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List of Abbreviations

ASEAN	Association of Southeast Asian Nations
CAF	Centre for Analysis and Forecast
CIEM	Central Institute for Economic Management
CIP	Competitive Industrial Performance
CPI	Consumer Price Index
CPTTP	Comprehensive and Progressive Agreement for Trans-Pacific Partnership
CRS	Constant Returns to Scale
EC	Enterprise Census
EU	European Union
FAEC	Factor Allocative Efficiency Change
FDI	Foreign Direct Investment
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GSO	General Statistics Office
GVC	Global Value Chains
ICOR	Incremental Capital Output Ratio
ILO	International Labour Organization
IoT	Internet of Things
IPSARD	Institute of Policy and Strategy for Agricultural and Rural Development
IR4.0	Fourth Industrial Revolution
LP	Labour productivity
MARD	Ministry of Agriculture and Rural Development
MHT	Manufacturing High-Technology
MOH	Ministry of Health
MOIT	Ministry of Industry and Trade
MOST	Ministry of Science and Technology
MPI	Ministry of Planning and Investment
MVA	Manufacturing Value Added
NCIF	National Centre for Socio-Economic Information and Forecast
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
PPP	Purchasing Power Parity
RCA	Revealed Comparative Advantage
RoK	Republic of Korea
SDG	Sustainable Development Goal

SEC	Scale Efficiency Change
SEDP	Socio-Economic Development Plans
SME	Small- and Medium-sized Enterprise
SOE	State-owned Enterprise
TE	Technical Efficiency
TFP	Total factor Productivity
TP	Technical Progress
UN	United Nations
UN Comtrade	United Nations International Trade Statistics Database
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
USD	United States Dollar
US	United States
VA	Value Added
VASS	Viet Nam Academy of Social Sciences
VDMA	Verband Deutscher Maschinen und Anlagenbau – (German Mechanical Engineering Industry Association)
VND	Viet Nam Dong
VSIC	Viet Nam Standard Industrial Classification
WG	Wage growth
WTO	World Trade Organization

Executive summary

This report provides an assessment of Viet Nam's manufacturing sector productivity and competitiveness as well as factors contributing to manufacturing labour productivity (LP) growth. It analyzed United Nations Industrial Development Organization (UNIDO) and General Statistics Office (GSO) Enterprise Census data using different indicators (revenue, employment, value added (VA), net exports, foreign direct investment (FDI) backward-forward linkages with domestic firms) to describe key characteristics of manufacturing VSIC 2-digit sub-sectors, LP, Revealed Comparative Advantage (RCA), domestic content of exports, VA-to-output ratios and wage growth to assess productivity and competitiveness of sub-sectors.

Based on the comprehensive analysis of manufacturing and its sub-sectors' productivity and competitiveness performances, this report recommends Viet Nam prioritize the enhancement of domestic private enterprises' productivity and competitiveness during its next development stage and as integral parts of public investment, State-owned enterprise (SOE) reform and FDI policies. This report also makes several specific recommendations to elevate the productivity and competitiveness of different sub-sectors tailored to their specific characteristics and past performances.

While the manufacturing sector experienced remarkable productivity and competitiveness improvements in recent years, gaps to middle-income and developed comparator countries remain large

In recent years, Viet Nam's industrial competitiveness index, manufacturing exports and RCA have continuously improved compared to other regional countries. In some indicators (VA-to-output ratio and RCA) Viet Nam outperformed India and Indonesia. In other manufacturing performance indicators, especially LP, Viet Nam lagged behind comparator countries with narrowing gaps still remaining large between Viet Nam and middle-income countries in the region (China, Indonesia and Malaysia) and very large to industrialized countries (Japan and the Republic of Korea (RoK)). While IR4.0 accelerates and leaves simple skilled and repetitive manufacturing jobs at risk to automation, the majority of Viet Nam's manufacturing firms have low levels of IR4.0 readiness. Key factors contributing to higher labor productivity and IR 4.0 readiness include: firm size, capital concentration, labour skills and geographical concentration of the industries.

Manufacturing sub-sectors differ by importance to the economy

Food and beverages, and furniture (medium-tech), textiles and wearing apparel, leather-footwear (low-tech) and electronics (high-tech) are sub-sectors with large economies of scale (except beverages and furniture that are medium-sized) making important contributions to the manufacturing sector and economy in terms of job creation, revenue, value addition and exports. Wood (excluding furniture), printing and tobacco as small-sized (low-tech) sub-sectors, other vehicles (high-tech) as a medium-sized sub-sector and non-metallic mineral products as a (medium-tech) large-sized sub-sector also contributed to manufacturing exports. A group of sub-sectors with high and medium technology, large and medium-sized, negative net exports (import substitution) included: (rubber-plastics, basic metal, fabricated metal), large-sized sub-sectors (chemicals, electrical equipment and motor vehicles), medium-sized sub-sectors (coke-petroleum-nuclear fuel, paper products, medical precision-optical equipment, machinery and equipment n.e.c.) and small-sized sub-sectors (repair and installation of machinery and other manufacturing).

FDI, SOEs and domestic private firms differ in sub-sector participation levels and sizes with limited linkages

FDI is the biggest player in manufacturing, dominating a majority of sub-sectors with large sizes and net export values, as well as in high and medium technology import substitution sub-sectors. FDI participation (measured by its VA share) in manufacturing was high in 16 out of 24 manufacturing sub-sectors and in four out of the top five manufacturing exporting sub-sectors (textiles and wearing apparel, leather-footwear, electronics and furniture). While FDI firms generate major employment, revenue and VA shares in many sub-sectors, they have weak linkages with domestic companies (especially in high- and medium-tech sub-sectors), while slightly stronger in resource-based sub-sectors.

SOEs are the smallest player in manufacturing, high profile in only two small-sized sub-sectors (coke-refined petroleum products-nuclear fuel and tobacco). Domestic private firms are the second biggest player in manufacturing, but commanding in only two sub-sectors with large positive net export values (food and beverages, and furniture). Domestic firms also dominate in large size non-metallic mineral products subsector with medium positive net export, small size wood and bamboo (excluding furniture) and printing subsectors with medium positive net export, but display medium-level participation in large size wearing apparel and textiles sectors which have positive net export. In the remaining large and medium-sized sub-sectors with positive net exports where FDI (and SOEs) dominate, domestic firms only have low participation levels. In contrast to often large-sized FDI and SOEs, domestic private firms tended to be SMEs.

Productivity and competitiveness performances varied substantially across manufacturing sub-sectors

Top exporting sub-sectors

Electronics: This manufacturing sub-sector had the highest VA and revenue shares, large employment share and largest positive net exports among manufacturing sub-sectors, with a high RCA. Its LP was assessed as "within reach" to comparator countries. Dominated by FDI (with a VA share of more than 98 percent), it was assessed as "competitive" in the stage of final product assembling with a "promising" increase in domestic suppliers of components as long as: (i) foreign firms maintained competitiveness of products, (ii) Viet Nam's sub-sector LP and wages remained competitive amid the high risk of losing repetitive assembling jobs to automation and (iii) Viet Nam's domestic firms accelerated participation as major suppliers in domestic and global value chains (GVCs). Electronics sub-sector industries that focused on assembling electronic home appliances for the domestic market (to substitute imports) also faced risks of FDI firms moving assembly plants to other countries if no longer competitive due to trade agreements. Looking forward, strengthened backward-forward linkages between FDI and domestic firms, solidified domestic firms' linkages in GVCs and movement to higher value chain stages will need to be prioritized.

Leather-footwear, textiles and wearing apparel: Major manufacturing sub-sectors in terms of exports, employment, revenue and VA share. These subsectors are dominated by FDI (while domestic firms have significant VA and employment shares in wearing apparel) and had the lowest LP among Viet Nam's manufacturing sub-sectors with LP gaps with comparator countries either widening or narrowing very slowly. The performance of these sub-sectors, mainly focused on the final stage of physical production in value chains (producing final products based on foreign firms' orders), can be assessed as rather "competitive" with weakening competitiveness (also evidenced by the leather-footwear and wearing apparel subsectors' wage growth higher than their LP growth, and especially wearing apparel's damaging competitiveness wage growth in addition to its long struggle to move vertically up value chains). Future competitiveness depends on several factors: (i) foreign firms' ability to maintain competitiveness of products, (ii) Viet Nam's sub-sector LP and VA-to-output ratio's ability to continue growing and (iii) how the high risk of losing repetitive jobs to automation will unfold. Given

these sub-sectors' large sizes and importance to Viet Nam's economy in terms of GDP, exports and employment, the impacts of not effectively increasing productivity and competitiveness as well as managing risks of losing jobs to automation will be highly significant for Viet Nam's socio-economic development. In the short term, however, the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTTP) will offer significant opportunities for leather-footwear, textiles and wearing apparel sub-sectors for growth in the context of increased exports demand and development of local value chains, including local firms to climb on value chains.

Furniture, food and beverages: Are the fourth and fifth largest of Viet Nam's manufacturing export sub-sectors, respectively. FDI firms have high participation levels in beverages and furniture with VA shares of 57 and 58.3 percent respectively, but low backward linkages with domestic firms. In these two sub-sectors, while SOEs have low participation levels, domestic private firms have medium VA and high employment shares in beverages and rather high VA, employment and revenue shares in furniture. Food processing is the only large-sized and large positive net export manufacturing sub-sector in which domestic private firms dominate with a VA share of 62.2 percent (FDI participation is medium level).

Labour productivity of food processing was at medium level, while high in beverages and low in furniture. The LP gaps with comparator countries were: (i) medium and narrowing in food processing, (ii) small and narrowing in beverages and (iii) large and slowly narrowing in furniture. VA-to-output ratios were low and gaps with comparator countries were large in food processing and beverages, while furniture featured a medium ratio and narrower gap. Wage growth was lower than LP growth in food processing, but higher (though remaining competitiveness enhancing) in beverages and furniture.

Overall, Viet Nam's food processing sub-sector was assessed as "competitive" (comparative advantages of local agriculture commodities a key factor). Domestic private firms are big players in this sub-sector, being export-oriented and aggressively expanding shares in global markets, diversifying export markets and moving up in the GVCs. To unlock further productivity and competitiveness, the sub-sector must build capacity in branding, marketing and play leading roles in GVCs and especially local value chains (increasing economy-of-scale for higher efficiency of agriculture production and ensure international quality, food safety and environmental standards, promote organic farming/ green production methods and application of IR4.0 technologies).

Furniture and beverages sub-sectors were assessed as "competitive" with risks. The furniture sub-sector's dependency on wood imports (while CPTPP requires higher export content from origin countries) presents the key threat. FDI domination in this sub-sector, negative (though still competitiveness enhancing) wage-LP growth and the likelihood of simple-skilled jobs being swallowed up by automation heighten the probability of FDI relocating production. In the beverages sub-sector FDI increased its participation level, while smaller-sized and fragmented domestic firms will face more robust competition in the near future. To confront increased competition, domestic firms must build linkages with local suppliers in domestic value chains to enhance productivity and competitiveness within the next five years.

Other export-contributing sub-sectors

Other vehicles: The only hi-tech (medium-sized in terms of employment, revenue and VA) sub-sector in this group is characterized by a large FDI footprint and very low backward-forward linkages with domestic firms. LP is high compared to other manufacturing sub-sectors in Viet Nam and "within reach" of comparator countries. Its medium-level VA-to-output ratio and gaps with comparator countries have narrowed. Notably within the sub-sector, the motorcycle industry experienced a significant improvement in "local" value chains and very high levels of "domestic" content, though possibly mainly produced by Viet Nam-based FDI firms. The sub-sector, mainly motorcycles (and production of bicycles/parts), was assessed as "competitive" and its competitiveness could be greatly enhanced through stronger linkages between FDI and Vietnamese firms to allow the latter to climb

local value chain. Strong linkages between Vinfast, the first leading domestic firm in electric bicycles, and domestic suppliers as well as effective domestic market competition to build capacity for future exports will be key to the success of Vinfast and Viet Nam's electric bicycle industry.

Wood (excluding furniture), printing, tobacco and non-metallic mineral products: Small-sized and low-tech sub-sectors, aside from the later which is large-sized and medium tech, are dominated by domestic private firms (SOEs are prominent in tobacco). Gaps between Viet Nam and comparator countries in VA-to-output ratios of wood (excluding furniture) and printing were closing, while distant in tobacco and non-metallic mineral products. LP gaps with comparator countries in these four sub-sectors remain wide and slowly narrowing. Overall, these sub-sectors were assessed as having "low competitiveness". Given their large domestic markets and presence of domestic firms, there is significant scope for policy interventions to elevate productivity and competitiveness. Tailored support to build stronger linkages between wood (excluding furniture) and local firms in the oil refinery and chemicals sub-sectors as well as suppliers of bamboo, rattan and other related materials available in Viet Nam and for sub-sector firms to upgrade technologies, branding and marketing capabilities must be explored.

High and medium technology sub-sectors with negative net exports

FDI firms have high VA shares in almost all sub-sectors in this group, while domestic firms have relatively higher VA shares in chemicals and fabricated metals and significant ones in rubber-plastics and medical precision-optical equipment. SOEs only have medium employment and high VA in coke-petroleum-nuclear fuel and repair and installation of machinery and equipment. FDI in resource-based industries tended to have higher backward-forward linkages with domestic firms (backward linkages in basic metals and chemicals were 96 and 62 percent, respectively and backward-forward linkages in rubber-plastics were 25 and 24 percent, respectively). Linkages in other sub-sectors were small during 2011-2015.

The basic metals, paper, chemicals, coke-petroleum-nuclear fuel and motor vehicles sub-sectors had high LP, with gaps to comparator countries narrowing. However, the performance measured by VA-to-output revenue showed only motor vehicles had a high ratio and reduced gaps to comparator countries, while paper, coke-petroleum-nuclear fuel, rubber-plastics, chemicals and basic metals had low/medium VA-to-output ratios and sizable gaps to other nations.

The motor vehicle sub-sector was assessed as "competitive" as long as FDI car-assembly plants in Viet Nam remained competitive. The main risks were trade agreements (including ASEAN), which could provide tax incentives for products with higher (20 percent and more) local content and fluid movement of goods encouraging FDI firms to relocate car-assembly plants if Vietnamese firms failed to become FDI suppliers. With the Vinfast car project operational in late 2018, its active presence in the domestic market and development of local value chains will elevate this sub-sector's productivity and competitiveness.

Basic metals, paper, rubber-plastics, chemicals, coke-petroleum-nuclear fuel sub-sectors were assessed as having "medium competitiveness" if the supply of local resource-based (as well as electricity supplies for energy-intensive basic metal sub-sector) inputs continued. Key challenges included: (i) accelerating LP and VA-to-revenue ratios, (ii) improving logistics and linkages with other sub-sectors in local value chains and (iii) applying higher environmental standards and changing competition rules towards application of more environment-friendly technologies. Moving up value chains in plastics and the rubber industry moving away from exporting rubber raw materials to producing high-quality plastics and rubber products for other sub-sectors (cars, bikes, motorcycles and electronics or high-quality rubber-plastics products for healthcare) is necessary for the industry to become more competitive.

Fabricated metals, electrical equipment, other manufacturing and machinery-equipment n.e.c., medical-precision equipment and installation of machinery have medium or low LP and VA-to-output ratios, with large LP and VA-to-output ratio gaps with comparator countries. These sub-sectors were assessed as having "low competitiveness".

Looking Forward, this Report Recommends

Enhancing Vietnamese firms' productivity and competitiveness, particularly: (i) linkages and upward movements in local and global value chains, (ii) increased productivity, value addition and (iii) local market shares and especially export volumes and values must be achieved through implementing a wide range of integrated and concerted policy actions. This should be a common prioritized goal within a wide range of national policies, from industrialization, SOE reforms and private sector/enterprise development to trade, FDI attraction, R&D, skills training and public investment. As lower middle-income Viet Nam, in its next stage of development, pursues an inclusive growth pathway to generate more productive jobs for its workers, enhance productivity and competitiveness, Vietnamese manufacturing firms must be at the centre of Viet Nam's growth strategy.

Urgent action is required to address well-known weaknesses of limited linkages between trade negotiations, industrial policies and programmes supporting enterprise development. Consultation and engagement of domestic private firms in formulation and implementation of such policies and programmes are paramount.

SOE reform efforts must focus on enhancing SOEs' (especially those at higher stages or leading local value chains with relatively high productivity and competitiveness) effectiveness and efficiencies, plus backward-forward linkages with domestic firms. Equitization of SOEs in industries/sub-sectors where domestic private firms are ready to take over leading roles from SOEs (with equitization going hand-in-hand with building capacity of domestic private firms) should be accelerated.

Public investment should aim to crowd-in domestic private sector investment. Public investment could help create demand for domestic private firms' products and services, and thus incentives to invest in business and technology upgrades. Public investment could also provide domestic private firms with opportunities to build capacity, including through learning-by-doing and receiving technology transfers through public investment from ODA loan projects.

Public investment in development of IT/telecommunications infrastructure (cloud computing, network and data security as well as e-commerce platforms, including for intermediate goods), e-payments and e-banking (similar to e-tax, e-customs and e-government payments), will not only help private firms (especially SMEs) improve IR4.0 readiness and efficiency, but also value chain connections. While public services (R&D and skills training) will benefit SMEs in general, special services such as testing and certification (and perhaps radiation and cold storage) have strong potential to enhance access and competitiveness of food and agriculture processing SMEs in global markets.

Within the overarching goals of sustainable development and creation of productive jobs for Vietnamese workers, Viet Nam must shift its focus from quantity to attraction of higher-quality FDI and bridge gaps between FDI and domestic private firms. The most important element of higher-quality FDI firms is long-term partnerships with local firms (as key players in production chains) as the core of their international competition strategy. Government should cooperate with such FDI firms, in a "win-win" approach, to support capacity development of domestic firms to benefit from technology transfers and connect them as first-tier suppliers to leading FDI firms and GVCs.

Domestic sector development will need to be prioritized in the upcoming Socio-Economic Development Strategy (2021-2030) and Plan (2021-2025). Key policy objectives should support domestic private firms to grow in size, accelerate transition to formalization and enhance productivity and competitiveness through development of local value chains, improved linkages within and upward movement in domestic and global value chains, with special attention to facilitate the emergence of big domestic firms to lead domestic value chains and become significant GVC players. In addition to continued efforts to nuance the business environment and support domestic private enterprises to access land and credit, more tailored support is needed for SMEs to elevate their: (a) capacity for business management and marketing, (b) linkages in domestic and international value chains and (c) technical capacity to adopt new

technologies and readiness to grasp opportunities unlocked by IR4.0 and a new wave of higher quality FDI. Establishment of independent (para-governmental) institutions specialized in providing training and R&D support to Vietnamese firms is necessary. Besides access to credit, guidance on technology upgrades is needed for domestic private firms to improve integration and generate upward movement in local and GVCs.

The assessment of productivity and competitiveness performance of the manufacturing sector and its sub-sectors presented in this report identified challenges and opportunities for Viet Nam to greatly enhance domestic firms' competitive edge through capturing more value added from a bigger local and global value chain footprint. With the enhancement of domestic firms' productivity and competitiveness as a central tenet in Viet Nam's growth strategy for its next development stage, it is the time for interlinked policy actions to be formulated and implemented within an integrated policy framework with concerted efforts by different stakeholders from government and business sectors.

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Introduction

Viet Nam achieved remarkable economic growth during 1991-2018, exceeding 6.8 percent. Per capita income increased 22-fold, from less than USD100 in the late 1980s to USD2,356 in 2017. During this time, Viet Nam passed the World Bank's USD1,000 income per capita threshold in 2008 to join the rank of lower middle-income countries. Despite these positive developments, it is widely acknowledged that Viet Nam's current growth model relies too heavily on cheap labour and the exploitation of natural resources.

The challenge for lower middle-income Viet Nam to ensure more inclusive and sustainable growth is to transition to a new growth model based on rapid productivity growth, innovation, high-value addition and enhanced internationally competitiveness to provide more productive employment for the majority of Vietnamese people. Recognizing this challenge, Viet Nam's Socio-Economic Development Strategy (2010-2020) and five-year Socio-Economic Development Plans (SEDPs), notably 2010-2015 and 2016-2020, have highlighted the importance of industrialization as well as increased productivity and competitiveness. Among the 2016-2020 SEDP's nine economic targets, two are to increase the contribution of total factor productivity (TFP) to growth and achieve 5 percent average annual increases in labour productivity.

