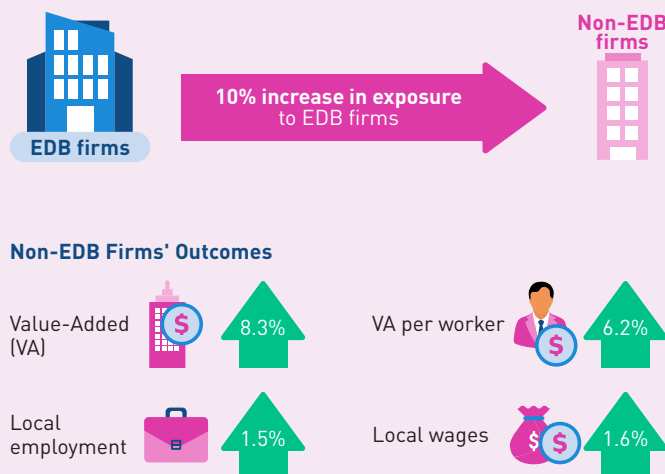
Finding 1:

Between 2012 and 2019, we estimate that the net spillover benefits that each EDB firm brought to non-EDB firms amounted to \$48.5 million in value-added annually. The positive spillover effects were driven largely by the labour market channel with EDB firms helping to improve the quality of the workforce in Singapore that in turn benefitted non-EDB firms.



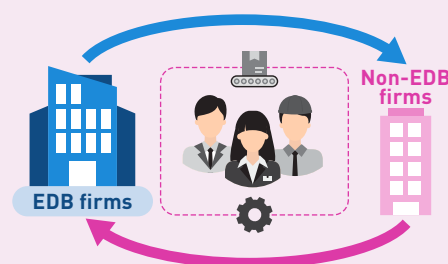
Finding 2:

Exposure to EDB firms was found to improve the performance of non-EDB firms across four outcomes. Specifically, a 10% increase in exposure to EDB firms improved the value-added (VA), VA per worker, local employment and local wages of non-EDB firms by 8.3%, 6.2%, 1.5% and 1.6% on average, respectively.



POLICY TAKEAWAY

There is scope for policymakers to explore mechanisms to strengthen the positive spillovers while mitigating the negative effects across the various spillover channels. This could include supporting capability building programmes for non-EDB firms and their employees to enhance their ability to attract skilled labour and benefit from knowledge spillovers through the labour market, while implementing supplier development initiatives to help them capitalise on increased business opportunities from EDB firms. This would ensure that Singapore captures maximum economic value from its strategic investments in high-quality firms.



EXECUTIVE SUMMARY

- The Economic Development Board (EDB)'s strategy of attracting foreign multinational corporations (MNCs) and developing high-potential local companies has generated economy-wide benefits. Besides their direct contributions to Singapore's economy, this study finds that EDB-supported firms (or EDB firms for short) also have net positive spillover effects on non-EDB firms.
- In particular, exposure to EDB firms was found to improve the performance of non-EDB firms across four outcomes. Specifically, a 10 per cent increase in exposure to EDB firms improved the value-added (VA), VA per worker, local employment and local wages of non-EDB firms by 8.3 per cent, 6.2 per cent, 1.5 per cent and 1.6 per cent on average, respectively. These positive spillover effects were driven largely by the labour market channel, with EDB firms helping to improve the quality of the workforce in Singapore that in turn benefitted non-EDB firms. By contrast, EDB firms had a small negative impact on non-EDB firms that were upstream to EDB firms (i.e., negative backward spillovers), likely reflecting constraints that limit non-EDB firms' ability to supply inputs to EDB firms and hence gain from the increase in demand generated by EDB firms.
- Overall, we estimate that between 2012 and 2019, the net spillover benefits that each EDB firm brought to non-EDB firms amounted to \$48.5 million in value-added (VA) annually. This represents 41 per cent of the total (i.e., direct and spillover) economic contributions of EDB firms to Singapore.
- While the overall net impact of EDB firms on non-EDB firms is positive, there is scope for policymakers to explore mechanisms to strengthen the positive spillovers while mitigating the negative effects across the various spillover channels. This could include supporting capability building programmes for non-EDB firms and their employees to enhance their ability to attract skilled labour and benefit from knowledge spillovers through the labour market, while implementing supplier development initiatives to help them capitalise on increased business opportunities from EDB firms. This would ensure that Singapore captures maximum economic value from its strategic investments in high-quality firms.

