




# LOCAL INSIGHTS INTO GLOBAL VALUE CHAINS

Leveraging firm-level data  
to inform anticipatory  
economic policy decisions.

Singapore Management University (SMU) research seeks to establish firm-level data infrastructure to paint a representative picture of the Singapore economy by tracking how firms interact through goods, services, and knowledge flows.

Effects of global shocks such as trade wars can propagate through supply chains, manifesting themselves through labour demand, productivity, and innovation of firms with ties to the global value chain (GVC).

Research results can be used to build structural models to run 'what-if' counterfactual analyses, enabling proactive decisions on economic policy, trade strategy, and workforce development.



In May 2025, Hon Hai Precision Industry (Hon Hai), the main manufacturer of Apple's iPhone which is the world's market-leading mobile phone, announced

a US\$1.5-billion investment into its operations in southern India.<sup>1</sup> This follows a nearly 60-percent increase in the number of iPhones assembled in India over the past 12 months to March 2025, amounting to US\$22 billion in value.<sup>2</sup>

The main reason Hon Hai – better known as Foxconn internationally – is shifting its production away from China is the US import tariffs on Chinese-produced goods. While the Trump administration has announced, suspended, and negotiated tariff rates for various countries, the uncertainty generated by the US-China tariff tit-for-tat and the possibility of a reinstatement of the 125-percent additional tax on Chinese imports are forcing companies to rethink where to make their products.

Zhengzhou, the capital city of Henan Province, China, where Hon Hai assembles some 70 percent of all iPhones,<sup>3</sup> is dubbed 'iPhone City'. Hon Hai's iPhone factory employs an estimated 200,000 workers during peak periods,<sup>4</sup> and has developed into a hub around which over 300 electrical and electronics suppliers have congregated, which further attracts other phone makers such as ZTE and OPPO.<sup>5</sup> These companies form links with one another, serving as both customers and suppliers in a vast network of related industries that have grown in tandem and reportedly account for about a quarter of Henan's gross domestic product (GDP).<sup>6</sup>



The effects of multinational enterprises (MNEs) such as Hon Hai ramping up production in India, and possibly scaling back operations in Zhengzhou, are instructive for understanding the mechanisms through which global shocks (such as trade wars and supply chain disruptions) propagate across firms' linkages. In establishing and analysing datasets on transactions among businesses, my research programme with several SMU and international collaborators will help us understand how shocks, both external and internal, affect the Singapore economy. We do so by examining the impact of the supplier-buyer network – or firm-to-firm input-output linkages – on firm-level outcomes, such as their productivity, labour demand, and innovation activities.

In this article, I describe how the research programme will establish the information infrastructure to collect and compile these firm-to-firm interactions in terms of goods, services, and knowledge flows across firms in the Singapore economy. My article will also explain how the macroeconomic trade environment affects forward and backward linkages in the GVC, and what policymakers and business leaders can learn from the insights of our research.

### BY THE NUMBERS

In economics literature, researchers typically use value-added tax (VAT) transaction information to compile data on firm-to-firm goods and services flow. VAT systems require firms to report every transaction with other firms, which includes

both the buyer and seller identifiers. This data captures virtually all business-to-business (B2B) transactions subject to VAT, creating a detailed map of the real economy.

In Singapore, there is no infrastructure in the public sector that systematically digitises the VAT data between business entities,<sup>7</sup> while what is available is understandably restricted. The research programme aims to use Singapore's Government Technology Agency (GovTech) enTRUST platform to merge datasets from multiple sources while ensuring data privacy is upheld. The country's Ministry of Trade and Industry (MTI) will help facilitate access to data from various government agencies, including firm-level financial statements and trade data, and employer-employee matched data.

We have also obtained agreement in principle from a large Singapore-based bank to share data on the banking flows of its account holders that are business entities. Banking outflows/inflows between two business entities are a reasonable proxy for the purchases or sales of goods and services between firms. The bank, which has a 70-percent market share of the local banking industry, offers the best available option to map firm-to-firm linkages in the Singapore economy.

SMU will also contribute data on patent creation and citation compiled from sources such as the United States Patent and Trademark Office (USPTO), which will be merged with the Singapore firm-level data. Among other objectives, this part of the research programme

will help determine the elasticity of idea flows to goods/services flow, i.e., how much patent filing and citation is linked to firm-level trade flow. This will help serve as input in quantifying the effects of global shocks on innovation.