A wide range of policies and programmes (SOE reforms, an enhanced environment for start-ups and to do business, support of SMEs to access credit and improve the quality of human resources) has been and are being formulated and implemented. Despite these policies, improvements in productivity and competitiveness remain below policy-makers' expectations with the weak implementation a key reason often cited. While this may be true, it is also widely acknowledged that weak policy designs (not accounting for the needs of enterprises in different sectors/sub-sectors and sizes, for example), political economy, incentives and capacity for implementation and institutional/cross-sector coordination aspects may have also contributed to the limited results.

One of the negative byproducts of weak policy design and to a lesser extent implementation, is the paucity of in-depth knowledge of key bottlenecks that impede productivity and competitiveness in sectors, especially the sub-sector/cross-sector and enterprise levels. While some research is available on TFP/productivity and competitiveness at economy-wide and some sector levels, it was based on the application of different methodologies and data sources that encountered numerous data and measurement consistency issues.

These limitations hamper the formulation of concrete and tailored policies and actions, as opposed to a one-size-fits-all approach, to address bottlenecks in sub-sectors and enterprises and support them to enhance productivity and competitiveness. This study sets out to close some of these knowledge gaps through utilizing the latest macro and micro-level data available from enterprise census, labour force and household surveys. It analyzes data within a coherent framework and uses a consistent set of productivity and competitiveness measurements cognizant of the data's limited scope.

The first part of this report briefly analyzes, within Viet Nam's macroeconomic context, the country's labour productivity performance, its sources and factors contributing to growth at economy-wide level. The second part assesses productivity and competitiveness in more detail at sectoral (manufacturing, service and agriculture[1]) and (2-digit VSIC) sub-sector levels. In this first volume, the report focuses on manufacturing and its sub-sectors, while an assessment of the service and agriculture sectors and

1 This report did not assess the construction and mining sub-sectors, important to Viet Nam's economy, due to data shortcomings as well as the non-tradable nature of these sub-sectors. Thus, they are less relevant to any assessment of international competitiveness.

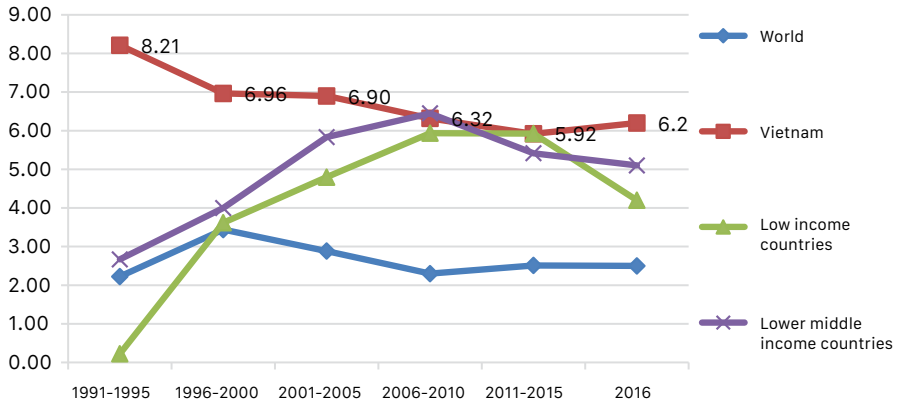
respective sub-sectors is delivered in volume two of this report. By examining the productivity and competitiveness performance of enterprises at sector and sub-sector levels, this report will provide technical notes on measurements and data used for such assessments. Importantly, a summary of assessments and policy recommendations will be provided in the last section of this report.

1. Labour Productivity at the Economy-Wide Level

1.1. Viet Nam's Macroeconomic context: Key highlights

Economic growth has been bottoming down

Figure 1.1: Economic growth rate, 1991-2016 (%)



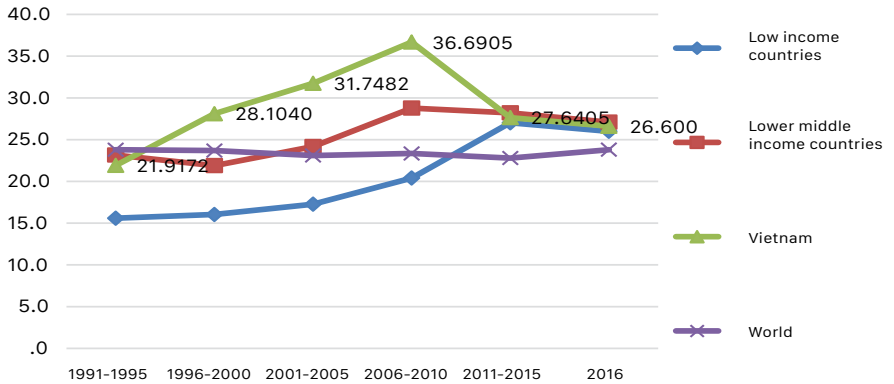
Source: Authors' calculation from World Bank's World Development Indicators

Figure 1.1 highlights economic growth in Viet Nam and low-income, lower middle-income countries and globally over a 25-year period (1991-2016). It shows that Viet Nam outperformed these comparator countries from 1991 to 2006. However, Viet Nam's growth rate declined and as a consequence, it was no longer superior to the low-income and lower middle-income groups during the ensuing period (2007-2015). Since 2016, Viet Nam's GDP growth has shown signs of iut, but it is too early to determine whether the country has resumed its robust growth performance over comparator countries.

The relatively high and increasing investment-to-GDP ratio reversed after Viet Nam reached lower middle-income status

Viet Nam's growth performance is arguably attributed to high investment rates sustained over an extended period of time. Figure 1.2 shows that during 1996-2010, the ratio of investment to GDP in Viet Nam was consistently and significantly higher than low- and middle-income countries. However, this rate subsequently fell to a level similar to comparator countries, reflecting significant changes that brought this important index to a more sustainable level. Specifically, the savings-investment gap in Viet Nam changed from -6 percent of GDP during 2006-2010 to +2.32 percent of GDP in 2011-2015 and +2.40 percent in 2016. This was in part attributed to improvements in efficiency of capital use, as evidenced by a reduction in the incremental capital output ratio (ICOR) from more than 6 in the late 2000s to approximately 5 in recent years.

Figure 1.2: Investment rate, 1991-2016: international comparison (%)

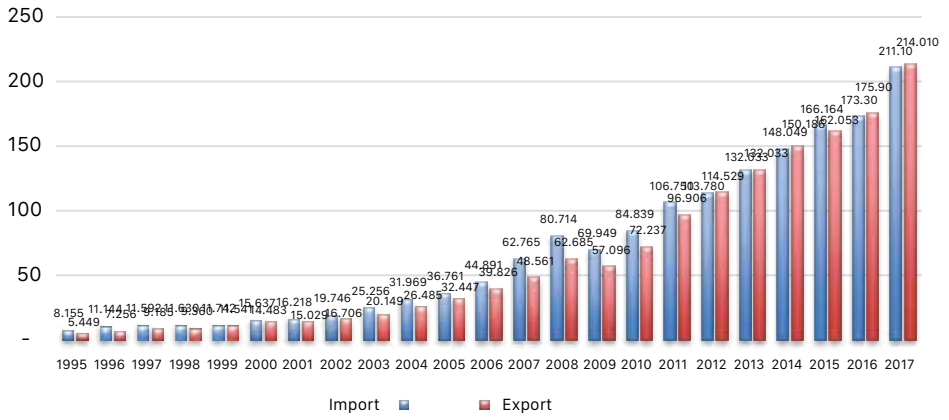


Source: Authors' calculation from World Bank's World Development Indicators

Trade performance improved with exports and imports rapidly rising, while the trade balance turned positive in recent years

The value of Viet Nam's exports and imports increased each year during 1995-2017, except for 2009. These figures highlight Viet Nam's strong trade performance, with exports and imports having accelerated over the last decade (Figure 1.3).

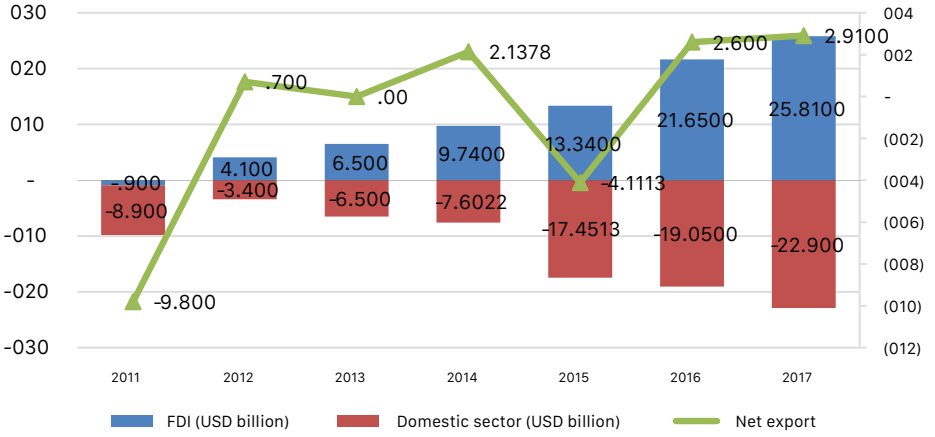
Figure 1.3: Viet Nam's trade performance, 1995-2017 (USD billion)



Source: GSO

A positive trend also emerged with respect to the trade balance in recent years. If imports increased faster than exports during 2000-2008 and resulted in a larger trade deficit, from 2009 until now the trade deficit has gradually decreased to move into a surplus in recent years, except in 2015. Such a positive change was largely driven by the FDI's strong trade performance, while the domestic sector persistently ran a large trade deficit (Figure 1.4).

Figure 1.4: Trade balance, 2011-2017 (USD billion)



Source: GSO

FDI is an increasingly important source of investment

The volume of FDI inflows into Viet Nam accelerated in a stable manner, especially after World Trade Organization (WTO) accession, to stand at a relatively high level in ASEAN - only below Indonesia and Singapore in 2015. The FDI share of total investment in Viet Nam reached a record level of 30.9 percent in 2008, and firmed up again to around 23.4 percent in 2015 and 2016. The FDI sector has made increasing contributions to account for around 20 percent of the country's GDP (from 15.2 percent in 2005), 72 percent of Viet Nam's exports (from 57 percent in 2005), 18 percent of government revenue and creating 3.7 million jobs for Vietnamese workers in 2017.

FDI in manufacturing accounts for almost 70 percent of total FDI into Viet Nam, the largest proportion of FDI in manufacturing in ASEAN followed by Indonesia (40 percent) and the Philippines (38 percent). GSO data shows that 64.6 percent of newly-registered FDI capital was in manufacturing, 10.1 percent in real estate and 2.4 percent in wholesale, retail and car-motorbike repairs in 2016. In 2017, electricity production and distribution, gas and air-conditioning attracted the most newly-registered FDI with USD8.4 billion (42.3 percent of total) and manufacturing only USD6.3 billion (31.7 percent).

The sources of FDI inflows into Viet Nam were diversified with Japan, RoK and Singapore the top investors out of 68 countries and territories.

Job vulnerability to automation and AI

Technological progress has accelerated in the recent decade, which is termed by numerous commentators as the Fourth Industrial Revolution (IR4.0). It is changing the global economic landscape, with far reaching implications for all actors – government, businesses and society at large. Among the key concerns of IR4.0 are (simple skilled/repetitive) job loses to automation and Artificial Intelligence (AI).

The report "The future of jobs at risks of automation"[2] (ILO 2016) estimated that in the next few decades among ASEAN-5 (Cambodia, Indonesia, the Philippines, Thailand and Viet Nam), the share of jobs with a high probability of automation was lowest in Thailand (44 percent) and highest in Viet Nam (70 percent). In the Philippines, Indonesia and Cambodia, the shares were 49, 56 and 57 percent, respectively (although some jobs, such as in agriculture, will be affected by structural challenges beyond mechanization). Within the average of 70.4 percent of all jobs in Viet Nam's economy assessed at risk of automation, some sectors/sub-sectors with very high proportions of jobs with a high probability of automation risks include agriculture, forestry and fisheries (83.3 percent), manufacturing (74.4 percent), food and beverages (68 percent), garments (85 percent) and electronics (75 percent), wholesale, retail and repair of motor vehicles (84.1 percent), service sector (32 percent), retail (70 percent), hotel and banking (around 40 percent). Occupations with the highest risk of disappearing in the future include shop sales assistants (2.1 million), garden labourers (1 million) and sewing-machine operators in garment manufacturing (770,000). Oxford Economics and Cisco's September 2018 report "Technology and the future of ASEAN jobs - The impact of AI on workers in ASEAN's six largest economies" (Oxford Economics and Cisco, 2018) forecasted that by 2028, "displaced workers" would number 9.5 million in Indonesia, 7.5 million in Viet Nam, 4.9 million in Thailand and 4.5 million in the Philippines. The report estimated varying employment impacts across ASEAN-6 countries (Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam) would be partly driven by differences in respective economic structures. It predicted that technological displacement would occur most intensively in the agriculture sector, affecting 13 percent of the workforce, which equates to around 10 million full time equivalent (FTE) jobs and would affect agriculture-dependent Indonesia and Viet Nam more heavily (sector accounts for 13 and 17 percent of their respective GDPs). In the manufacturing sector, also a major employer across ASEAN-6, technology was projected to displace up to 10 percent of the workforce over the next decade, equating to more than four million FTE jobs.

At the same time, the Oxford Economics and Cisco report found that as technological innovations would be more widely adopted in the coming years, labour productivity would be enhanced across all ASEAN-6 economies, as the technology that would displace some workers would also boost economic growth and create more jobs. New technologies cut production costs, which lowers the prices of goods, services and raises population spending power (known as the 'income effect'). The report outlined a modelling scenario in which Viet Nam would benefit from: (i) a vibrant mobile economy, driven by a large, young, digital-savvy workforce, (ii) high levels of investment in advanced infrastructure meant 5G connectivity would be established in cities and most rural areas covered by internet services, (iii) state-of-the-art

2 *"The future of jobs at risk of automation", International Labour Organization, July 2016. Available at: http://www.ilo.org/actemp/publications/WCMS_579554/lang--en/index.htm*

IoT technologies supported export manufacturing and logistics, (iv) data localization policies proved an impediment to advanced use of the cloud, distributed computing and AI development and (v) the prevalence of cheap and abundant labour meant the domestic economy would be characterized by outdated practices. Under this scenario, the report forecasted that by 2028:

- Sectors with the most displaced jobs were agriculture: 3.4 million displaced (17.1 percent of workforce), manufacturing: 1.3 million (13.2 percent) and wholesale and retail: 840,000 (10.9 percent)
- Sectors with most jobs created (through the above-mentioned 'income effect') were manufacturing: 1.7 million jobs created (8.5 percent of workforce), wholesale and retail: 1.6 million (16.4 percent) and hotels and restaurants: 1.3 million (16.8 percent)
- 1.8 million existing roles would disappear from the labour market, with more than 90 percent of redundancies in agriculture, pushing workers into other industries and occupations.

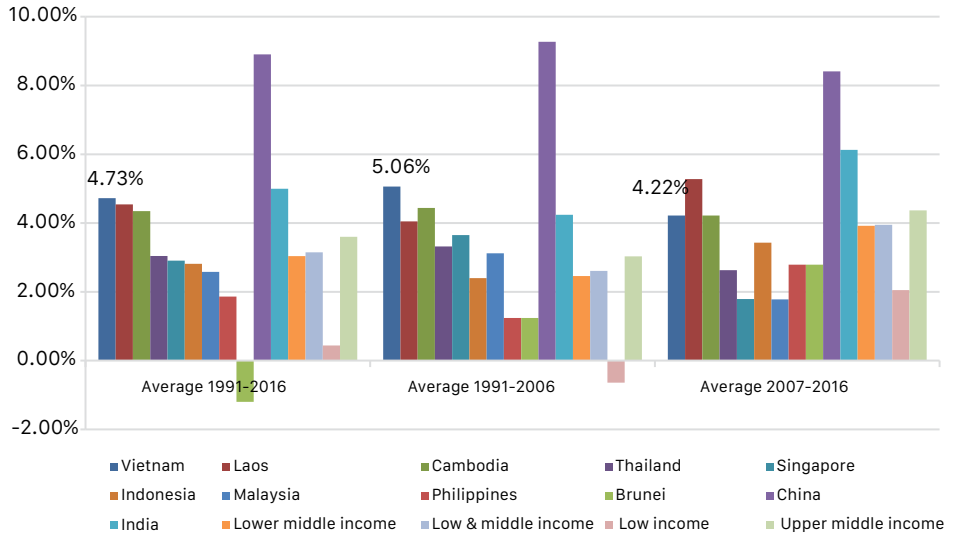
1.2. Labour Productivity Performance

Data from the World Bank's World Development Indicators shows labour productivity in Viet Nam grew by 4.7 percent per year on average during 1991-2016. The growth rate was the highest in ASEAN, greatly exceeding the -0.7 and 2.5 percent of low- and lower middle-income countries respectively, but much lower than China (9 percent) during this period (Figure 1.5).

This was largely attributed to Viet Nam's impressive performance during the 1991-2006 sub-period, when labour productivity grew by 5.1 percent per annum on average, the highest in ASEAN. It must be noted, however, that Viet Nam's labour productivity growth decreased since 2007, with 4.1 percent average annual growth during the 2007-2016 sub-period[3] and the rate was only the second highest (behind Lao PDR) among ASEAN countries. Across the same period, average labour productivity in low- and lower middle-income groups grew at 2 and 3.7 percent, respectively. As such, labour productivity growth in Viet Nam accelerated during 1991-2006 (when Viet Nam was in the low-income group) and slowed during 2007-2016 (Viet Nam joined the lower middle-income group) in contrast to the low- and lower middle-income groups' trend to slow in the first sub-period and accelerate in the second.

3 The year 2007 is an important milestone in Viet Nam's modern economic history, as the country graduated from one of the least developed nations to a lower middle-income one. On the integration front, Viet Nam also officially became a member of the WTO.

Figure 1.5: Labour productivity in selected countries, 1991-2016: Average annual growth rate (%)



Source: Authors' calculations from data of World Bank's World Development Indicators

Outside ASEAN, Viet Nam's labour productivity growth rate was consistently below those of China in both sub-periods and India's 6 percent during 2007-2016. Viet Nam's average annual labour productivity growth during 1991-2016 was south of these two countries by large margins. This demonstrates that labour productivity growth can keep pace with rapid development in giant economies.

Box 1. 1: How long does Viet Nam need to fully close absolute labour productivity gaps with ASEAN countries?

The issue of "catching-up" in labour productivity has recently featured prominently in policy debates in Viet Nam, as the country has set an objective of rapid and sustainable growth for the five-year 2016-2020 period and beyond. Thanks to its highest average labour productivity growth rate during 1991-2016, Viet Nam somewhat closed labour productivity gaps with other ASEAN countries relatively fast - especially compared to Brunei and Cambodia. However, gaps between Viet Nam and other ASEAN countries remain significant. If and how many years it would take Viet Nam to close these gaps can be assessed through the following "simple algebra".