The views expressed in this paper are solely those of the authors and do not necessarily reflect those of the Ministry of Trade and Industry or the Government of Singapore¹

INTRODUCTION

In many countries, governments have comprehensive strategies to attract multinational companies (MNCs) as well as develop high-potential local companies in order to bring about economy-wide benefits. In Singapore, the Economic Development Board (EDB) was set up to undertake investment promotion and industry development. In 2024, EDB attracted \$13.5 billion in fixed asset investments, which are expected to create 18,700 jobs over the next five years and generate \$23.5 billion in value-added (VA) per annum (3.2 per cent of nominal GDP in 2024).

While the direct economic contributions of EDB-supported firms (or EDB firms for short) are clear, their indirect impact on the broader economy (i.e., non-EDB firms) has not been quantified previously. This study addresses this gap by estimating the indirect impact of EDB firms on non-EDB firms through various transmission channels.

¹ We would like to thank Ms Yong Yik Wei, Dr Andy Feng and Dr Kuan Ming Leong for their useful suggestions and comments, as well as the Singapore Economic Development Board (EDB) for their inputs to this study. All remaining errors belong to the authors.

LITERATURE REVIEW

Studies have found that MNCs generate direct and indirect benefits to the economy (Alfaro-Urena et al., 2021; Setzler and Tintelnot, 2021). Specifically on indirect benefits, a review of the literature suggests that there are various transmission channels through which MNCs could have an effect on other firms, such as the production, labour market and technology space channels.

For the production-related channels, a meta-analysis of studies on the spillovers from foreign direct investment (FDI) by Havranek and Irsova (2011, 2013) identified three commonly studied channels – horizontal, forward and backward spillovers. Horizontal spillovers refer to the effects of FDI on the outcomes of firms in the same industry, while forward and backward spillovers refer to the effects of MNCs on the outcomes of their customers and suppliers in other industries, respectively. Across these channels, studies have generally found the effects of horizontal and forward spillovers to be negligible, while that of backward spillovers to be positive and larger.

In Singapore, a study by Guo and Yuen (2012) on productivity spillovers from FDI to other manufacturing firms found that local-owned firms in industries that were upstream to foreign-owned firms were more likely to experience productivity gains (i.e., positive backward spillovers). At the same time, they found that the presence of foreign-owned firms had no clear productivity impact on local-owned firms in the same industry (i.e., insignificant horizontal spillovers).

Apart from the production-related channels, MNCs and other firms also interact in labour markets. A study by Alfarenó et al. (2021) found that MNCs in Costa Rica had a positive impact on the wages of workers in other firms through their impact on labour demand. In particular, as MNCs offered jobs that paid a premium, they improved the outside options of workers in other firms by altering both the level and composition of labour demand. Finally, MNCs and local firms also interact in the technology space, where Bloom et al. (2013) found that positive knowledge spillovers dominated the negative effects of increased competition from their technological rivals.

While the existing literature provides valuable insights into the spillover effects of MNCs, most of these studies focussed on individual channels (e.g., labour market) or specific outcomes (e.g., productivity) in isolation. This fragmented approach may underestimate the net impact of MNCs as positive effects through one channel could offset the negative effects through another. Few studies have examined the relative importance of the different spillover channels or assessed the overall net impact of MNCs on the wider economy. Our study addresses these gaps by simultaneously estimating the effects of multiple spillover channels and quantifying MNCs' total economic contributions to Singapore.

In particular, this study estimates the impact of EDB firms on non-EDB firms through five spillover channels viz. i) labour market, ii) technology space, iii) horizontal spillovers, iv) backward spillovers, and v) forward spillovers. Exhibit 1 elaborates on these channels and their possible positive or negative effects.

Exhibit 1: Spillover channels from EDB firms to non-EDB firms**(i) Labour Market Spillovers**

- (+) Non-EDB firms benefit from direct knowledge transfers when they hire workers formerly from EDB firms, as well as from labour quality improvements in the ecosystem due to the presence of EDB firms.
- (-) Non-EDB firms face increased competition for labour and talent.