### THE GLOBAL VALUE CHAIN AND SINGAPORE

With the firm-to-firm dataset in place, we will be able to embark on interrelated research projects to study the effects of trade shocks on Singapore's economy. A big part of the research will focus on the firm-level GVC structure of the local economy, which will piece together the local firm-to-firm input-output linkages, the local firm-level imports and exports, and the global inter-country input-output (ICIO) tables, such as the Organisation for Economic Co-operation and Development (OECD) ICIO and World Input-Output Database (WIOD), which trace the goods and services flows at the country-sector level.

The GVC research studies will help us better understand the Singapore firms' participation and position in the GVC via direct participation in imports and exports, but also indirectly via the local production network. The end product of this project is what economists call a gross-export decomposition framework, which breaks down a firm's gross exports into value-added by sources and destinations of final demand. The framework will help measure entities such as a firm's backward and forward linkages in the GVC, as well as its GVC position (e.g.,



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upstream or downstream) in the world's production network.

Suppose a one-dollar piece of plastic is exported by Singapore, and it includes 20 cents of Chinese value added and five cents of Malaysian value added. These foreign contents would be considered backward linkages in Singapore's exports. Forward linkages, on the other hand, capture the Singapore value added that is exported and further embedded in other countries' production of exports. For example, if the one-dollar piece of plastic consists of 20 cents of Singapore value added and is exported to Taiwan, which

then uses the piece of plastic in its production of exports to the US, this 20 cents would be considered part of the forward linkages in Singapore's gross exports.

These backward and forward linkages constitute the GVC-related trade. This decomposition framework will be extended to the firm level for the local economy in the research project, given the data compiled. A firm is positioned relatively upstream if its GVC-related exports consist of a larger fraction of forward linkages than backward linkages. An example will be raw materials producers. In contrast, those in a downstream GVC position have

relatively more backward linkages than forward ones.

With the firm-level GVC measure, it would be possible to paint a granular view of backward/forward linkages and how they are connected with the firm-level productivity, labour demand, and innovation activities.

### EFFECT OF GVC LINKS AND TRADE SHOCKS

With firm-level data on the linkages, we aim to analyse the effect of trade shocks, such as the US tariffs that the Trump administration has slapped on all imports into America in

April 2025. The programme will look at their effects on three firm-level performance measures: productivity, labour demand, and innovation activities.

#### Productivity

For productivity, the project brings together information about firms' financial data such as their revenue and assets with data on who they buy from and sell to. This helps us understand how a firm's local production network and its position in global supply chains affect the efficiency of its operations. For example, firms that are well-connected may be more productive because they have better access to materials, ideas, and business opportunities.

To illustrate, imagine Firm A, which is a supplier to Firm B and a customer of Firm C. Firm A also sources intermediate goods from overseas suppliers and exports to foreign markets. By integrating this network information with Firm A's financial data, we can examine how shifts in its network position affect its productivity. For instance, an increase in Firm A's productivity may correlate with expanding its buyer/supplier network and deepening integration into the GVC.

Let us further assume the majority of Firm A's imported intermediate goods are sourced from the US, with backward linkages in China. The US import tariffs on Chinese goods would increase the cost of inputs that Firm A relies on for production. The indirect reliance of Firm A on Chinese contents routed via the US could result in weakened price competitiveness,

which in turn could show up in terms of revenues and knock-on effects on Firms B and C.

Detailed knowledge of its supplier network, e.g., knowing which components come from China and their tariff exposure, enables Firm A to evaluate strategic responses such as diversifying sourcing to reduce tariff exposures. By embedding this granular understanding of its GVC position and tariff impact, Firm A can develop targeted strategies to sustain competitiveness despite heightened trade barriers, turning a potential vulnerability into an opportunity for adaptive growth.

#### Labour demand

When firms integrate into the GVC, they often require different skills, occupations, and workforce sizes. Firms in high-tech industries such as semiconductors may demand more skilled labour to handle complex assembly or management tasks. Similarly, exporting firms exposed to foreign demand might expand production, increasing overall labour demand or shifting towards higher-value activities that require more skilled workers.