Assessment model: Suppose that in year 0 (the initial year), relative labour productivity of country i over Viet Nam is γ_i^0 $\gamma_i^0 = \frac{Z_i^0}{Z_v^0}$, where Z denotes labour productivity, i – country i, v – Viet Nam

Suppose that in year t, labour productivity of country i and Viet Nam will be $Z_i^t = Z_i^0 * (1+\theta_i)^t$, and $Z_v^t = Z_v^0 * (1+\theta_v)^t$ respectively; where θ_i, θ_v are respectively the average rates of labour productivity of country I and Viet Nam in the period from 0 to t

Then relative labour productivity of country i against Viet Nam in year t will be

$\frac{Z_i^t}{Z_v^t} = \frac{Z_i^0*(1+\theta_i)^t}{Z_v^0*(1+\theta_v)^t} = \frac{\gamma_i^0*(1+\theta_i)^t}{(1+\theta_v)^t} = \gamma_i^0 * \left(\frac{1+\theta_i}{1+\theta_v}\right)^t$ (1.1)

The catch up, $Z_i^t = Z_v^t$ implies that $\gamma_i^0 * \left(\frac{1+\theta_i}{1+\theta_v}\right)^t = 1 \Leftrightarrow \log(\gamma_i^0) + t * \log\left(\frac{1+\theta_i}{1+\theta_v}\right) = 0$

$\Leftrightarrow t = \frac{\log(\gamma_i^0)}{\log(1+\theta_v) - \log(1+\theta_i)}$ (1.2), where t is the number of years that are needed for Viet Nam to fully close the labour productivity gaps with comparator countries.

Equation (1.2) says that if the initial relative labour productivity is large (then the numerator is large) and/or the difference in growth rates of labour productivity is small (then the denominator is small), the number of years required for the catch up would be bigger.

Assessment results: If the year 2016 is used as the initial one, under different scenarios of growth rates comparable to those achieved in 1991-2016 and 2007-2016 periods as presented in Figure 1.5, the number of years required for Viet Nam to fully close the absolute gaps with the comparator countries is presented in Table 1.1.

Table 1.1: Number of years required for Viet Nam to catch regional countries in labour productivity

Countries	Absolute LP in 2016 (in USD PPP 2011)	Relative LP in 2016 (Việt Nam = 1)	The number of years required, if countries keep growing as in the period of	
			1991 - 2016	2007 - 2016
Brunei	156,100	15.8	48	46
Singapore	144,424	14.6	149	101
malaysia	55,350	5.6	81	59
Thái Lan	27,165	2.7	60	66
Indonesia	23,352	2.4	45	135
Philippines	17,373	1.8	20	39
Laos	11,192	1.1	72	Never
Vietnam	9,891	1		
Cambodia (*)	6,254	0.6	Never	Never
China	25,530	2.6	Never	Never
India	16,282	1.6	Never	Never

Source: Authors' calculations. Note: If past performance is a good predictor of the future, Viet Nam would never catch China and India as the current gaps are large, but more importantly labour productivity in Viet Nam has grown consistently and considerably slower than in these two countries. Viet Nam would never catch Lao PDR if future labour productivity growth rates between the pair remained the same as the 2007-2016 sub-period. Cambodia would not catch Viet Nam if its labour productivity growth remained the same.

This implies Viet Nam must do considerably more to achieve better labour productivity growth than in the recent past if it wants to catch up.

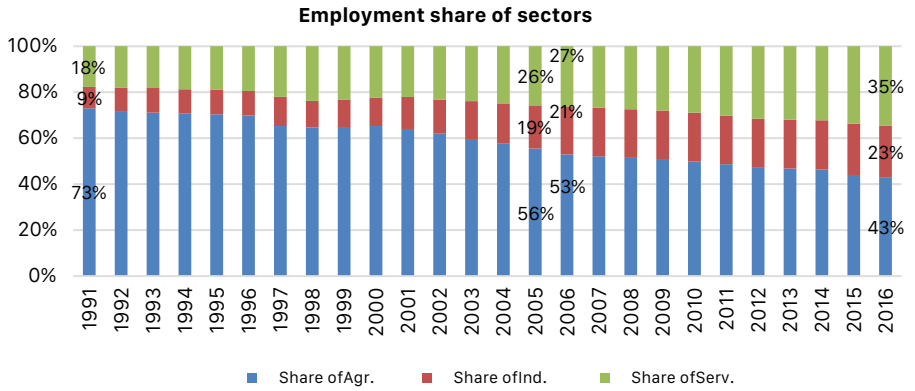
1.3. Sources of Labour Productivity Growth: a Shift Share Analysis

To understand sources of labour productivity growth, a shift share analysis is a useful tool. It allows for the decomposition of labour productivity growth into three components: (i) the 'within sector effect' that measures the contribution of each sector's productivity growth to overall productivity growth, (ii) the 'structural change effect' that measures the contribution of structural change as measured by changing sectoral employment shares to overall productivity growth and (iii) the 'interactive effect' that measures the contribution of interactions within a sector and shift effects to overall productivity growth. Details on this methodology are given in Appendix A.1.2.

Viet Nam's economy has been structurally transformed over the last few decades, as evidenced by a substantial reduction in agriculture's employment share from 73 percent in 1991 to 43 percent in 2016. During the same period, employment shares of industry and services rose from 9 and 18 percent in 1991 to 23 and 35 percent in 2016, respectively (Figure 1.6). Such structural change is a key driver of labour productivity growth, as productivity gaps between agriculture and industry and services sectors have been large, yet narrowed over time. Specifically, labour productivity of industry and services were 4.6

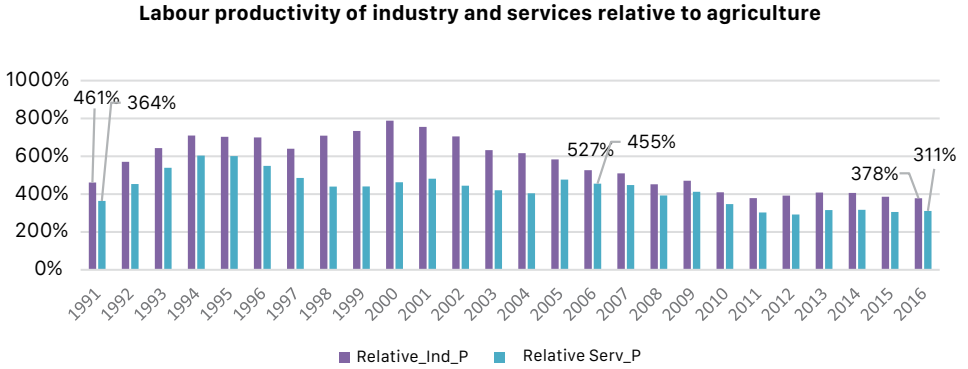
and 3.6 times that of agriculture in 1991, and 3.8 and 3.1-fold in 2016 (Figure 1.7). Therefore, such a shift in workers out of agriculture towards industry and services resulted in productivity gains through the 'reallocation effect'.

Figure 1.6: Structural transformation in Viet Nam during 1991-2016



Source: Authors' calculations based on data of the World Bank's World Development Indicators

Figure 1.7: Sectoral labour productivity[4] in Viet Nam during 1991-2016

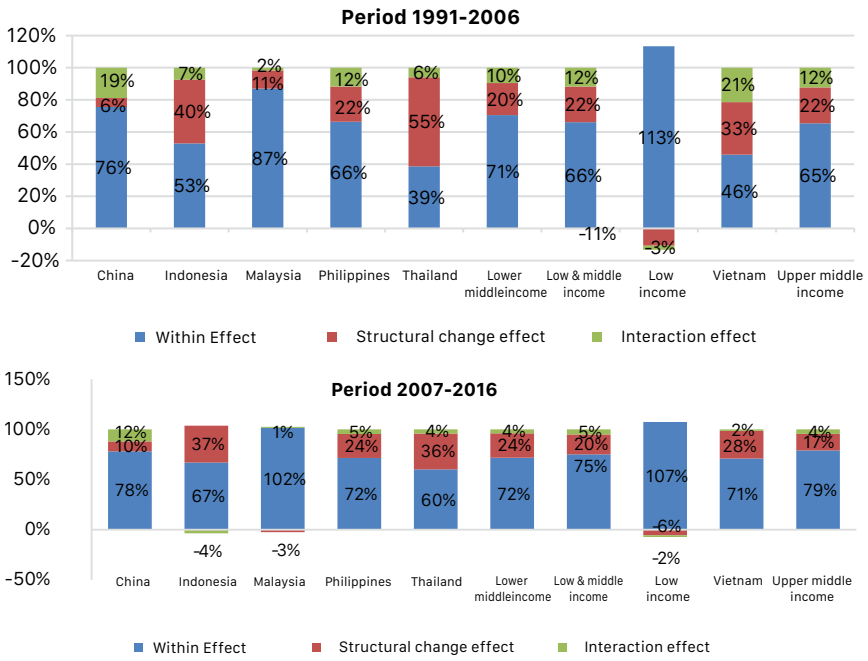


Source: Authors' calculations based on data of the World Bank's World Development Indicators

Shift share analysis results are presented in Figure 1.8. The upper panel captures 1991-2006 and the lower panel 2007-2016. A comparison of the two periods reveals the contribution of the 'structural change effect' on productivity growth in Viet Nam declined over time, from 33 percent during 1991-2006 to 28 percent during 2007-2016, while the influence of the 'within sector effect' rose significantly (46 to 71 percent). The 'interaction effect' was positive across both periods, as the employment shares of sectors with lower-than-average labour productivity shrunk, while those of sectors with higher-than-average labour productivity rose. As such, the 'within sector' and 'structural change' effects reinforced one another to raise labour productivity over time in Viet Nam. However, the 'interaction effect' declined significantly from 21 percent in the first period to only 2 percent in the second.

4 *Labour productivity is calculated in USD, 2011 PPP.*

Figure 1.8: Sources of labour productivity growth (%)



Source: Authors' calculation based on data of the World Bank's World Development Indicators

Figure 1.8 shows that sources of labour productivity growth in Viet Nam appeared to follow low middle-income group patterns in both sub-periods. During 1991-2006 (when Viet Nam a a low middle-income nation, Viet Nam's shares of 'structural change' and 'within sector' effects were 33 and 46 percent respectively, resembling average shares in lower middle-income countries (20 and 71 percent) and in 2007-2016 when Viet Nam was a lower middle-income nation the shares were 28 and 71 percent versus the average of 20 and 75 percent of lower middle-income countries.

It is interesting to note the case of Thailand, which has a much higher share 'reallocation effect' contribution to productivity growth than Viet Nam and other countries in comparison. Thailand clearly is at a more advanced level of development than Viet Nam and some other comparators, and common wisdom suggests the former's economy would have a more stable structure and thus less scope for structural changes to contribute to productivity gains. But, Thailand's data shows otherwise and suggests room may exist for Viet Nam within its next higher development stage.

1.4. Determinants of Labour Productivity at Firm Level

The previous section showed how the 'within sector effect' became a dominant source of labour productivity growth in Viet Nam in recent periods. Therefore, it is important to analyze the determinants of labour productivity at firm level, presumably a major component of the 'within sector effect' in labour productivity increases.

As labour productivity in firms is measured by the ratio of value added over the number of workers, this section examines three categories of "standard" factors - workers, firms and their operational environments - that affect value added and thus influence labour productivity of firms. Econometric analysis of the 2017 Enterprise Census (which covered more than 330,000 firms, including 265,000 firms in the 2012-2017 two-wave panel dataset)[5] suggests the following determinants of (or more rigorously, factors associated with) firms' labour productivity:

5 *Brief description of Enterprise Census is given in Section A.3.1. of Appendix 3. Details on regression results are provided in Section A.3.2. of Appendix 3.*

Worker-related factors

The presence of foreign workers in a firm is beneficial to productivity. Raising their share by 1 percent boosts productivity by 119 percent (e^{779} - 1), indicating the presence of strong spill-over effects from foreign to Vietnamese workers. With regard to human capital of workers as proxied by the level of educational attainment, most indicators (e.g. ratios of workers with primary vocational certificates, secondary (vocational) or (vocation) college degrees, ratio of workers with degrees or higher) had unexpectedly negative characteristics, except the ratio of workers with short-term training certificates. This may indicate production is predominantly based on simple skilled labour and short-term training yields positive returns to firms' labour productivity, while the yield in other indicators is more ambiguous. Age of workers also matters. Firms with a bigger share of workers under 30 years of age were the most productive and this may reinforce the above explanation.

Firm-related factors

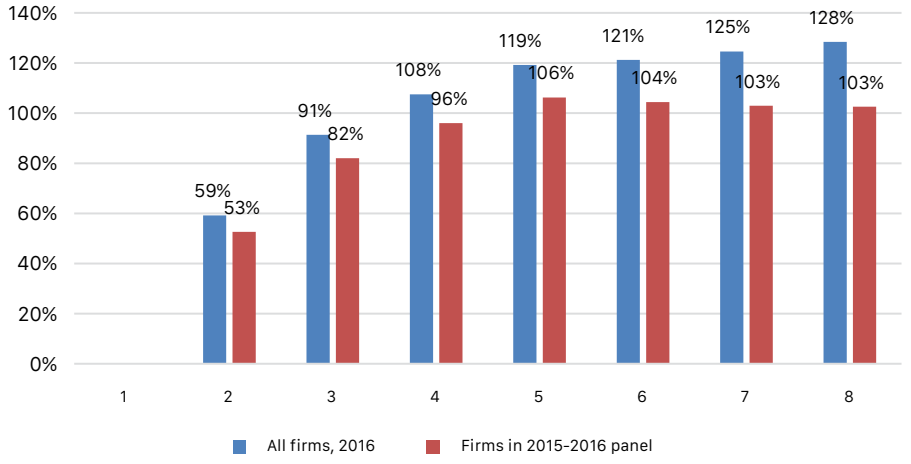
Capital deepening is important:

Raising the ratio of capital over labour, which measures how well workers are equipped, by 1 percent will increase labour productivity by 0.37 percent (0.38 percent, if firms not in the 2012-2017 panel are excluded).

Firms' size matters:

The size premium, as measured by the productivity gap between firms with different sizes and micro-firms with less than five workers as a reference group, becomes larger at a diminishing speed as a firm's size increases (Figure 1.9). For example, firms with 50-99 workers have higher productivity, by 119 percent (i.e. $e^{0.785}$ - 1) more than firms with less than five workers, with other things being equal. If firms in the 2012-2017 panel were taken into account, the size premium exhibits an inverted U-shape pattern with firms' sizes: (i) more than five workers are more productive than the latter and (ii) between 50-99 workers are the most productive (with labour productivity higher by 106.3 percent (i.e. $e^{0.724}$ - 1) than firms with less than five workers), with other things being equal (Figure 1.9). This finding indicates that a larger firm size depicts higher labour productivity, as it presumably facilitates the learning process among peers as well as other advantages arising from economies of scale. The inverted U-shape indicates a turning point in the size premium where the additional costs, associated with limits on managerial capabilities for example, outweigh the additional benefits of bigger size.

Figure 1.9: Size Premium



Source: Authors' calculation using 2017 Enterprises Census data

Firms' managerial capabilities matter

If a firm's top manager holds a masters degree or higher, labour productivity increases by 2.1 percent from the base case, where the manager only has a junior college degree or lower. A manager's experience as proxied by its age also matters, with experience premium following an inverted U-shaped pattern.

Digitization makes a difference

Firms that use computers more intensively, have a website and use the internet in various activities are more productive. Specifically, productivity of firms with computers is 9.1 percent higher than those without. Firms with a website, an important sign of being online, are 5.7 percent more productive than off-line firms. Companies that use the internet for operational management are 2.8 percent more productive than others.

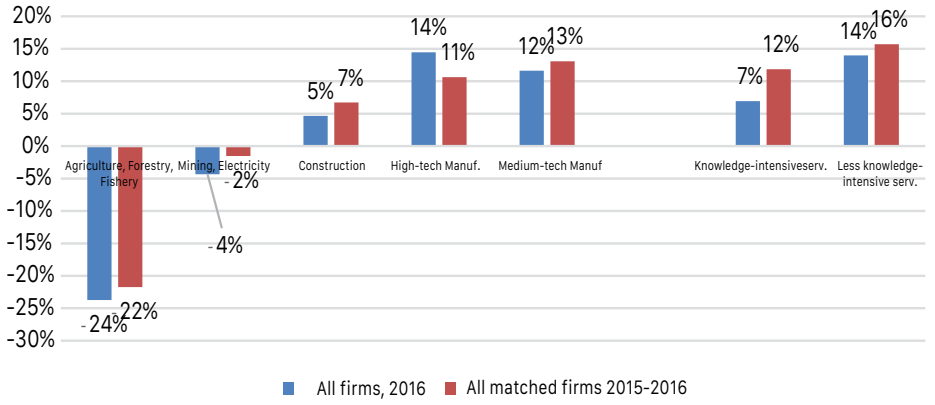
Participating in the global market helps

Firms engaged in export and/or import activities are 29.6 percent more productive than those not.

Level of technological sophistication in manufacturing and knowledge intensity in services matters

With all other factors being equal, firms in medium and high-tech manufacturing as well as services and construction are more productive than ones in low-tech manufacturing, while companies in agriculture, forestry and fisheries, electricity and mining are less productive (Figure 1.10).

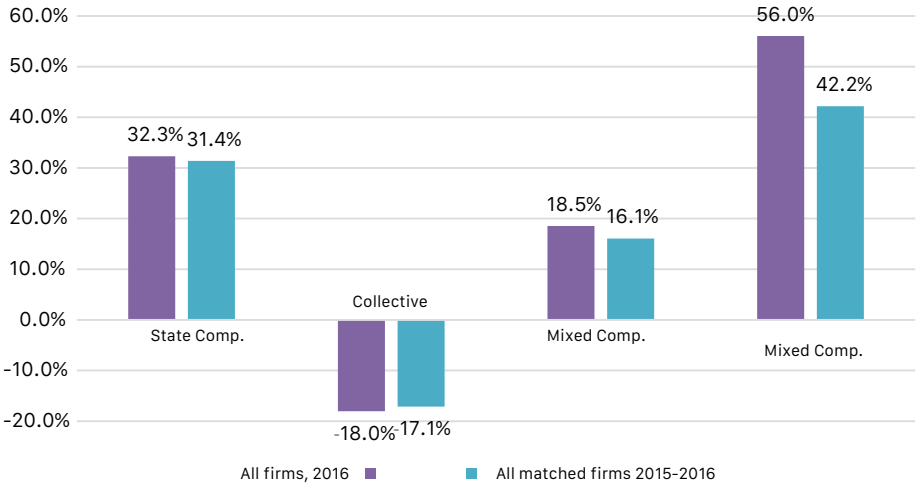
Figure 1.10: Labour productivity of firms in sectors relative to ones in low-tech manufacturing



Source: Authors' calculation using Enterprises Census data

Foreign firms are the most productive

Figure 1.11; Ownership and productivity (reference: private firms)

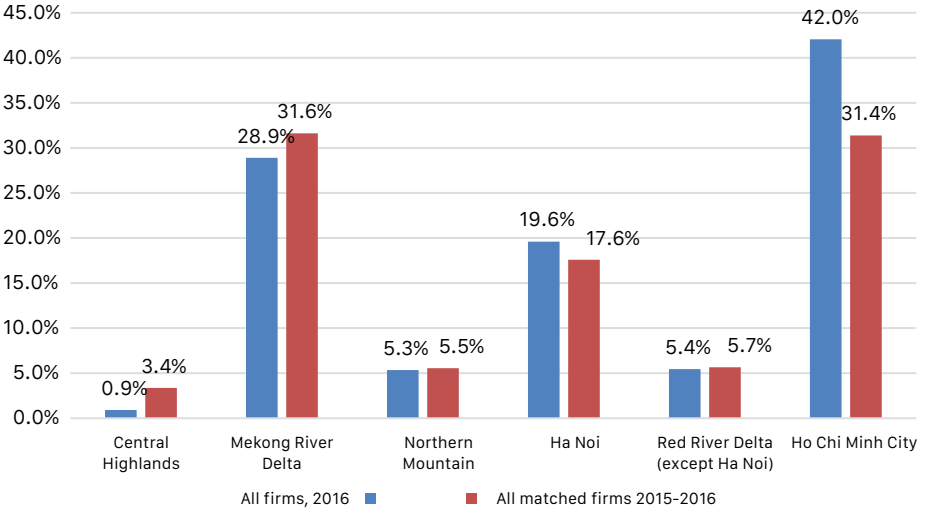


Source: Authors' calculation using Enterprises Census data

With other factors being equal, foreign firms are the most productive with labour productivity exceeding private firms' by 56 percent (if all firms in Enterprise Census are taken into account) or 42 percent (if only firms in the 2012-2017 panel are taken into account), outperforming SOEs by 32 and 31 percent, respectively and mixed-ownership companies by 19 and 16 percent, respectively. Cooperatives are the least productive, with labour productivity below private firms' by 18 and 17 percent (Figure 1.11).