(ii) Technology Space Spillovers

- (+) Non-EDB firms improve their production and organisational processes by learning from EDB firms.
- (-) EDB firms face increased competition from EDB firms in the same technology space.

(iii) Horizontal Spillovers

- (+) Non-EDB firms in the same industry as EDB firms improve their competitiveness due to greater competitive pressures.
- (-) Non-EDB firms in the same industry as EDB firms lose market share amidst stiffer competition from EDB firms.

(iv) Backward Spillovers

- (+) Non-EDB firms that supply production inputs to EDB firms benefit from greater demand and new business opportunities.
- (-) Non-EDB firms in upstream industries closer to EDB firms may possess less market power in the sales of their output to EDB firms, potentially becoming price takers with reduced margins.

(v) Forward Spillovers

- (+) Non-EDB firms benefit from higher-quality production inputs supplied by EDB firms.
- (-) Non-EDB firms in downstream industries closer to EDB firms may possess less market power in their purchases of production inputs from EDB firms, potentially becoming price takers with higher input costs.

Note: The (+) and (-) symbols represent the potential positive and negative spillover effects from EDB firms to non-EDB firms through the respective channels.

DATA AND EMPIRICAL METHODOLOGY

Our study uses an anonymised dataset that tracks individual firms annually from 2011 to 2019. The dataset contains firm-level characteristics, such as the revenue of the firm, the remuneration paid out by the firm, the characteristics of the employees in the firm, and the industry that the firm is in. This dataset is supplemented by EDB data on the firms that it supports, and IPOS and Orbis data on patent applications in Singapore.

Using a similar approach as Bloom et al. (2013), we compute a spillover variable, which measures the exposure of each non-EDB firm (n) to all EDB firms (e). Each spillover variable is constructed with three component variables:

$$\text{Spillover variable}_{n,t} = \sum_e (\text{EDB support}_{e,t} \times \text{firms' closeness}_{n,e,t} \times \text{duration of exposure}_{n,e,t})$$

EDB Support

This is a dummy variable² that denotes whether the EDB firm received any form of government support³ (i.e., monetary or non-monetary). This is to capture when the EDB firm was likely to have started generating spillovers to the non-EDB firms.

Firms' Closeness

This component measures the distance between each non-EDB firm (n) and each EDB firm (e) for the channel being examined [Exhibit 2]. The variable is constructed such that a higher value indicates a greater degree of closeness between the non-EDB firm (n) and EDB firm (e).

Duration of Exposure

This component measures the overlap in the years of establishment between the non-EDB firm (n) and each EDB firm (e), and ranges from 0-1.⁴

2 This variable equals to 1 starting from the first year a firm appears in EDB's list of supported firms and remains equal to 1 in subsequent years. Otherwise, the variable equals 0.

3 Government support can be in the form of monetary (i.e., grants and tax incentives) and/or non-monetary support (e.g., business facilitation services such as providing information on doing business in Singapore, connecting firms with potential partners and providing insights on the region).

4 Specifically, the duration of exposure is capped at 1 if the EDB firm is older and will be less than 1 if the EDB firm is younger.

The product of these three component variables (viz. EDB support, firms' closeness and duration of exposure) is then summed across all EDB firms (e) for each non-EDB firm (n) such that the resulting spillover variable measures the "exposure" of each non-EDB firm to all EDB firms. Intuitively, the greater the "exposure" that a non-EDB firm has to EDB firms, the more likely that the presence of the EDB firms would have spillover impact on the firm. As there are five spillover channels in which to measure firms' closeness, we construct five different spillover variables.

Exhibit 2: Measure of distance between each non-EDB firm and each EDB firm for the five spillover channels⁵

	Labour Market Spillovers Correlation between each non-EDB firm and EDB firm based on the composition of their workforce across 40 bands (age, gender and wages)
	Technology Space Spillovers Correlation between each non-EDB firm and EDB firm based on the distribution of their patents across 35 technology classes
	Horizontal Spillovers Equals to 1 if the non-EDB firm and EDB firm are in the same industry in DOS' input-output (IO) tables and 0 otherwise (proxy for being in the same product market)
	Backward Spillovers Share of intermediate output of the non-EDB firm's IO industry that is <u>sold</u> to the EDB firm's IO industry (non-EDB firm is the seller)
	Forward Spillovers Share of intermediate inputs <u>purchased</u> by the non-EDB firm's IO industry from the EDB firm's IO industry (non-EDB firm is the buyer)