Research has shown that MNEs in a local market could increase the local wage level because of the compositional change in demand for higher value jobs, and the payment of a premium to their direct hires.<sup>8</sup> In the example of Hon Hai, its presence in a new location would not only create vacancies for high-paying jobs such as electronic engineers and skilled machine operators, but could also give workers leverage

to negotiate for better pay at their existing companies. Because of costs associated with hiring new workers, companies would rather pay more to keep existing workers who now have better employer options in the form of MNEs.

By studying how trade shocks such as tariffs could increase the cost of imports or lower demand for exports, we can understand how the resulting cutbacks in production or research and development (R&D) investment are reflected in labour demand both within the firm and across its supply network.

#### Innovation

As mentioned, SMU will cull data from the USPTO. Its data on patent creation serves as a proxy for a firm's innovation output, and we can track patent citations for the flow of knowledge and ideas among firms in the local network. By linking USPTO patent data to firm-level data, the programme can piece together a more sophisticated picture on whether and how being connected to innovative firms might lead to more innovation (as measured by increased patent filings) by domestic firms.

The programme will also look at the knowledge spillover from firms having links with MNEs. Local firms supplying to MNEs might be required to raise technical standards, more so by being exposed to technical specifications and technology that MNEs have developed with bigger R&D budgets. If a local firm starts filing patents after working with an MNE, it suggests some form of knowledge spillover. Even if firms do not



work directly with MNEs, they can observe and imitate competitors who do, and thereby raise standards.

Returning to the Hon Hai example, local suppliers would be exposed to technology and product specifications pertaining to market-leading products such as the iPhone. Hon Hai relocating some of its operations to India could open up more opportunities for local firms to tap into their technology ecosystem. For the firms in Zhengzhou, there might be fewer contracts to go around, which might reduce their exposure to the innovations that Hon Hai's R&D budget makes possible.

## COUNTERFACTUALS AND THE REAL-WORLD IMPACT

With firm-level data and the information infrastructure in place, the project can then build structural models to conduct counterfactual analyses of 'what-if' scenarios. For example, this would allow the cost-benefit analysis of offering tax credits to MNEs, by simulating the expected benefits in local firms' productivity, potential gains in labour demand (especially for higher-skilled roles), and innovation/knowledge spillover effects, taking into account the firm-to-firm input-output linkages. Conversely, decision-makers can run the model to simulate the effects of an MNE relocating out of Singapore, and make plans in anticipation to plug resulting gaps in labour demand and business revenue.

The model could also be used to simulate alternative trade policy scenarios that would inform trade negotiations. For example, if Singapore negotiated an expanded free trade agreement with the

European Union that removed tariffs for electronic parts, the model could simulate gains in export volumes and the associated employment gains. It could also identify firms, via their GVC-connectedness, that would benefit from the increased demand.

This approach is especially useful and relevant for open economies such as Singapore, which are closely tied to global trade and the GVC. External shocks such as the ongoing US tariff situation can manifest through the local economy in the form of decreased revenue and consequent job losses. By identifying vulnerable business clusters and sectors, policymakers can design targeted policies to incentivise R&D investments or upskilling efforts to enhance resilience.

Business leaders can also use our model to optimise performance and manage risks. The firm-to-firm linkage maps identify the channels through which shocks propagate through the economy, providing executives with markers of the degree of vulnerability in different local/global supply chains and their firms' reliance on each of these supply chains. Firms can also use the GVC insights to identify cross-border linkages beyond the immediate suppliers or customers, and formulate their best response to potential regime shifts such as the threat of the US reciprocal tariffs.

## CONCLUSION

As global trade dynamics continue to shift, economies like Singapore must equip themselves with sharper tools to navigate uncertainty. By building a robust, comprehensive, and data-driven

understanding of how firms are connected through local supply chains and knowledge flows, this research programme provides a foundation for more informed, forward-looking policy. Rather than reacting to crises after they happen, Singapore can use the insights from the research programme to anticipate disruption, strengthen its competitive edge, and shape resilient growth strategies. In doing so, the country moves towards a model of anticipatory governance – one that is better prepared for the next global shock, not just the last. <sup>SMU</sup>



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