Location matters

Figure 1.12: Labour productivity of firms in different regions (reference: northern central and central coast)



Source: Authors' calculation using Enterprises Census data

Firms in Ho Chi Minh City are the most productive with other factors being equal, followed by companies in the South East, Mekong River Delta and Ha Noi. Firms in other regions are considerably less productive than ones in Ho Chi Minh City (Figure 1.12).

Agglomeration effect is evident

A 1 percent increase in the spatial concentration of firms from the same sector raises their labour productivity by 0.54 percent.

2. Productivity and Competitiveness at Sector and Sub-sector Levels

2.1. Measurements to assess productivity and competitiveness of manufacturing sector and its sub-sectors

The measurements used in this report to assess the manufacturing sector's productivity and competitiveness include: (i) Manufacturing Value Added (MVA)-to-GDP ratio, in which MVA is the total value added of manufacturing sector and the increase (decrease) in MVA-to-GDP ratio is commonly seen as a sign of industrialization (de-industrialization), (ii) Viet Nam's (and comparator countries') MVA share of the global MVA, (iii) per capita MVA, (iv) Competitive Industrial Performance (CIP) index ranking[6], (v) labour productivity (LP), (vi) value added-to-output ratio and (vii) Revealed Comparative Advantage (RCA)[7].

Measurements used to (i) describe key characteristics of the manufacturing VSIC 2-digit sub-sectors include revenue, employment, value added (VA), net exports, FDI backward and forward linkages and (ii) to assess productivity and competitiveness of sub-sectors LP, RCA, domestic contents of exports, VA-to-output ratios and wage growth are applied.

Data for international comparisons of MVA-to-GDP ratios, MVA share of global MVA, per capita MVA and LP are drawn from WDI and UNIDO database (2017) and for RCA and net exports data from UN Comtrade database is utilized. Viet Nam's data from the Enterprise Census for 2012 and 2017 are used to analyze productivity and competitiveness performance at sub-sector level, especially for revenue, employment, VA, FDI backward and forward linkages, VA-to-output ratios, LP and wage growth.

Important points on Enterprise Census data and methods used to estimate value added are:

- The Enterprise Census only covers formal enterprises in Viet Nam. The household business sector, comprising unregistered household enterprises, is large in terms of number and estimated at nine million. It contributes an estimated 23 percent of GDP (Doumer et al. 2017). However, the collection of data on household businesses was not conducted by GSO systematically, but instead in an ad hoc manner by research institutions (Cling et. al. 2009, Doumer et. al 2017). Therefore, the household business sector was not included in this study and analyses results in this report are only representative for the formal enterprise sector.
- VA can be calculated from either production method or income method. This report used VA data derived from both methods, namely: UNIDO's VA data estimated by using the production method for international comparisons and VA estimated by using Enterprise Census data and income method for comparison between subsectors within Viet Nam.
- UNIDO's recommended VA calculation method and data: the VA of the manufacturing industry refers

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6 As a performance indicator, CIP reflects a country's productivity, structural change and competitiveness. These concepts are taken as a departure point for the selection of indicators under the three major dimensions of the CIP (Dimension 1 "Capacity to produce and export" measured by indicators: 1. manufacturing value added per capita, 2. manufacturing export per capita; Dimension 2 "Technological upgrading and deepening" measured indicators: 3. share of manufacturing high-technology (MHT) activities in total MVA, 4. share of MVA in GDP, 5. share of MHT manufactures exports, and 6. share of manufactures export in total exports; Dimension 3 "Impact on world production and trade" measured indicators, 7.sShare of the country in world MVA and 8. share of the country in world manufactures exports). The first dimension includes MVA per capita, which is the ratio of output to the country's population. This indicator represents the level of overall productivity and quantifies the country's capacity to produce. Another indicator of the same dimension shows the extent of the realization of domestic manufacturing products in external markets. The second dimension of the CIP consists of indicators relating to the intensity of industrialization and quality of manufacturers' exports. As industrialization progresses, two forms of major structural change may occur. First, the manufacturing sector's position in the overall economy may strengthen (increased share of MVA in GDP) and second, a gradual shift from low-technology and resource-based to high-technology products may occur. Increasing levels of industrialization trigger the export of high-technology and high quality products. The third dimension comprises indicators on the country's share in the world market and thus introduces exogenous factors into the analytical framework of the CIP. Source: https://unstats.un.org/unsd/ccsa/isi/2013/Paper-UNIDO.pdf

7 RCA is calculated as the proportion of a country's share of export of a certain class of goods or services (from, for example, a certain sub-sector or sector) in the country's export divided by the proportion of world exports that are of that class. When a country's RCA value higher than unity on a certain class of goods or services, the comparative advantage of the country in this class is "revealed" and when the RCA is less than unity, comparative disadvantage is "revealed".

to the given industry's net output derived from the difference in gross output and intermediate consumption calculated without deducing consumption of fixed assets. Viet Nam's VA data in UNIDO's database is at producer prices, meaning VA at producers' prices = Gross Output at producers' price minus Intermediate Consumption at purchasers' price, where: the producer price is the amount receivable by the producer, inclusive of taxes on products except deductible value added tax and exclusive of subsidies on products and the purchaser price is the amount payable by the purchaser (purchaser price = producer price + trade and transport margins + non-deductible Value Added Tax). As survey data on industry VA may disregard the contribution of small and household-based manufacturing units, and weak quality of the primary data for estimating gross output and intermediate consumption, producer's and purchaser's prices, industry VA is best used to measure the growth and structure, but not the level[8].

- VA estimation using the Enterprise Census data: data for calculating intermediate consumption of enterprises is only collected in the Enterprise Census (EC) every five years and 2012 was the latest year when EC collected such data. For years when data is not collected, the intermediate consumption of enterprises is estimated based on data collected in the latest year. Given the fast changes in enterprises' production and prices of intermediate goods, such estimates may contain a degree of inaccuracy. As such, this study employs the income method to estimate VA of manufacturing sub-sectors based on the Enterprise Census data. Namely, also based on the same principle of VA is what producers get from output less the cost of intermediate goods used for producing the output, the income method estimates VA as a sum of: (i) after-tax profit + taxes + payments of wages and employer's compulsory social and health insurance contributions + depreciations (of fixed capital). As is the case when VA is calculated by the standard method recommended by UNIDO, the quality of primary data relating to taxes, after tax profit, wages and compulsory insurance contributions paid by employers, and especially depreciation of fixed assets also resulted in inaccuracy in VA estimation, and for these reasons, VA estimated by this method is also used to measure the growth and structure or in ratios rather than absolute level. In this study, when observed any contradiction or missing information, the VA calculated by income method was replaced by the estimation by production method, in which the intermediate expenditure was estimated from the latest (2012) I-O table provided by GSO.
- The report (in its analysis of growth and structure of VA and other indicators using VA) used VA calculated by both methods, while VA data from the UNIDO database (calculated by the standard method) are utilized more for international comparisons and VA estimates by income method using EC data – more for comparisons between subsectors in Viet Nam. Consistent results of VA calculated by both methods are presented in this report with differences highlighted.

2.2. Productivity and Competitiveness of Manufacturing

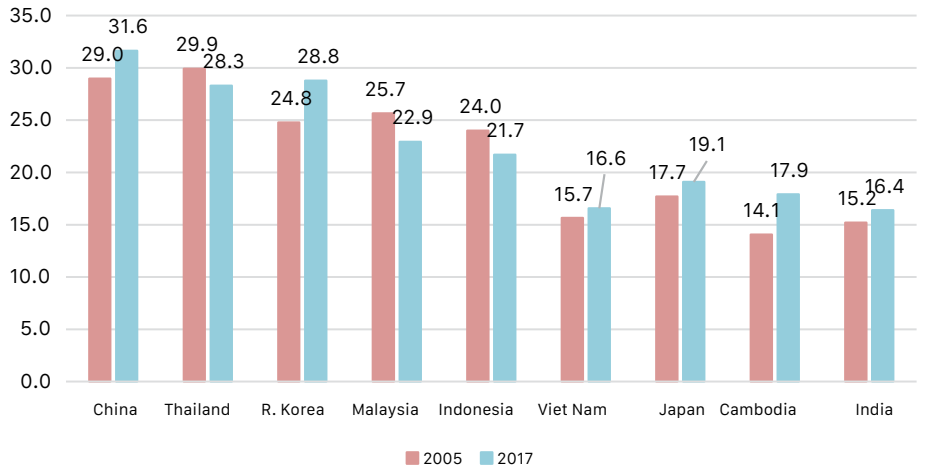
2.2.1. Performance at Sector Level

Performance measured by manufacturing value added (MVA)

Viet Nam's MVA-to-GDP ratio rose by 0.9 percent during 2005-2017. Compared to selected countries (Figure 2.1), such a rise in absolute terms was lower than those of Cambodia, China, Japan, India and RoK, while exceeding other comparator countries (Indonesia, Malaysia and Thailand) which saw these ratios shrink. The decline in manufacturing's contribution to GDP (indicating de-industrialization) in these countries was mainly due to domestic production having shifted to the service sector with higher VA and as manufacturing costs in industrialized countries rise, companies move manufacturing plants to developing nations to sustain international competitiveness.

8 *Further information on VA can be found in "What is manufacturing value added?" at http://stat.unido.org/content/focus/what-is-manufacturing-value-added%3F;jsessionid=82D5D3FAAC4ECE658DBFE31D5B1A4686*

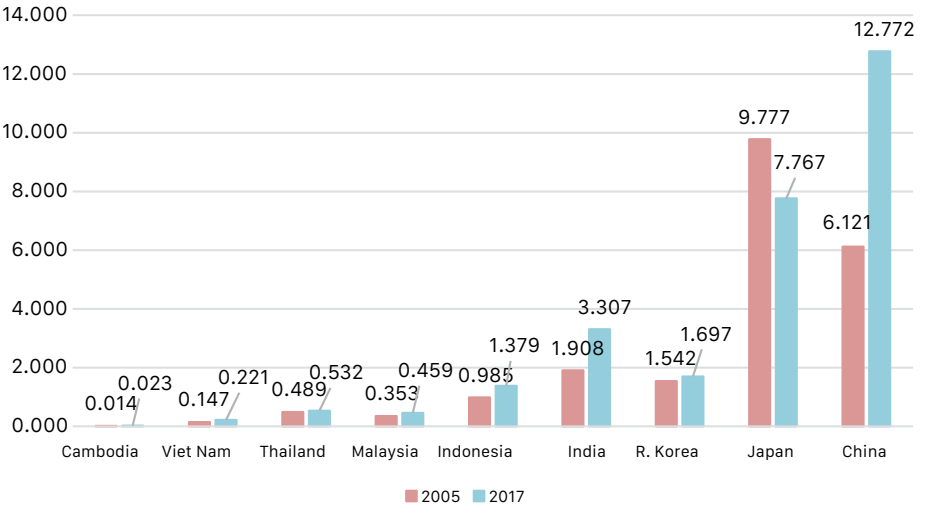
Figure 2.1: MVA as a percentage of GDP



Source: Calculated from UNIDO MVA data (2018)

Despite climbing, Viet Nam's share in global MVA is still small compared to others in the region. Specifically, in 2005, Viet Nam's MVA accounted for only 0.15 percent of total global MVA and increased to 0.22 percent in 2017. During the same period, China's more than doubled from 6.12 to 12.77 percent and as a result, it became a major global manufacturing powerhouse. Japan's share of global MVA decreased from 9.78 to 7.77 percent, but the latter figure is still significant. Malaysia and Thailand's shares only slightly changed in this period (Figure 2.2a).

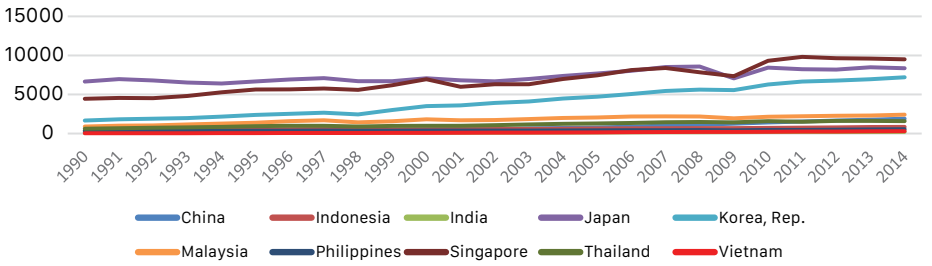
Figure 2.2a: Global MVA share of selected countries (%)



Source: Calculated from UNIDO data (2017)

Similarly, Figure 2.2b shows that Viet Nam's VA per capita, despite increasing, is lower than all comparator countries except India.

Figure 2.2b: Manufacturing VA per capita (USD)

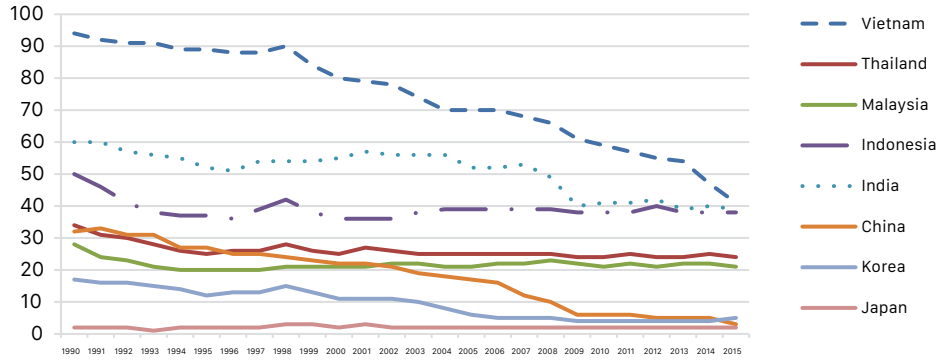


Source:https://tcdata360.worldbank.org/indicators/mva.per.cap?country=BRA&indicator=3798&viz=line_chart&years=1990,2014

Performance measured by Competitive Industrial Performance (CIP) index

In the early 1990s, Viet Nam had the worst performing in CIP ranking by some distance to comparator countries. Thanks to significant improvements in export value, MVA, VA of high-tech and medium-tech manufacturing over the last three decades, Viet Nam significantly improved its CIP ranking and catch the middle-income group (India, Indonesia) and gradually narrowed the gap with industrialized countries (Figure 2.3). However, this CIP improvement is mainly attributed to the FDI sector, with limited contributions from the domestic sector.

Figure 2.3: CIP rankings



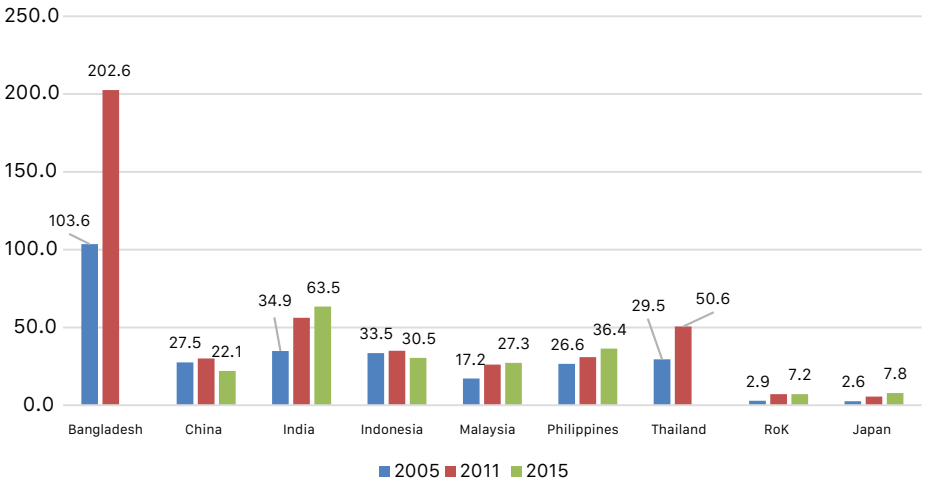
Source: UNIDO (2017)

Kết quả đo bằng Năng suất lao động (LP)

Performance measured by Labour Productivity (LP)

Labour productivity of Viet Nam's manufacturing industry is low compared to others in Asia, standing at 63.5 percent of India's LP, 29.26 percent of Indonesia's, 27.3 percent of Malaysia's, 36.4 percent of the Philippines', 7.2 percent of RoK's and 7.8 percent of Japan's in 2015. It is noted, however, that Viet Nam's manufacturing industry closed such LP gaps with India (by 28.6 percentage point), Malaysia (10.1 percent point), the Philippines (9.8 percent point), RoK (4.3 percent point) and Japan (5.2. percent point) between 2005-2015 and with Thailand (21.1 percent point) between 2005-2011. Between 2005-2015, Viet Nam's manufacturing LP gap between China and Indonesia widened by 5.4 and 3 percent, point respectively (Figure 2.4). Despite improvements, Viet Nam still faces an uphill task to close these wide LP gaps.

Figure 2.4: Viet Nam's manufacturing LP as a share of other countries' manufacturing LP

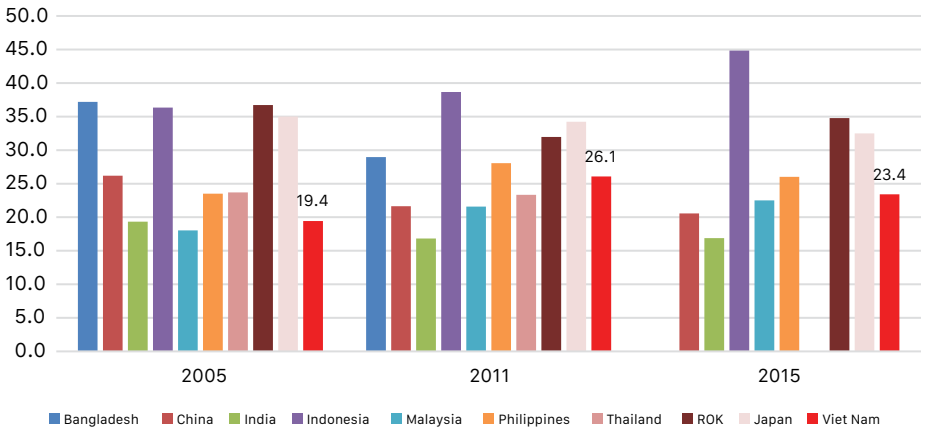


Source: Authors' calculation from UNIDO data

Performance measured by value added-to-output ratio

Another indicator to assess the competitiveness of firms (in sub-sectors/sector) is the VA-to-routput ratio, which measures what firms get out of their output after deducting the cost of intermediate consumption (costs of intermediate goods used for production). Viet Nam's manufacturing sector performance measured by this indicator resembles its manufacturing performance measured by other (presented above) indicators. Figure 2.5, using the UNIDO database, shows that Viet Nam's manufacturing VA-to-output ratio improved and is slightly higher than that of China, India and Malaysia, while lower than Japan, the Philippines and RoK. Enterprise Census data from 2017 reveals Viet Nam's average manufacturing VA-to-revenue[9] increased from 20.53 percent in 2011 to 26.22 percent in 2016.

Figure 2.5: Manufacturing VA-to-output ratio



Source: UNIDO database, authors' calculation

9 *As the UNIDO database provides data on output, not revenue, the "VA-to-output" ratios are calculated, not "VA-to-revenue" as analyzed using the Enterprise Census which provides data on firms' revenue. Strictly speaking, output is different from revenue as the former only takes monetary values of outputs into account, while revenue also includes other incomes (such as royalties and donations) of firms.*

2.1: Decomposing Total Factor Productivity: A stochastic frontier approach in measuring performance of Viet Nam's manufacturing sector

Following recent developments in the measurement of productivity growth, a stochastic frontier production function is applied to decompose TFP growth in Vietnamese manufacturing into technical progress and changes in technical efficiency. Along with technical progress, changes in technical efficiency (gap between frontier technology and a firm's actual production) can also contribute to productivity growth. Stochastic frontier models assume that firms do not fully utilize existing technology because of various non-price and organization factors that lead to inevitable technical inefficiencies in production. Under these circumstances, TFP growth may arise from improvements in technical efficiency (TE), without technical progress (TP).