We use a fixed effects regression model to estimate the spillovers from EDB firms to non-EDB firms' outcomes: β_1, β_2

$$\begin{aligned}
asinh(Y_{nt}) = & \beta_1 asinh(Labour\ Market\ spillover_{n,t}) \\
& + \beta_2 asinh(Technology\ Space\ spillover_{n,t}) \\
& + \beta_3 asinh(Horizontal\ spillover_{n,t}) \\
& + \beta_4 asinh(Backward\ spillover_{n,t}) \\
& + \beta_5 asinh(Forward\ spillover_{n,t}) \\
& + \gamma X_{nt} + H_n + \theta_t + \varepsilon_{nt}
\end{aligned}$$

Where:

- Y_{nt} is an outcome of non-EDB firm (n) in time t . The outcomes examined are value-added (VA), productivity (VA per worker), local employment and local wage outcomes;
- $spillover\ variable_{nt}$ measures the exposure of non-EDB firm (n) to all EDB firms (e). As explained earlier, there are five different spillover variables;
- X_{nt} is a vector of non-EDB firm (n)'s controls such as age, firm size and ownership;
- H_n denotes non-EDB firm (n) time-invariant firm fixed effects;
- θ_t is a vector of year dummies that captures effects that are common to all firms in the specific year; and
- ε_{nt} is the error term assumed to be uncorrelated with the independent variables in all time periods.

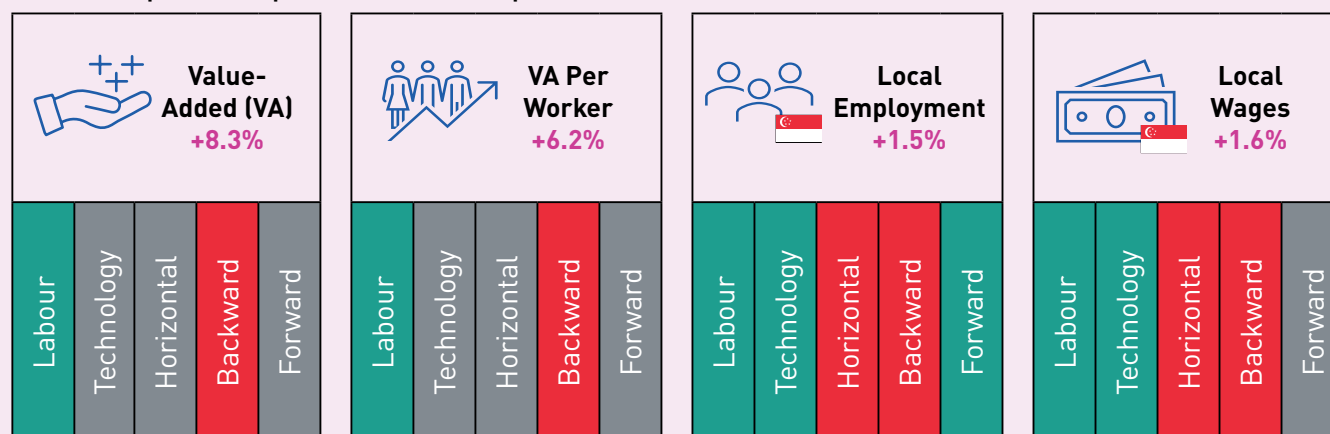
$\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 measure the impact of EDB firms collectively on the average outcomes of non-EDB firms through the five spillover channels.

⁵ Ideally, we should use firm-to-firm transaction data to measure the closeness of firms. However, comprehensive data of such nature does not exist in Singapore. As such, we develop proxies to measure the closeness of firms across the five spillover channels in line with the academic literature.

RESULTS AND DISCUSSION

Our results show that greater exposure to EDB firms improved the performance of non-EDB firms across all four outcomes. In particular, a 10 per cent increase in exposure to EDB firms improved the VA, VA per worker, local employment and local wages of non-EDB firms by 8.3 per cent, 6.2 per cent, 1.5 per cent and 1.6 per cent on average, respectively [Exhibit 3].⁶

Exhibit 3: Impact of a 10 per cent increase in exposure to EDB firms on non-EDB firms' outcomes



Note: Green and Red denote channels that had statistically significant positive and negative spillover effects respectively. Grey denotes spillover channels that had statistically insignificant results.

The effects of the various spillover channels varied depending on the outcome of interest.

For VA and VA per worker, the net positive spillover impact of EDB firms was driven by the labour market channel, suggesting that the positive effect of workforce quality improvements resulting from the EDB firms' presence outweighed the negative effect of increased competition for talent for non-EDB firms. Conversely, the backward spillover effect was negative, indicating that non-EDB firms in upstream industries closer to EDB firms could have experienced reduced margins from their sales of output to EDB firms due to weaker market power, which more than offset the gains from the increase in demand generated by EDB firms. The remaining three channels were not statistically significant.

For local employment, the impact of the labour market and backward spillover channels were in the same direction as that found for the VA and VA per worker outcomes. However, the other three channels became statistically significant, with the technology space and forward spillover channels turning positive, and the horizontal spillover channel turning negative. The positive effect from the technology space channel indicates that exposure to EDB firms allowed non-EDB firms to improve their production and organisational processes to a greater extent than any negative competition effects arising from operating in the same technology space as the EDB firms. Similarly, the positive forward spillover effect suggests that non-EDB firms on net benefitted from the higher-quality inputs supplied by EDB firms. On the other hand, the horizontal spillover channel exerted a negative impact on non-EDB firms, suggesting that market share losses arising from stiffer competition against EDB firms in the same industry was the dominant effect.

For local wages, the impact of the various channels was directionally similar to that for employment. Overall, the net positive impact of EDB firms on non-EDB firms was driven by positive effects through the labour market and technology space channels, even as the backward and horizontal spillover channels exerted a negative impact. However, the forward spillover channel was no longer statistically significant.

⁶ The 10% increase is applied on all five spillover variables. The net impact on each outcome is calculated by summing the statistically-significant coefficients of the spillover variables in the respective regressions.

Across all four outcomes, the labour market channel was consistently positive while the backward spillover channel was consistently negative. For the latter, this may reflect various constraints that limit non-EDB firms' ability to supply inputs to EDB firms, including their inability to meet required specifications, relative lack of competitiveness compared to overseas suppliers, and mismatches in resource profiles for manufacturing activities. At the same time, the effects of the remaining three channels were mixed or limited. In particular, the weak impact of the horizontal and forward spillover channels may reflect EDB firms' outward-orientation towards global markets, which tends to reduce both direct competition with non-EDB firms and the scope for EDB firms to supply inputs to non-EDB firms.

At the aggregate level, the net positive spillover effects translate into substantial economic benefits for Singapore. Between 2012 and 2019, we estimate that EDB firms contributed to an increase in the VA of non-EDB firms as a whole by around \$48.5 million per EDB firm annually. This accounted for 41 per cent of the total (i.e., direct and spillover) economic contributions of EDB firms.

CONCLUSION

Overall, our results suggest that EDB's strategy of attracting foreign MNCs while developing high-potential local companies has led to substantial economy-wide benefits. The positive spillover effects generated by EDB firms were primarily through the labour market channel, which suggests that EDB firms had contributed to raising the quality of workers in the broader ecosystem. Crucially, the positive effects from improved workforce quality significantly outweighed the negative effects from the increased competition for labour, resulting in a net benefit to Singapore's economy.

Nevertheless, significant opportunities remain to enhance these benefits and address the weaker spillover channels. To maximise the labour market channel's positive impact, policymakers should support capability building programmes for non-EDB firms and their employees to enhance their ability to attract skilled labour and benefit from knowledge spillovers through the labour market. This targeted approach would amplify the positive labour market spillover effects and strengthen Singapore's broader business ecosystem.

Equally important is the need to address the weaker spillover channels that currently limit the full potential of EDB firms' contributions. In particular, for the backward spillover channel, where non-EDB firms do not seem to have been able to benefit from increased demand opportunities generated by EDB firms, targeted supplier development initiatives could enhance non-EDB firms' capabilities and competitive position. This would in turn help them to better capitalise on the increased demand from EDB firms.

These complementary approaches would ensure that Singapore captures the maximum economic value from its strategic investments in attracting high-quality firms, and transform the current spillover patterns to benefit the entire economy.

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