From a policy perspective, researchers acknowledge that the decomposition of TFP into efficiency and technical changes provide useful information in productivity analysis. Policy recommendations that are based on the better understanding on the sources of variation in productivity growth can lead to more effective policies in enhancing the productivity of firms or sectors. For example, if low productivity results from slow TP, then a policy to induce technological innovation should be recommended to shift up the production frontier. If high rates of TP coexist with deteriorating TE, resulting in slow productivity growth, then a policy to increase the efficiency (with a known and applied technology) is required and might include aiming at improvements in learning-by-doing processes and managerial practices.

The growth rate of TFP can be decomposed into four components, i.e. the change of productivity due to TP, technical efficiency (TEC), scale effect (SEC) and factor reallocation effect (FAEC). That is,

$$TFP = TP_{it} + TEC_{it} + SEC_{it} + FAEC_{it}$$

SEC captures the productivity improvement resulting from the evolution of scale economy of industrial sectors. FAEC is referred to as factor allocative efficiency change. Under the two inputs of capital and labour, FAEC consists of two kinds of efficiency due to labour reallocation and capital reallocation. FAEC depend on the relative growth magnitude of two inputs. If the sum of labour allocation efficiency and capital reallocation efficiency is substantial, factor shifts have an impact on productivity. In turn, we can expect that the FAEC term reflects the industrial restricting efforts at the reallocation of factors in order to increase industrial productivity and growth.

Table 2.1: Decomposition of TFP

Growth components	Time period	Growth in total manufacturing sample (%)	Growth in high-tech manufacturing sectors (%)	Growth in medium-tech manufacturing sectors (%)	Growth in low-tech manufacturing sectors (%)
TP	2001-2015	6.82	6.86	6.39	6.05
TEC	2001-2015	-0.28	-0.35	-0.44	-1.15
SEC	2001-2015	5.17	6.78	3.92	7.38
FAEC	2001-2015	18.04	-27.10	8.02	53.77
TFP	2001-2015	29.74	-13.82	17.89	66.05

Table 2.1 presents the average of the rates of technical progress (TP, technical efficiency change (TEC), scale efficiency change (SEC), factor allocative efficiency change (FAEC) and the total factor productivity growth for the manufacturing industry, high-technology manufacturing, medium-technology manufacturing and low-technology manufacturing sectors samples during 2001-2015.

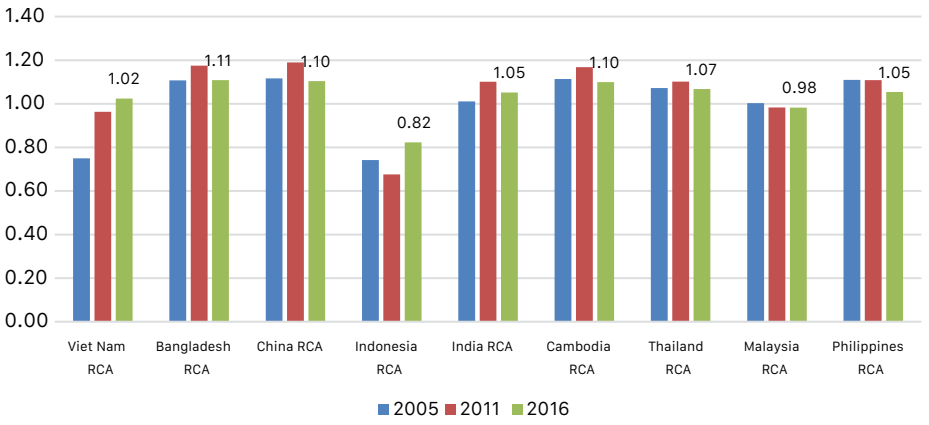
At the total manufacturing industry sample level, the contribution of FAEC (allocative effect) to TFP growth is significant and dominates for the whole sample period. TC ranked second and was slightly higher than SEC at the same time. TE exerted a negative effect on TFP growth.

In terms of the high-tech manufacturing sector sample, estimated FAEC has a negative value and given its magnitude negative FAEC resulted in reduced TFP. This implies the existence of an inefficient allocation of inputs (when factor prices are not equal to their marginal product) in production of firms in high-tech manufacturing sector. In contrast, FAEC was estimated to be positive and much larger for the medium- and low-tech manufacturing sectors. This discrepancy in FAEC amongst sub-sectors indicates that the degree of market distortion varied across these sectors. The resulting inefficiency costs were generally greater in high-tech than low-tech manufacturing sectors.

In all three groups, scale efficiency is a factor contributing slightly more to TFP growth than technical progress. On the other hand, technical efficiency in all three groups deteriorates. Obviously, TFP growth highly depends strongly on the reallocation in factors.

Performance measured by Revealed Comparative Advantage (RCA)

Figure 2.6: Manufacturing RCA of Viet Nam and comparator countries



Source: Authors' calculation based on UN Comtrade database

Figure 2.6 shows that Viet Nam's manufacturing RCA steadily increased from 0.75 in 2005 to 0.963 in 2011, and for the first time Viet Nam's manufacturing RCA had a value (1.024) higher than unity in 2016. That is, in 2016, Viet Nam's manufacturing comparative advantage was "revealed" in relation to countries, such as Indonesia and Malaysia, with lower-than-unity RCAs (that "revealed" their comparative disadvantages in manufacturing). A more detailed analysis of manufacturing RCA improvements at sub-sector level is provided later in this report.

Box 2.2: RCA as a measurement of international competitiveness

It is noted that RCA as a measurement has some limitations (for example, RCA index does not take into account the size/volume of countries' exports) and comparisons between RCA values higher than unity of countries may mislead. For example, China's RCA value almost at the same level of Bangladesh and Cambodia's and just a little higher than Viet Nam's may seem to counter the commonly accepted fact that China is the world manufacturing hub. Indeed, China's share in total world manufacturing export is 14.16 percent, much higher than Bangladesh's 0.24 percent, Cambodia's 0.07 percent and Viet Nam's 1.1 percent in 2016 (sources: Authors' calculation using UN Comtrade database) and these numbers indicate that Viet Nam's manufacturing export share in world manufacturing exports is higher than those of Bangladesh and Cambodia (though Viet Nam's manufacturing RCA is lower). The RCA index calculation method, described above, is defined by its own manufacturing export share in its total exports (while the share of world manufacturing exports in total world exports is the same for all countries), and thus if a country has a high manufacturing export share in its total exports, the RCA is high. China's manufacturing export share in its total exports is very high (98.65 percent), but Viet Nam's, Cambodia's and Bangladesh's manufacturing export shares in their total exports are also very high (91.5, 98.25 and 99.02 percent respectively), (sources: Authors' calculation using UN Comtrade database). The manufacturing RCA values of these countries are rather close. A country's lower (but higher than unity) manufacturing RCA value may indicate the country has more significant shares of exports in agriculture and services sectors in its total exports than other countries (as is the case when comparing Viet Nam to Bangladesh and Cambodia).

IR4.0 readiness of manufacturing[10]

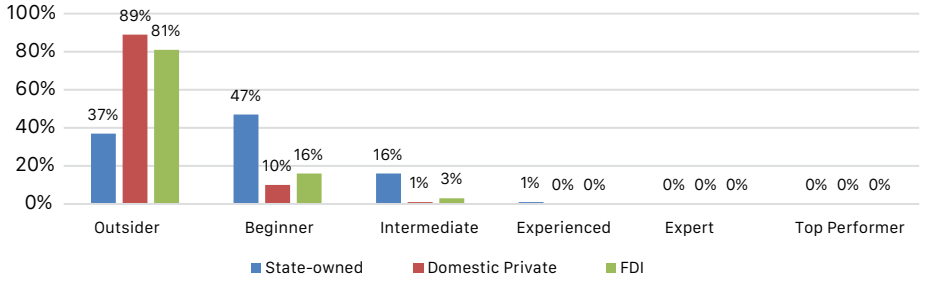
As noted in the first section of this report, several studies have suggested disruptive technologies and innovation will affect manufacturing in major ways. In this context, manufacturing firms must be ready to capture the opportunities and rise to the challenges associated with IR4.0.

A study on the IR4.0 readiness of manufacturing firms jointly conducted by MOIT, VASS and UNDP in late 2017 and early 2018 found the overwhelming majority of Viet Nam's industrial enterprises, more than 85 percent, were not engaged in IR4.0 (termed by VDMA as "outsiders" to IR4.0), 13 percent of enterprises in the survey were at "beginner" level, only 2 percent were at "intermediate" level and negligible numbers were at "experienced" and "expert" levels and zero at "" "top performer" level.

With regards factors associated with IR4.0 readiness, a firm's size was the strongest predictor of its participation in IR4.0, other factors being equal. In terms of ownership, SOEs have the highest level of participation in IR4.0, followed by foreign-invested enterprises. Domestic private firms have the lowest participation rates. However, differences between these types of ownership may be derived from other firms' characteristics, crucial for IR4.0 readiness, i.e. level of capital intensity, employment size, technology level, industry concentration and level of technology used (Figures 2.7 and 2.8).

10 This section draws on key findings of a study on the IR4.0 readiness of manufacturing firms jointly conducted by MOIT, VASS and UNDP in late 2017 and early 2018. Under this study: (i) a survey of 2,659 industrial firms, of which the overwhelming majority were from manufacturing (sampled firms in water and electricity, oil and gas sub-sectors were also included in the survey), (ii) methodology developed by the German Mechanical Engineering Industry Association (Verband Deutscher Maschinen- und Anlagenbau – VDMA) was used for assessing firms' IR4.0 readiness. Firms/sub-sectors are classified at "outsider" level if the score (based on scores in six dimensions: Strategy and Organization, Smart Factory, Smart Operations, Smart Product, Data-Driven Services and Employee Skills) is 0, from 0-1, beginner; 1-2, intermediate; 2-3, experienced; 3-4, expert; and top performer: 4-5.

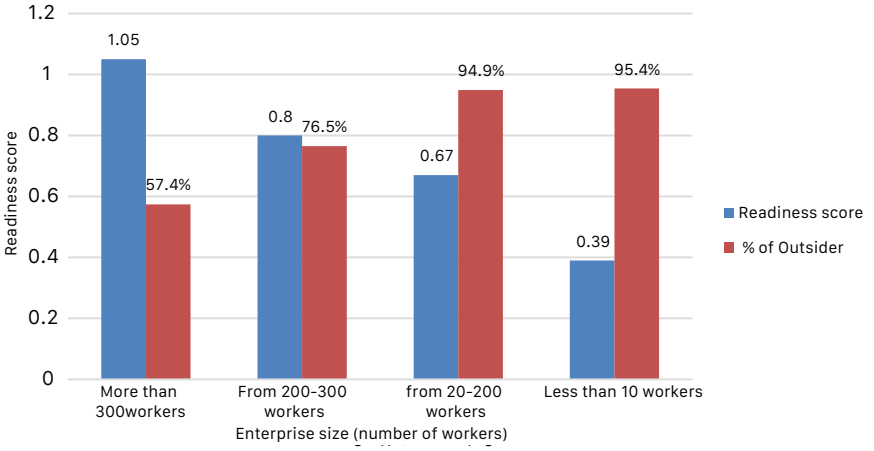
Figure 2.7: Proportions of SOEs, domestic private and FDI firms at different IR4.0 readiness levels



Source: MOIT-VASS-UNDP (2018)

Figure 2.8 shows the larger firms (with other characteristics equal) correspond with higher scores (higher IR4.0 readiness level).

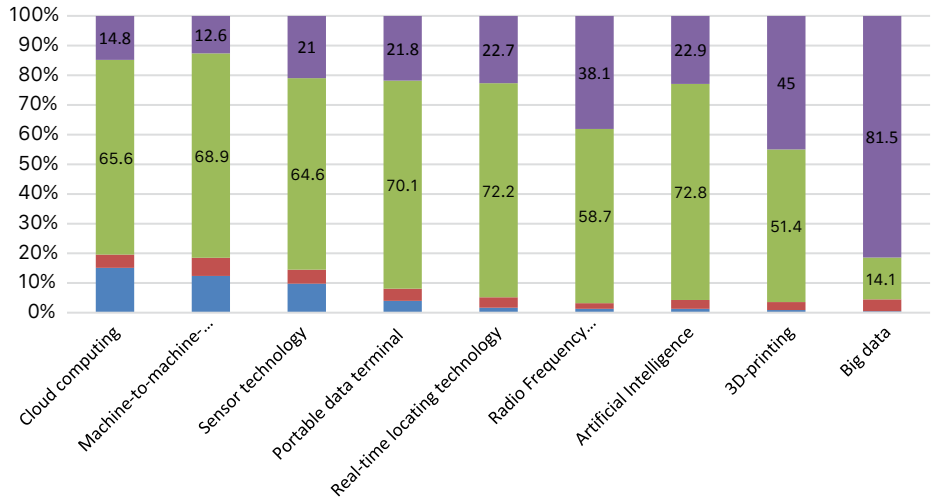
Figure 2.8: Readiness scores by size of firms



Source: MOIT-VASS-UNDP (2018)

Furthermore, the study found the overwhelming majority of manufacturing firms were unfamiliar with IR4.0's disruptive technologies. Figure 2.9 shows a small percentage of enterprises had applied typical IR4.0 technology. Only cloud computing and device-to-device/products were used by more than 15 and 12 percent, respectively of surveyed firms, with the usage rate of other technologies below 10 percent. Less than 1 percent of manufacturing firms used 3D printing and big data in their businesses.

Figure 2.9: Level of enterprises applying IR4.0 technologies



Source: MOIT-VASS-UNDP (2018)

While many IR4.0 disruptive technologies will remain out of reach for many firms globally in the foreseeable future, cloud computing has become increasingly popular in the business sector, particularly among SMEs. The is due to this on-demand service's reliance on third parties' digital resources to substantially cut firms' operating costs. This is crucial for firms to stay competitive in an increasingly digitized world. However, with mean and median values of 14 and 13 percent, the adoption rate of cloud computing by Viet Nam's manufacturing firms appears modest.

Size and ownership also make a difference. Table 2.2 shows the utilization rate and scale increases in tandem (except for groups of 10-200 and 200-300 employees). In terms of ownership, this proportion differed little between foreign-invested enterprises and private domestic firms.

Table 2.2: Firms' usage of cloud computing by size and ownership (%)

	In use	To be used	No plan	Not relevant	All
By size (%)					
Less than 10 workers	10.8	2.4	73.8	13.0	100
10-200 workers	17.0	4.3	64.6	14.0	100
200-300 workers	16.1	4.4	58.3	21.2	100
> 300 workers	22.3	17.5	32.9	27.2	100
By ownership (%)					
SOEs	28.7	22.4	23.3	25.6	100
Private firms	14.5	4.2	68.3	12.9	100

Source: MOIT-VASS-UNDP (2018)

2.2.2 Performance at Sub-sector Level

Important characteristics of manufacturing sub-sectors[11]

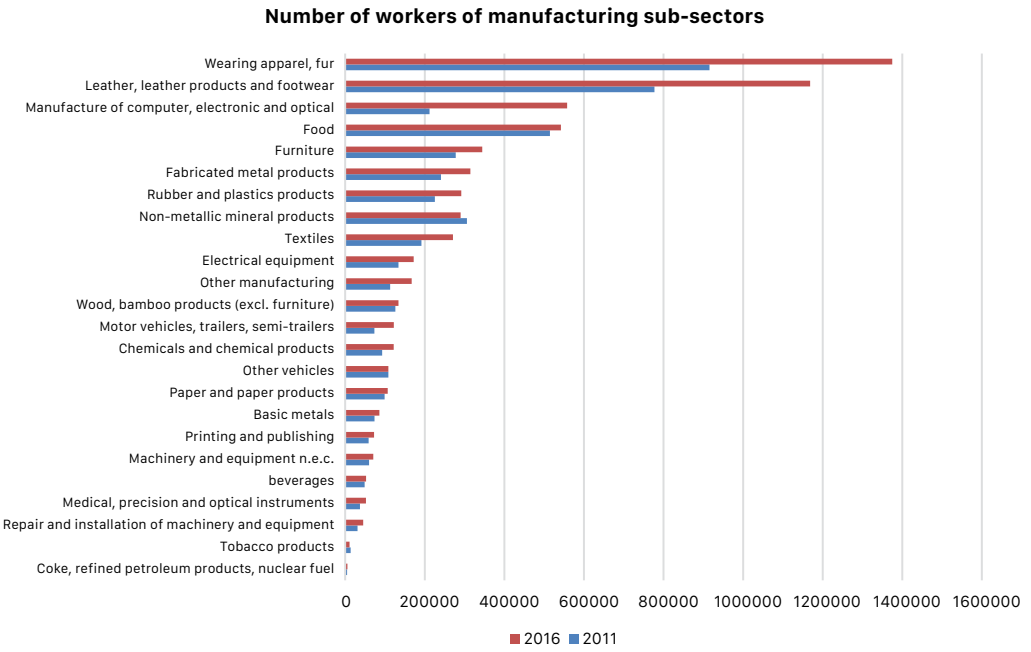
Before assessing productivity and competitiveness performance at sub-sector level, the following section highlights important characteristics of manufacturing sub-sectors, such as: (i) size of employment and share in manufacturing employment, (ii) revenue, VA volumes, share of manufacturing VA and revenue, (iii) FDI, SOE, domestic private and large firms' and SMEs' shares of sub-sector revenues, VA and employment and (iv) imports and exports as well as sub-sectors' IR4.0 readiness. These characteristics help explain the analysis of productivity and competitiveness performance at sub-sector level and deliver recommendations synergized with sub-sector characteristics.

Employment

Figure 2.10 paints a picture of employment size of manufacturing sub-sectors. Apparel is the largest employer with almost 1.4 million workers in 2016, up from 0.9 million in 2011. Leather is second, with almost 1.2 million workers in 2016, up from 0.8 million in 2011. These million-worker sub-sectors are followed by electronics, computers and optical products as well as food processing, each employing more than 500,000 workers. In contrast, some sub-sectors only employ more than 5,000 workers (coke-refined petroleum products-nuclear fuel) or approximately 11,000 workers (tobacco).

11 While Enterprise Census data allows for an accurate analysis of trends and relative ratios, the absolute values - such as ones used in this section - must be treated with caution.

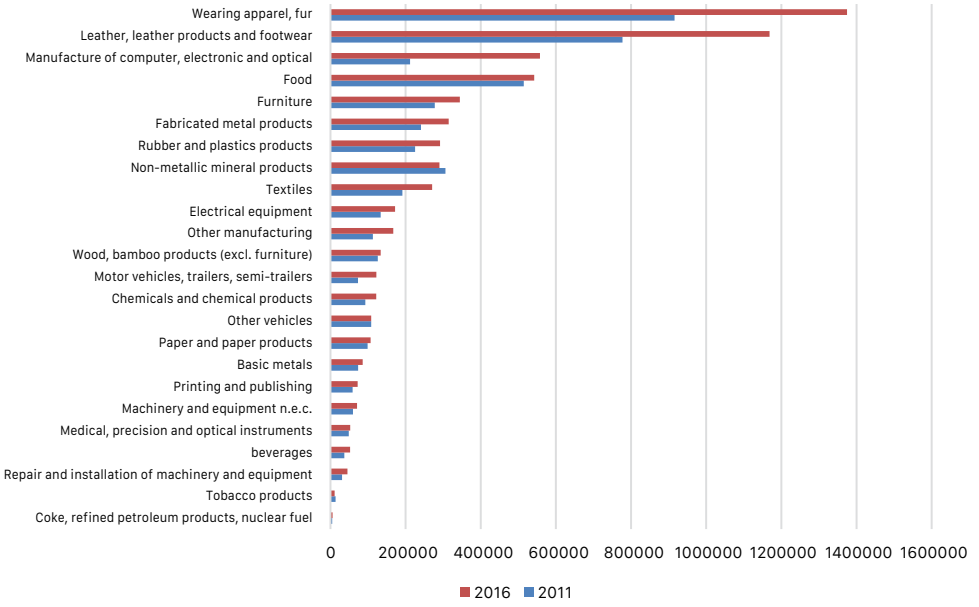
Figure 2.10: Employment size of manufacturing sub-sectors



Source: Authors' calculation based on 2017 Enterprise Census data

While almost all sub-sectors (except non-metallic mineral products and tobacco) experienced increases in workers between 2011-2016, the rises varied. They were highest in the three sub-sectors with the most workers (apparel, leather and especially electronics, computer and optical products) resulting in higher shares in total manufacturing employment in 2016 compared to 2011. Slightly higher shares were also observed in motor vehicles-trailers-semitrailers, textiles, medical-optical-precision equipment, while the remaining sub-sectors experienced declining shares (Figure 2.11).

Figure 2.11: Sub-sector shares in manufacturing employment (%)



Source: Authors' calculation based on 2017 Enterprise Census data

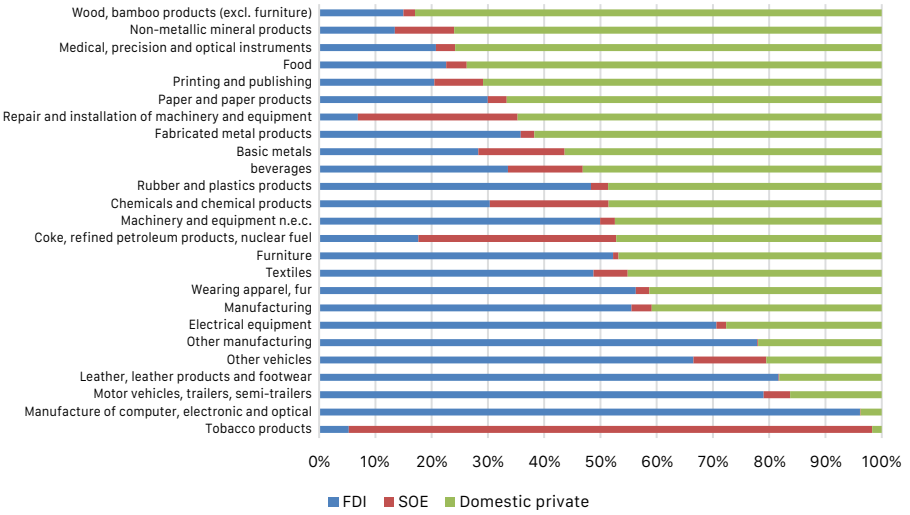
Figure 2.12 shows FDI employed the highest number of workers in manufacturing (55.52 percent), followed by domestic private firms (47.88 percent). SOEs employed the least number of workers (3.6 percent).

In a few sub-sectors, where SOEs play somewhat significant roles, their share in sub-sector employment was modest (except the dominate share of 94.02 percent in tobacco), 36.17 percent in coke-petroleum products-nuclear fuel, 28.40 percent in repair and installation of machinery and equipment, 21.1 percent in chemicals, 15.34 percent in basic metals, 13.3 percent in beverages, 12.95 percent in other vehicles and 10.56 percent in non-metallic mineral products. Notably all these sub-sectors employ less than 150,000 workers, while only non-metallic mineral products accounts for 300,000 workers in 2016 (Figure -2.10).

In contrast, FDI dominates in terms of number of workers in around half of large-employing manufacturing sub-sectors. Its shares in sub-sector employment are: 96.13 percent in computer-electronics and optical equipment (third-largest employing sub-sector), 81.66 percent in leather (second-largest employing sub-sector), 56.3 percent in apparel (largest employing sub-sector), 79.02 percent in motors-trailers-semitrailers, 66.53 percent in other vehicles, 77.88 percent in other manufacturing, 77.62 percent in electric equipment, 48.6 percent in textiles, 52.24 percent in furniture, 49.94 percent in machinery and equipment n.e.c., 38.31 percent in rubber-plastics – all with "medium" numbers of workers.

Domestic private firms generally dominate in terms of sub-sectors with small and medium numbers of workers: 82.97 percent in wood and bamboo products (excluding furniture), 75.99 percent in non-metallic mineral products, 75.84 percent medical-precision and optical equipment, 73.76 percent in food (fourth-largest employing sub-sector), 70.85 percent in printing, 66.65 percent in paper, 64.72 percent in repair and installation of machines and equipment, 61.76 percent in fabricated metal products (sixth-largest employing sub-sector), 56.36 percent in basic metals, 53.15 percent in beverages and 48.64 percent in rubber-plastics.

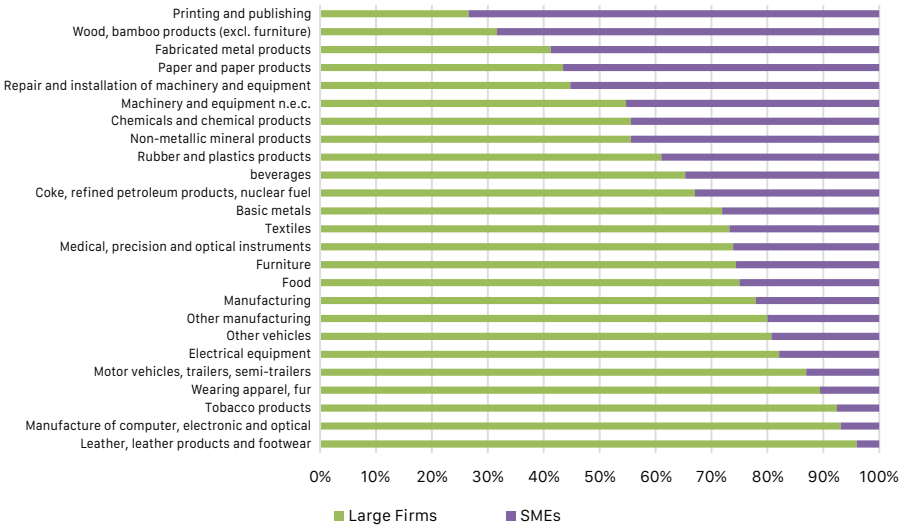
Figure 2.12: Sub-sector employment structure by ownership (2016)



Source: Authors' calculation based on 2017 Enterprise Census data

Figure 2.13 shows big firms dominate in terms of workers in large and medium-employing sub-sectors where FDI is prominent, while small firms are visible in small and medium-employing sub-sectors where domestic private firms are influential. The few exceptions include tobacco, coke-refined petroleum products-nuclear fuel, basic metals and repair and installation of machinery and equipment, in which large (SOE) firms have bigger shares in employment.

Figure 2.13: Large and small firm shares in sub-sector employment (%), 2016 (Source: Authors' calculation based on 2017 Enterprise Census data)



Source: Authors' calculation based on 2017 Census data Enterprise

Box 2.3: Firms' size and ownership

Enterprise Census data points to the large size of FDI firms, as evidenced by the negative correlation between FDI and SME labour shares across manufacturing sub-sectors: the coefficient of correlation estimated at minus 0.55. In sub-sectors with higher participations of domestic private firms (lower participation of FDI), domestic firms are often small- and medium-sized, while SOEs tend to be large. However, "small- and medium-sized enterprises" in this report are based on the definition within Viet Nam's Enterprise Law, which specifies that SMEs are registered firms "with no more than 200 workers and revenue of VND300 billion and lower", while the EU defines SMEs as: "The category of micro, small- and medium-sized enterprises is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million euros, and/or an annual balance sheet total not exceeding 43 million euros."

Revenue

In terms of revenue, all sub-sectors (except coke-refined petroleum products-nuclear fuel) enjoyed increases during 2011-2016, with the robust electronics sub-sector having pushed food to second in 2016 (Figure 2.14).

The biggest revenue jump in electronics and relatively large rises in leather-footwear, wearing apparel, motor vehicles-trailers-semitrailers resulted in increased shares in total manufacturing revenue, while other sub-sectors declined except optical and precision equipment (Figure 2.15).

Figure 2.14: Revenue of manufacturing sub-sectors (VND billion, 2016 prices)t

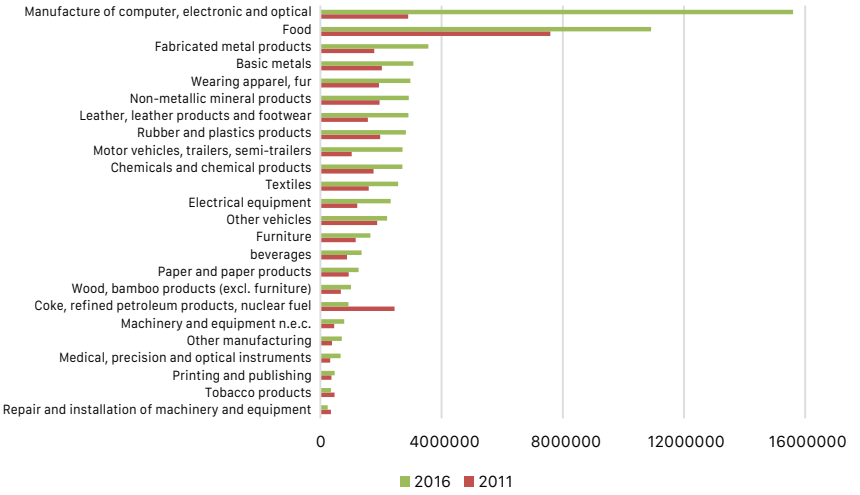
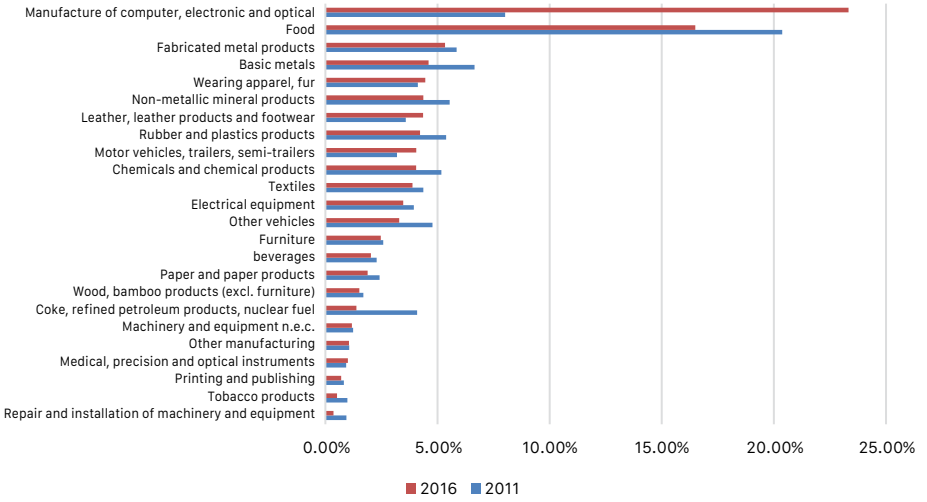


Figure 2.15:: Sub-sector revenue shares in manufacturing revenue (%)



Source: Authors' calculation based on 2017 Enterprise Census data

Similar to the employment structure, FDI had the largest share (54.66 percent) in total manufacturing revenue, followed by domestic private firms (34.79 percent) and SOEs (10.55 percent) in 2016. Naturally, shares of FDI revenue were robust in sub-sectors with high employment shares, but FDI had: (i) relatively high revenue shares in some sub-sectors with medium employment shares (chemicals, medical and precision equipment and fabricated metal) and (ii) medium revenue shares where its employment share was low (non-metallic mineral products and tobacco). SOEs, similar to their employment share, only have higher revenue shares in tobacco and coke-refined petroleum-nuclear fuel and medium revenue shares in beverages and repair-installation of equipment. Domestic firms' revenue shares were: (i) high in wood and bamboo (excluding furniture), paper, medical and precision equipment, rubber-plastics, non-metallic mineral products, basic metal, fabricated metal products, furniture and repair-installation of machinery and (ii) at a medium level in beverages, textiles, wearing apparel, chemicals, electrical equipment, machinery and equipment n.e.c and motor vehicles (Figure 2.16 - upper panel).

Figure 2.16 (lower panel) shows that large enterprises dominated almost all sub-sectors in terms of revenue. Large firms' share of total manufacturing revenue was 86.11 percent and only three sub-sectors (printing, wood (excluding furniture) and repair-installation of machinery) had SME revenue shares of around 60 percent.

Figure 2.16: (upper panel): Domestic private firms, SOEs and FDI shares in sub-sector revenue (%), 2016

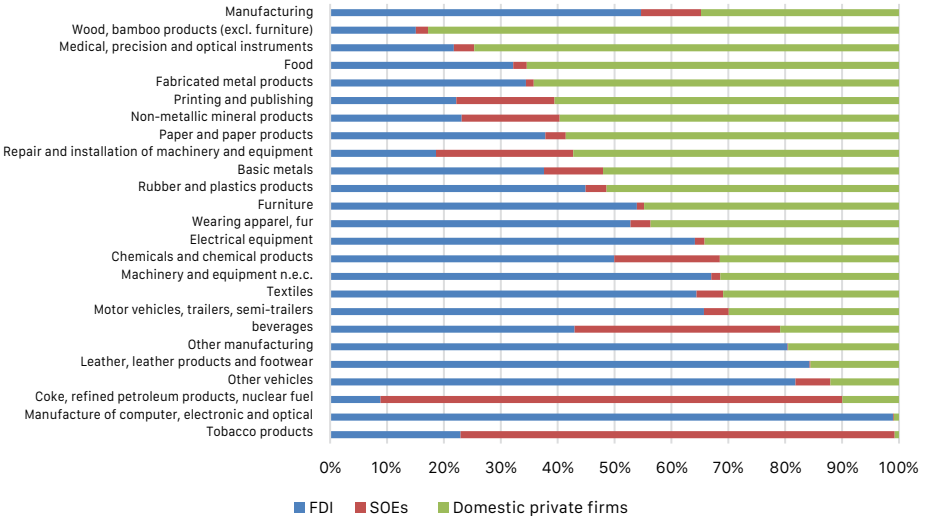
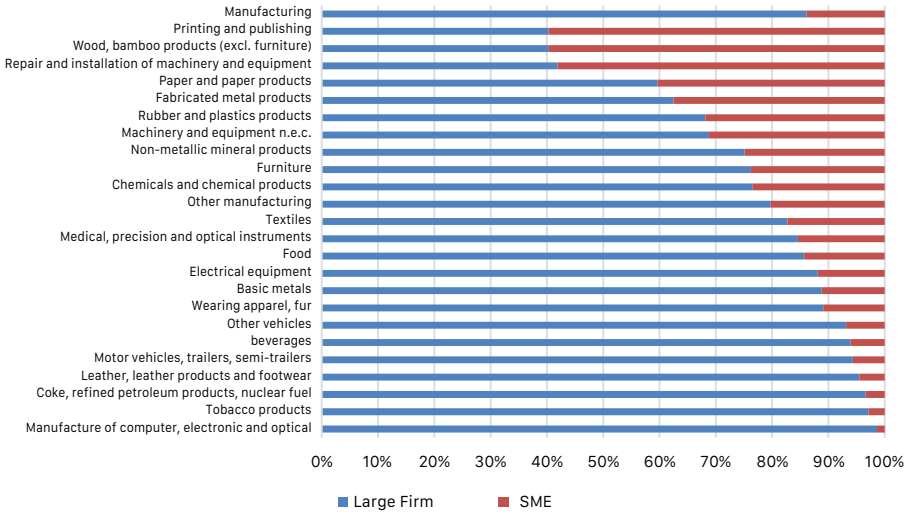


Figure 2.16: (lower panel): Large and SME shares in sub-sector revenue (%), 2016



Source: Authors' calculation based on 2017 Enterprise Census data

Value added

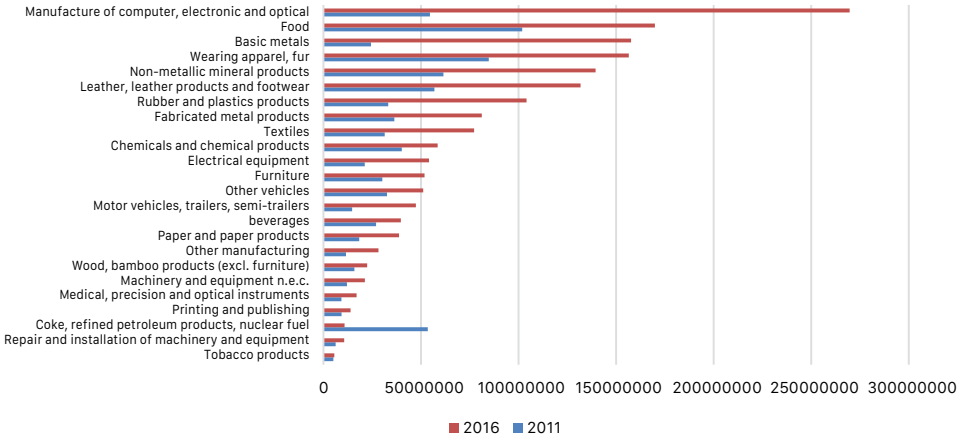
In terms of value added, food processing was the biggest sub-sector in 2011, but overtaken by electronics in 2016 and the wearing apparel sub-sector was only the second and third largest sub-sector in 2011 and 2016, respectively (Figure 2.17 - upper panel)[12].

In terms of shares in total MVA, electronics' performance was exceptional as its share more than doubled, from 7.4 percent in 2011 to 15.65 percent and thus it was the largest manufacturing sub-sector in 2016 (in absolute volume of VA and share in total MVA). The basic metal products sub-sector is another rising star, with its VA share rising from 3.9 percent in 2011 to 10.84 percent to claim the second biggest share in MVA in 2016, leaving food processing's VA share (reduced from 13.36 percent in 2011 to 9.53 percent in 2016) in third place. Notably, the VA shares of wearing apparel, non-metallic mineral products and leather-footwear having ranked second, third and fifth, respectively in 2011 slipped in 2016 to fifth, fourth and sixth, respectively (Figure 2.17 - lower panel). Figure 2.17 – upper panel also shows that while

12 *As noted in Section 2.1, due to estimation methods and data problems, MVA is used to measure the growth and structure, but not the level. The VA values provided in this paragraph and upper panel of Figure 2.17 are only for an illustration setting basis for the "structure" of VA distribution across manufacturing sub-sectors in the lower panel of Figure 2.17.*

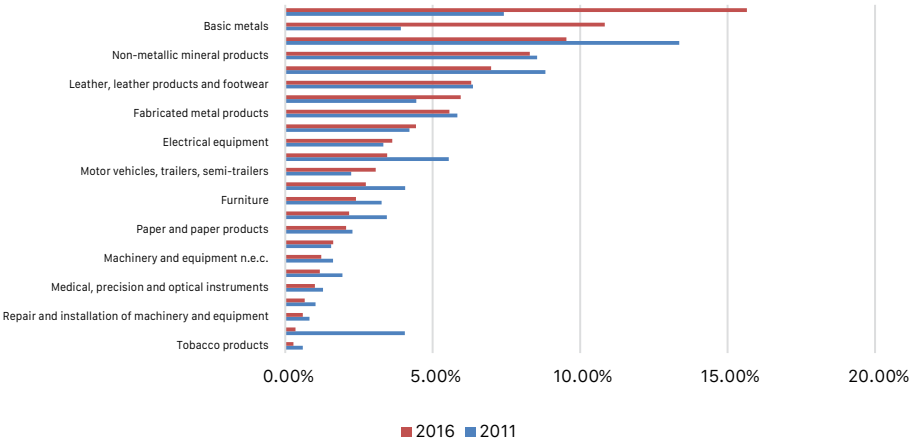
all sub-sectors (except coke-refined petroleum-nuclear fuel) experienced VA rises between 2011-2016, the higher 2016 VA shares (meaning relatively faster VA growth compared to other manufacturing sub-sectors) compared to 2011 shares were only observed in some sub-sectors (electronics, basic metal, rubber-plastics, textiles, electrical equipment, motor vehicles and other manufacturing).

Figure 2.17: (upper panel): Value added of manufacturing sub-sector, VND billion (2016 prices)



Source: Authors' calculation based on 2017 Enterprise Census data

Figure 2.17: (lower panel): Sub-sector share in MVA



Source: Authors' calculation based on 2017 Enterprise Census data

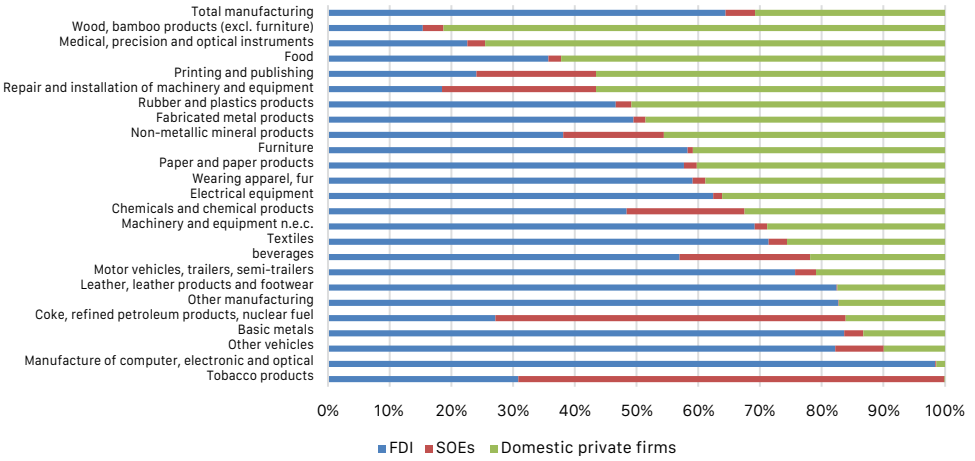
FDI's share in total manufacturing VA in 2016 (similar to its employment and revenue shares) was the largest: 64.44 percent and higher than its employment share (47.88 percent) and revenue share (54.66 percent) in manufacturing employment and revenue, respectively. SOEs' VA share (4.77 percent) was smallest (higher than their employment share (3.6 percent) and lower than their revenue share (6.07 percent), and domestic private firms' VA share was 30.79 percent (lower than their employment share (40.88 percent) and revenue share (35.47 percent) in 2016 (Figure 2.18).

In addition to sub-sectors where FDI VA shares were high and corresponded to large FDI shares in manufacturing and employment, it is interesting to note that FDI had: (i) relatively high VA shares, while its shares in manufacturing employment and revenue were only at medium level in beverages and paper sub-sectors and (ii) of its medium VA shares, its employment share was low in tobacco, non-metallic metal products and basic metals, indicating higher productivity than SOEs, domestic private firms and SMEs in these sub-sectors. SOEs only had higher VA shares in tobacco, repair-installation of equipment and coke-refined petroleum-nuclear fuel and a medium VA share in beverages. Domestic firms had relatively high VA shares in food, wood and bamboo (excluding furniture), printing, medical and precision equipment, rubber-plastics and non-metallic mineral products, in contrast to low VA shares in tobacco,

electronics, vehicles and other manufacturing and medium VA shares in the remainder (Figure 2.18).

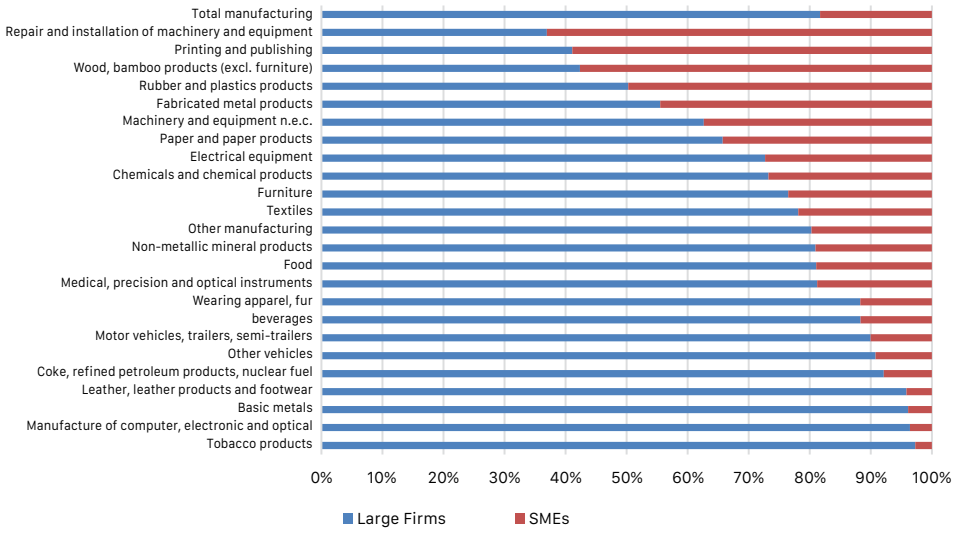
Figure 2.19 shows large enterprises dominated almost all sub-sectors in terms of VA. Large firms' share of total manufacturing revenue was 81.69 percent and only three sub-sectors (printing, wood excluding furniture and repair-installation of machinery) had SME VA shares of more than 50 percent and SME VA share is close to 50 percent in rubber-plastics, and fabricated metal products.

Figure 2.18: FDI, SOE and domestic firms' shares in sub-sector VA (%) 2016



Source: Authors' calculation based on 2017 Enterprise Census data

Figure 2.19: Large firms and SME shares of sub-sector VA (%), 2016

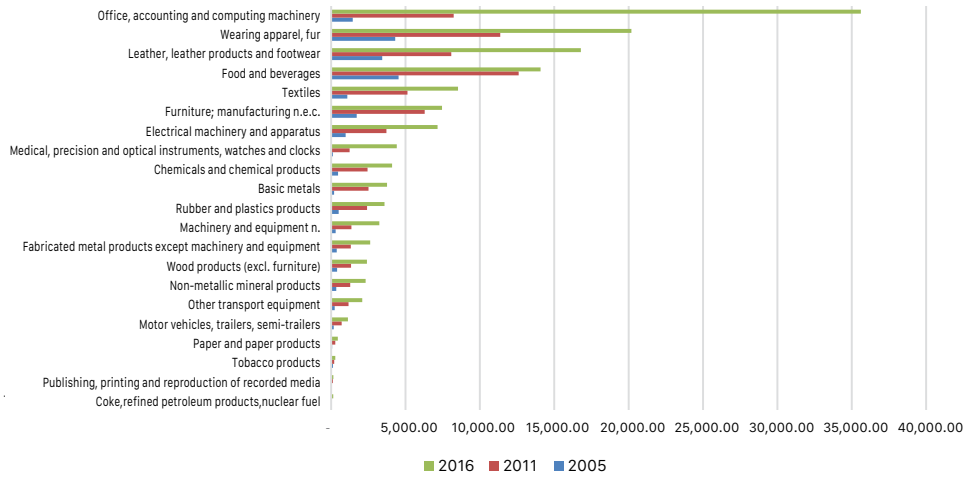


Source: Authors' calculation based on 2017 Enterprise Census data

Exports and net exports

All sub-sectors experienced increases in export volumes between 2005-2016. The largest rises occurred in electronics, leather-footwear to make these sub-sectors the largest and third largest export volume sub-sectors in 2016. Wearing apparel's export volume was second largest, followed by food and beverages (fourth largest), textiles (fifth) and furniture (sixth) in 2016 (Figure 2.20).

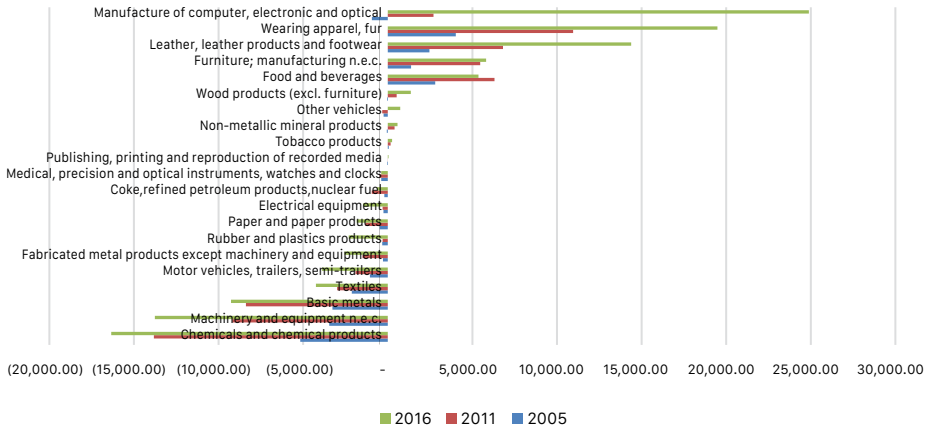
|Figure 2.20: Sub-sectors' export volume (USD million, current price)



Source: Authors' calculation, UN Comtrade

Figure 2.21 shows net export (exports minus imports) values of sub-sectors and indicates that only few sub-sectors have positive net export values. This together with the level of FDI, SOE and domestic private firms' participation (as indicated by the analysis on employment, revenue and VA shares) suggest that: (i) electronics (mainly smart phones), wearing apparel, leather-footwear were the largest export-oriented and FDI-led sub-sectors (noting that wearing apparel had a medium participation level from domestic private firms), (ii) furniture, food and beverages and wood (excluding furniture) were medium export-oriented and domestic private firms led sub-sectors (noting that furniture had high and food and beverages had medium participation levels of FDI). The other vehicles (mainly motorbikes) sub-sector was also a positive net exporter and led by FDI. The only sub-sector to be a positive net exporter led by SOEs was tobacco. The remaining sub-sectors (chemicals, machinery and equipment n.e.c., basic metals, textiles[13], motor vehicles, fabricated metal, rubber-plastics, paper, electrical equipment) had high and medium levels of FDI participation with negative net export-import substitution sub-sectors.

Figure 2.21: Manufacturing sub-sector net exports (USD million, current prices)



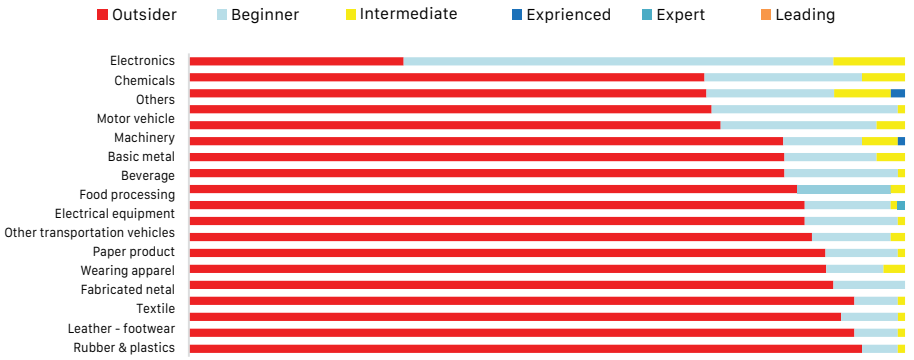
Source: Authors' calculation, UN Comtrade

13 *As trade agreements require more origin countries' inputs in exported products, demand for made-in-Viet Nam textile products (inputs to wearing apparel – Viet Nam manufacturing's second largest export sub-sector) increases. This explains: (i) the volume of textile exports was the third highest in 2016, but the sub-sector net export was negative, (ii) increased FDI inflows to Viet Nam in this sub-sector and suggests (trade negotiations and industrial policies may not have worked in tandem and resulted in the fact that) domestic firms may not have effectively captured the increased demand created by trade agreements and negatively affected the local content of value added in this sub-sector.*

IR4.0 readiness of manufacturing enterprises at sub-sector level

The MOIT-VASS-UNDP study on IR4.0 readiness of Viet Nam's industry firms found that manufacturing sub-sectors were assessed at "outsider" level with readiness scores varying from 0.42 to 0.80. The proportion of sub-sectors' firms at "outsider" level ranged from 73-92 percent, at "beginner" level from 4-25 percent and at "intermediate" level from 1-6 percent (Figure 2.22).

Figure 2.22: Proportion (%) of enterprises' IR4.0 readiness levels by sub-sector

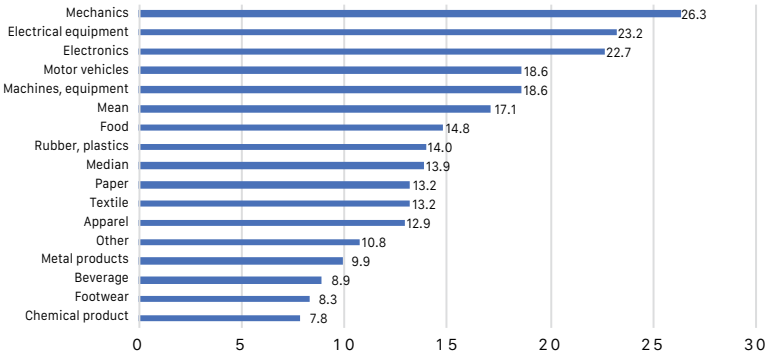


Source: Survey on IR4.0 Readiness of Viet Nam's Industry Firms (MOIT-VASS-UNDP 2018)

Sub-sectors with high export volumes (wearing apparel, leather-footwear) had the lowest IR4.0 readiness scores and the highest proportions of firms at "outsider" level. Figure 2.22 shows that rubber-plastics, fabricated metals, textiles, wearing apparel, and leather-footwear sub-sectors had very high (above 90 percent) proportions of firms at "outsider" level, compared to 75 percent in chemicals and electronics sub-sectors.

This IR4.0 study also found differences across manufacturing sub-sectors (Figure 2.23) in the rate of cloud computing: (i) sub-sectors with higher cloud computing adoption rates included fabricated metal (denoted in Figure 2.23 as "mechanics") (26 percent), electrical equipment (23 percent), electronics (23 percent) and (ii) sub-sectors with lower rates of adoption included chemicals (8 percent), leather-footwear (8 percent) and beverages (9 percent).

Figure 2.23: Firms' usage of cloud computing by sub-sectors (%)



Source: MOIT-VASS-UNDP (2018)

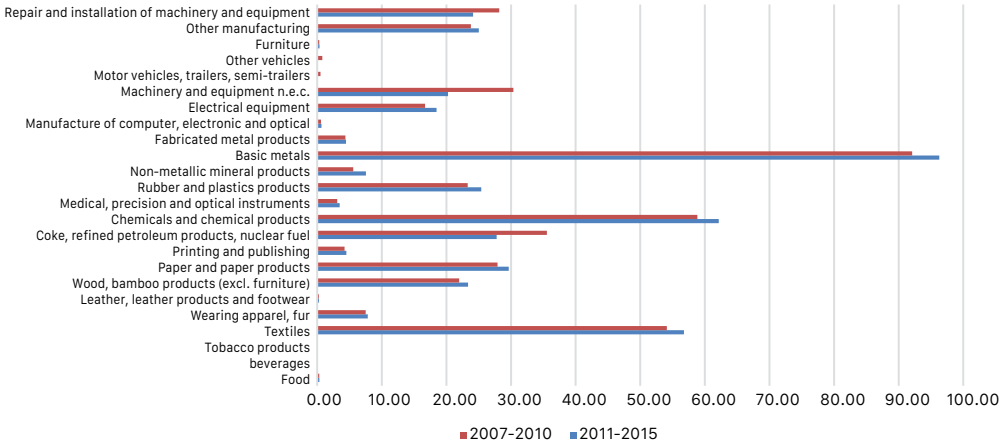
FDI linkages with domestic firms

As a result of sharply rising inflows of FDI into Viet Nam with the major share (70 percent) into manufacturing, FDI's share in manufacturing employment, revenue and value addition have grown (as discussed above). Despite rapid rises in exports and FDI's contribution to Viet Nam's GDP, exports and

job creation[14], FDI's forward and backward linkages[15] to the rest of the economy remain modest, although rising as shown in Figures 2.24 and 2.25[16]. FDI linkages with domestic firms are particularly weak in high-tech manufacturing sub-sectors (such as electronics and motor vehicles), in which FDI firms focus mainly on assembling (imported) components and packaging final products for export (electronics) or local market (motor vehicles). In resource-based manufacturing sub-sectors (basic metals, chemicals and textiles) FDI tends to exhibit stronger linkages. Besides FDI using natural resources delivered by domestic firms, the longer presence of FDI in resource-based manufacturing sub-sectors (underpinning narrower gaps between domestic and FDI firms, or alternatively higher absorptive capacity of domestic firms) may also explain examples of stronger linkages between FDI and domestic firms.

Weak linkages between FDI and domestic firms indicate that Viet Nam's integration into the global economy in general and global value chains (GVCs) in particular through the FDI channel is still shallow. Weak linkages also present the biggest obstacles to realization of FDI spillover effects through which technologies, labour skills and managerial experience are transferred to domestic firms as expected by Viet Nam's policy-makers through FDI policies as is the case in other nations. This result is consistent with previous studies on spillover effects of foreign capital in Viet Nam, such as by Chuc et al. (2008), CIEM (2012), Porter (2010) and Tran Van Tho (2005).

Figure 2.24: Backward-linkages between FDI and domestic firms in Viet Nam's manufacturing industry (%, max=100%)



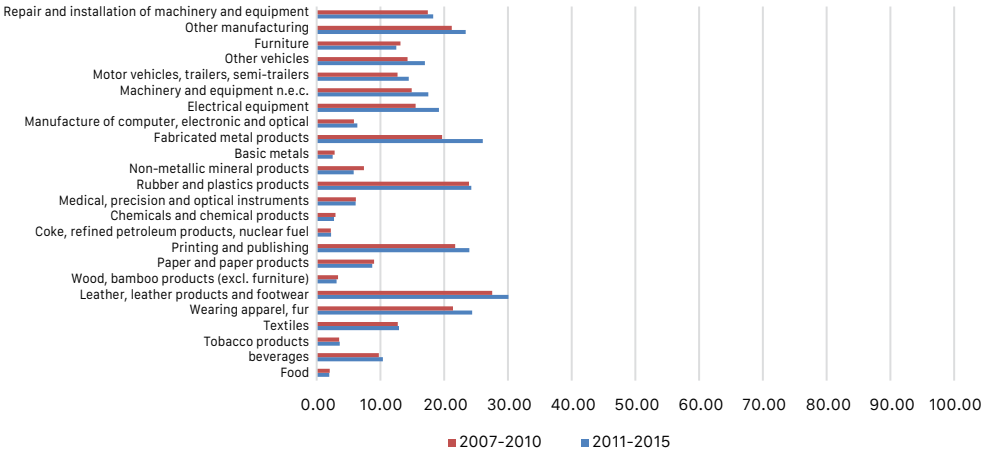
Source: Authors' calculation, 2017 Enterprise Census

14 FDI has made increasing contributions of around 20 percent of Viet Nam's GDP (from 15.2 percent in 2005), 72 percent of the country's exports (from 57 percent in 2005), 18 percent of government revenue and creating 3.7 million jobs for Vietnamese workers in 2017.

15 The idea of linkages grew out of Hirschman's theory of unbalanced growth and describes the relationships that exist between parties involved along the supply chain. Backward linkages describe the process of how a company in a given sector purchases its goods, products, or supplies from a company in a different sector; these are called inputs. Forward linkages describe the process of how a company in a given sector sells its goods, products, or supplies to a company in a different sector; these are called outputs.

16 The backward and forward linkage indexes are calculated to 2007-2010 and 2011-2015. They receive the value from 0-100 percent: 0 percent means "no linkage" and the value of the index approaching 100 percent means a stronger linkage. Details on how backward and forward linkages of the FDI sector with the rest of the economy are calculated are given in Section A.1.4 of Appendix 1.

Figure 2.25: Forward-linkages between FDI and domestic firms in Viet Nam's manufacturing industry (%, max = 100%)



Source: Authors' calculation, 2017 Enterprise Census

Summary

Key characteristics of manufacturing sub-sectors are summarized in Table 2.3 (besides low IR4.0 readiness and FDI's backward-forward linkages across sub-sectors with degrees of variation as mentioned above). To more easily digest characteristics that feed the analyses of productivity and competitiveness performance in the following section, the sub-sectors' importance (in terms of employment, revenue and exports) and the FDI, SOE, domestic private and large firms' and SMEs' participation levels in sub-sectors are divided into the following categories (with thresholds defined based on 2017 Enterprise Census data) to present the later analysis on performance of enterprises more systematically:

Sub-sector sizes (measured by employment, revenue and VA shares in manufacturing totals) are divided into three groups: (i) large (sub-sector shares in total manufacturing employment, revenue and VA are above 4 percent), (ii) medium (sub-sector share in total manufacturing employment, revenue and VA are between 2-4 percent) and (iii) small (sub-sector shares in total manufacturing employment, revenue and VA are less than 2 percent)

Participation level of FDI, SOEs and domestic private firms in sub-sectors (measured by employment, revenue and VA shares in manufacturing sub-sector totals) are divided into three groups: (i) high (FDI, SOE and domestic private firm shares in sub-sector employment, revenue and VA are above 45 percent), (ii) medium (FDI, SOE and domestic private firm shares in sub-sector employment, revenue and VA are 20-45 percent) and (iii) low (FDI, SOE and domestic private firm shares in sub-sector employment, revenue and VA are less than 20 percent)

Sub-sector's importance in terms of exports (measured by net export value) is divided into three groups: (i) large positive net export (net export > USD5 billion/year), (ii) medium positive export (0<net export< USD5 billion/year) and (iii) negative net export (net export<0).

Table 2.3: Summary of key sub-sector characteristics

VSIC code	Tiểu ngành	Qui mô tiểu ngành	Xuất khẩu ròng	Mức độ tham gia của các DN lớn	Mức độ tham gia của các DN VVN	Mức độ tham gia của các DN FDI	Mức độ tham gia của các DNNN	Mức độ tham gia của các DN tư nhân trong nước
10	Chế biến thực phẩm	Lớn	Xuất khẩu ròng dương lớn	Cao	Thấp (Trung bình về số lao động)	Trung bình	Thấp	Cao
11	Đồ uống	Trung bình (Nhỏ về số lao động)		Cao	Thấp (Trung bình về số lao động)	Trung bình (Cao về VA)	Thấp	Trung bình (Cao về số lao động)
12	Thuốc lá	Nhỏ	Xuất khẩu ròng dương trung bình	Cao	Thấp	Trung bình (Thấp về số lao động)	Cao	Thấp
13	Dệt	Lớn (Trung bình về doanh thu)	Xuất khẩu ròng âm	Cao	Trung bình (Thấp về doanh thu)	Cao	Thấp	Trung bình
14	May	Lớn	Xuất khẩu ròng dương lớn	Cao	Thấp	Cao	Thấp	Trung bình
15	Da giầy	Lớn	Xuất khẩu ròng dương lớn	Cao	Thấp	Cao	Thấp	Thấp (Trung bình về VA)
16	Sản phẩm gỗ (không bao gồm đồ gỗ)	Nhỏ (Trung bình về số lao động)	Xuất khẩu ròng dương trung bình	Trung bình	Cao	Thấp	Thấp	Cao
17	Giấy	Nhỏ (Trung bình về VA)	Xuất khẩu ròng âm	Cao (Trung bình về số lao động)	Trung bình (Cao về số lao động)	Trung bình (Cao về VA)	Thấp	Cao
18	Xuất bản và in ấn	Nhỏ	Xuất khẩu ròng dương trung bình	Trung bình	Cao	Trung bình	Thấp	Cao
19	Coke, sản phẩm hóa dầu và nguyên liệu hạt nhân	Nhỏ	Xuất khẩu ròng âm	Cao	Thấp (Trung bình về số lao động)	Thấp	Cao (Trung bình về số lao động)	Trung bình (Cao về số lao động and Thấp về doanh thu)
20	Hóa chất và sản phẩm hóa chất	Trung bình (Nhỏ về số lao động, lớn về doanh thu)	Xuất khẩu ròng âm	Cao	Trung bình	Cao (Trung bình về số lao động)	Thấp	Trung bình (Cao về số lao động)
21	Sản phẩm y tế, quang học và chính xác	Nhỏ	Xuất khẩu ròng âm	Cao	Thấp (Trung bình về số lao động)	Trung bình	Thấp	Cao
22	Cao su và nhựa	Lớn	Xuất khẩu ròng âm	Cao	Trung bình	Cao	Thấp	Cao
23	Sản phẩm khoáng sản phi kim loại	Lớn	Xuất khẩu ròng dương trung bình	Cao	Trung bình (Thấp về VA)	Trung bình (Thấp về số lao động)	Thấp	Cao
24	Kim loại cơ bản	Lớn (Nhỏ về số lao động)	Xuất khẩu ròng âm	Cao	Thấp (Trung bình về số lao động)	Trung bình (Cao về VA)	Thấp	Cao (Thấp về VA)
25	Chế biến kim loại	Lớn	Xuất khẩu ròng âm	Cao (Trung bình về số lao động)	Cao (Trung bình về doanh thu)	Trung bình (Cao về VA)	Thấp	Cao
26	Điện tử	Lớn	Xuất khẩu ròng dương lớn	Cao	Thấp	Cao	Thấp	Thấp
27	Máy móc thiết bị điện	Trung bình	Xuất khẩu ròng âm	Cao	Thấp (Trung bình về VA)	Cao	Thấp	Trung bình
28	Máy móc phụ tùng chưa phân loại	Nhỏ	Xuất khẩu ròng âm	Cao	Trung bình (Cao về số lao động)	Cao	Thấp	Trung bình (Cao về employment)
29	Xe có động cơ	Trung bình (lớn về doanh thu)	Xuất khẩu ròng âm	Cao	Thấp	Cao	Thấp	Trung bình (Thấp về employment)
30	Phương tiện giao thông khác	Trung bình (Nhỏ về số lao động)	Xuất khẩu ròng dương trung bình	Cao	Thấp	Cao	Thấp	Thấp (Trung bình về employment)
31	Đồ gỗ	Trung bình (lớn về số lao động)	Xuất khẩu ròng dương lớn	Cao	Trung bình	Cao	Thấp	Cao
32	Các sản phẩm chế biến chế tạo khác	Nhỏ (Trung bình về số lao động)	NA	Cao	Thấp (Trung bình về doanh thu)	Cao	Thấp	Thấp (Trung bình về số lao động)
33	Sửa chữa và lắp đặt thiết bị	Nhỏ	NA	Trung bình	Cao	Thấp	Trung bình (Cao về VA)	Cao (Trung bình về VA)
	Ngành chế biến chế tạo	NA	NA	Cao	Thấp (Trung bình về số lao động)	Cao	Thấp	Trung bình

Source: Authors' calculation, 2017 Enterprise Census

Productivity and competitiveness performance at sub-sector level

In this section, productivity and competitiveness of sub-sectors at (VSIC) 2-digit level will be assessed using different measurements, such as LP, RCA, domestic contents, value addition (VA/output and profit/revenue).

Labour productivity performance at sub-sector level

International comparison:

With a certain degree of similarity to the overall trend of Viet Nam's and comparator countries' manufacturing labour productivity (Figure 2.4), Table 2.4 (using UNIDO database, ISIC Rev.3[17]) shows, on the other hand, interesting nuances and variations at sub-sector level, namely:

- Viet Nam's labour productivity as a share of labour productivity of Japan and RoK remained very low in all sub-sectors: just above 15 percent in textiles, coke-refined petroleum products-nuclear fuel and basic metals, while in the remaining sub-sectors it was around 10 percent. However, almost all of Viet Nam's sub-sectors have narrowed labour productivity gaps with Japan and RoK at high speeds. Viet Nam's LP as a share of Japan's and RoK's LP increased by more than 70 percent between 2005-

17 *Some inconsistencies were observed by the authors while examining the UNIDO database, especially data related to: (i) some sub-sectors such as tobacco and coke-petroleum products-nuclear fuel and (ii) Indonesia. Careful treatment of the analysis using such data is advised.*

2015. Viet Nam's LP increased with less high speed in tobacco products compared to Japan and RoK and motor vehicles-trailers-semitrailers compared to Japan.

- In almost all sub-sectors, Viet Nam's LP remained lower than China's and Indonesia's and the LP gaps widened. Few sub-sectors narrowed LP gaps (at low speed below 50 percent between 2005-2015) compared with: (a) China (wood excluding furniture, machinery and equipment n.e.c and electronics) and (b) Indonesia (wood products excluding furniture and furniture), the LP gap narrowed by more than 70 percent and Viet Nam's LP is "within reach" of Indonesia's. Regarding electronics, Viet Nam's LP was 85.4 percent of Indonesia's and the gap narrowed, while the gap closed at a lower speed with respect to paper and paper products and non-metallic mineral products.
- During 2005-2015, Viet Nam closed LP gaps with (and within reach to LP levels of) Malaysia in almost all sub-sectors, except tobacco, wearing apparel and fabricated metal where LP gaps widened. Non-metallic mineral products, electrical equipment and motor vehicle sub-sectors' LP gaps with Malaysia narrowed at slow speeds. Viet Nam's LP exceeded and was "within reach" of Philippines' LP in numerous sub-sectors, while LP gaps widened only in tobacco, non-metallic mineral products and motor vehicles. LP gaps in wearing apparel, wood (excluding furniture), furniture and other manufacturing n.e.c. and chemicals narrowed slowly.
- Viet Nam's LP performance, compared to Bangladesh and India, is remarkable. Viet Nam outperformed the pair in many manufacturing sub-sectors. However, Viet Nam's LP was lower and slowly catching India's (and the Philippines, yet widened with China, Indonesia and Malaysia) in apparel, which plays an important role in Viet Nam's exports and job creation.

Together with the information on sub-sector characteristics, Table 2.4 shows:

Relative to comparator countries, the best performing sub-sectors (i.e. Viet Nam's sub-sector LP either already higher than those of some comparator countries or the LP gap between Viet Nam and comparator countries had reduced fast[18]) included: food (big sub-sector dominated by large and domestic private firms, and with robust positive net exports), beverages (a medium sub-sector, FDI and domestic private have medium participation levels, while FDI has high VA), textiles (large sub-sector, FDI dominated with negative net exports), printing (small, domestic private sector-led, with negative net exports), chemicals (medium-sized sub-sector, FDI dominated with negative net exports), coke-refined petroleum products-nuclear fuel (small-sized, SOE-led, negative net exports), electronics[19] (large, FDI dominated sub-sector with large positive net exports), basic metal (large sub-sector with FDI dominating VA share and negative net exports) and other transport equipment (medium-sized sub-sector, led by FDI and medium positive net exports).

18 With the exception of comparisons with China and Indonesia, the LP gaps between which and Viet Nam widened in 2005-2015.
19 Which includes: medical precision-optical equipment, office accounting and computing machinery, radio-television and communication products. Since 2011, the UNIDO database combined the last two subsections into one. For ease of comparison, in this section all three subsections are included in one sub-sector "electronics".

Table 2.4: Labour productivity of Viet Nam relative to comparator countries (%)

		Bangladesh		China		India		Indonesia		Malaysia		Philippines		ROK		Japan	
ISOC Rev.3 Code	Subsector Name	2005	2011	2005	2015	2005	2015	2005	2015	2005	2015	2005	2015	2005	2015	2005	2015
15	Food and beverages	94.3	138.5	30.8	39.2	97.2	170.9	46.6	44.5	24.2	49.6	28.6	51.8	4.2	13.5	5.1	18.8
16	Tobacco products	---	683.9	14.1	5.2	669.6	434.4	119.0	76.6	108.6	10.9	45.4	8.2	2.8	2.5	1.4	1.7
17	Textiles	222.8	216.5	53.3	27.0	86.9	155.1	74.2	67.6	39.2	51.2	60.5	167.4	6.1	19.3	6.1	17.9
18	Wearing apparel, fur	---	60.3	29.5	11.2	63.1	64.2	58.4	27.5	27.8	23.9	53.5	52.5	2.7	4.1	4.6	8.1
19	Leather and footwear	8.4	47.0	22.3	14.9	33.7	61.9	26.9	26.5	14.1	21.0	21.7	42.2	1.9	4.6	1.7	6.0
20	Wood products (excl. furniture)	90.0	137.8	19.0	29.7	36.3	103.6	25.1	84.0	16.4	54.7	37.5	52.7	2.2	13.2	2.0	11.1
21	Paper and paper products	121.1	146.9	27.5	13.7	43.9	89.2	14.7	20.8	23.7	43.1	36.8	70.9	3.4	9.8	2.6	9.1
22	Publishing and printing	187.9	192.2	59.8	30.6	57.5	66.5	48.3	42.6	35.7	45.6	82.7	100.0	6.6	20.7	5.4	9.3
23	Coke, refined petroleum products, nuclear fuel	8.7	2024.3	65.4	82.9	16.8	114.3	156.4	553.7	2.4	43.0	1.9	83.5	1.9	17.9	7.6	96.2
24	Chemicals and chemical products	65.5	182.4	41.0	37.9	40.6	79.1	30.2	22.7	9.9	31.4	33.0	38.4	3.1	7.3	2.0	6.8
25	Rubber and plastics products	36.6	135.2	36.3	28.5	51.4	63.7	47.9	37.9	29.9	44.1	44.6	79.1	4.4	9.7	3.2	8.5
26	Non-metallic mineral products	67.0	260.2	59.1	39.1	76.0	114.2	40.0	45.1	28.0	38.0	26.0	19.6	3.9	8.5	3.9	10.2
27	Basic metals	1.1	97.2	32.9	27.2	38.5	112.1	27.1	25.7	36.0	98.1	43.7	106.0	3.2	16.3	2.6	17.0
28	Fabricated metal products	107.9	91.2	52.3	21.9	76.7	86.2	64.0	34.4	39.0	29.7	71.1	77.3	7.3	12.5	5.2	9.7
29	Machinery and equipment n.e.c.	105.4	156.8	21.2	23.3	23.5	57.4	25.0	26.4	12.5	38.9	24.5	42.2	2.7	10.6	1.9	8.2
30-32	Electronics	308.3	80.4	50.4	60.3	58.4	115.3	77.5	88.9	43.0	55.8	77.3	109.2	5.2	9.7	6.0	17.9
31	Electrical machinery and apparatus	90.0	59.0	45.7	41.4	44.5	78.7	42.5	15.6	42.4	41.9	47.7	56.8	6.8	11.7	5.0	9.3
33	Medical, precision and optical instruments	70.1	---	34.2	---	31.9	---	77.9	---	22.1	---	17.4	---	4.8	---	2.8	---
34	Motor vehicles, trailers, semi-trailers	2.4	45.8	62.5	43.8	61.7	100.6	17.2	12.6	55.2	42.9	62.7	34.5	8.0	10.9	6.3	10.3
35	Other transport equipment	25.1	188.7	59.9	42.7	44.0	116.2	21.8	37.2	34.4	67.4	33.4	89.2	5.3	17.2	4.4	15.1
36	Furniture and manufacturing n.e.c.	4.6	71.6	31.4	27.3	31.1	46.1	57.4	81.2	22.6	35.5	42.7	57.6	3.1	10.3	2.2	6.1
	Total Manufacturing	103.6	202.6	27.5	22.1	34.9	63.5	33.5	30.5	17.2	27.3	26.6	36.4	2.9	7.2	2.6	7.8

Note: Electronics in this table includes: Office, accounting and computing machinery; Radio,television and communication equipment. Since 2011 UNIDO database does not provide data on Medical, precision and optical instruments, watches and clocks.

Color coding:

Good performance: Viet Nam's LP exceeds (red numbers) or "within reach" i.e. Viet Nam's LP is of 70% or more of comparator countries's LP and LP gaps reduced between 2005 and 2016

Promissing performance: Viet Nam's LP is below 70% of comparator countries' LP in 2016 but the LP gaps have been reduced faster than 50% between 2005 and 2016

"Needing improvement" performance: Viet Nam's LP is below 70% of comparator countries' LP in 2016 but the LP gaps have been reduced less than 50% between 2005 and 2016

Poor performance: Viet Nam's LP is below 70% of comparator countries' LP in 2016 but the LP gaps with comparator countries' LPs have been widened

Source: Authors' calculation from UNIDO data

The sub-sectors with promising performances (LP gap between Viet Nam and comparator countries was reduced – see the above footnote 18 on comparisons with China and Indonesia) included leather-footwear (large sector, dominated by FDI with large positive net exports), wood (excluding furniture) and paper (two small sub-sectors led by domestic private firms, wood has medium positive net exports and paper has negative net exports). Rubber-plastics (large sub-sector) and other manufacturing (small sub-sector) are two sub-sectors led by FDI with negative net exports, non-metallic mineral products (large sub-sector) and furniture (medium-sized sub-sector), both led by domestic private firms and with medium and large positive net exports.

Less well-performing sub-sectors (LP gap between Viet Nam and comparator countries had widened or reduced at slow speed) included: (i) tobacco products (small-sized, dominated by SOEs with medium positive net exports), (ii) wearing apparel (LP gaps with China and Indonesia widened and closed slowly with Bangladesh, India, Malaysia, the Philippines and Thailand, large sub-sector, FDI-led with large positive net exports), (iii) fabricated metals (large sub-sector with negative net exports led by FDI), electrical equipment and motor vehicles (medium-sized sub-sectors with negative net exports, dominated by FDI in which LP gaps with some countries widened and/or slowly narrowed).

Sub-sector LP analysis using 2017 Enterprise Census data[20]*:*

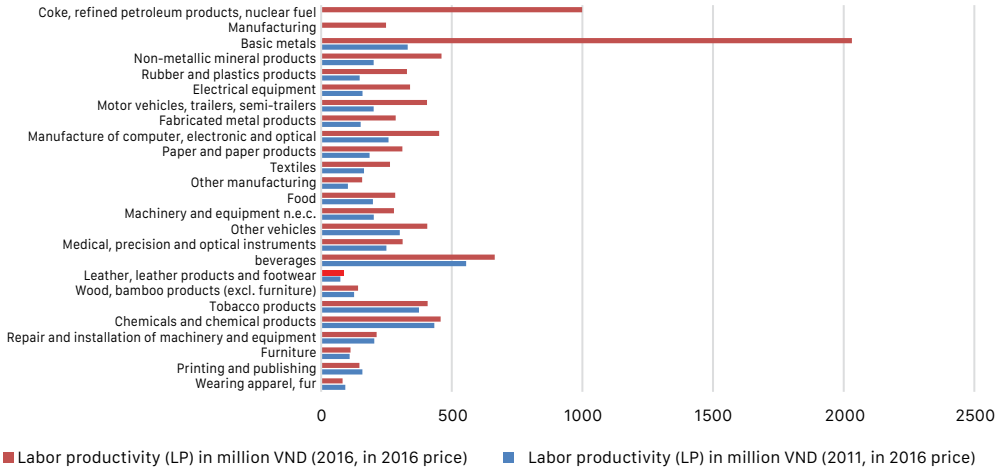
The GSO's 2017 Enterprise Census data shows that all manufacturing sub-sectors experienced increased labour productivity during 2011-2016, except apparel, printing and publishing which experienced LP reductions by 12 and 7 percent, respectively (Figure 2.26). Sub-sectors with the highest LP increases included basic metals (by more than five-fold), non-metallic mineral products, rubber-plastics products, electrical equipment, motor vehicles-trailers-semitrailers (by more than 100 percent). Fabricated metal products, computer-electronic and optical and paper products also experienced significant LP rises by 89, 75 and 68

20 Noting that 2011 data for coke-refined petroleum products-nuclear fuel was excluded as the value in 2011 was unexplainably inconsistent. Importantly, as in the case of VA, due to the estimation methods and data issues, it is better to use the LP estimated in the report for analysis on structure and trends rather than in absolute values.

percent, respectively. Sub-sectors with low LP increases included furniture (3 percent), chemicals (6 percent), wood products excluding furniture (12 percent), leather-footwear (19 percent) and beverages (20 percent).

Figure 2.27a shows changes in sub-sectors' LP relative to manufacturing LP, underlining the basic metals sub-sector's exceptional productivity performance. Its labour productivity relative to average manufacturing LP more than tripled, rising 2.52-fold in 2011 to 8.18-fold in 2016. It, thus, overtook beverages to become the most productive manufacturing sub-sector in 2016 (Figure 2.26) and as shown in Table 2.4, the LP of Viet Nam's basic metals is rapidly catching comparator countries.

Figure 2.26: Labour productivity of manufacturing sub-sectors (VND million, 2016 prices)

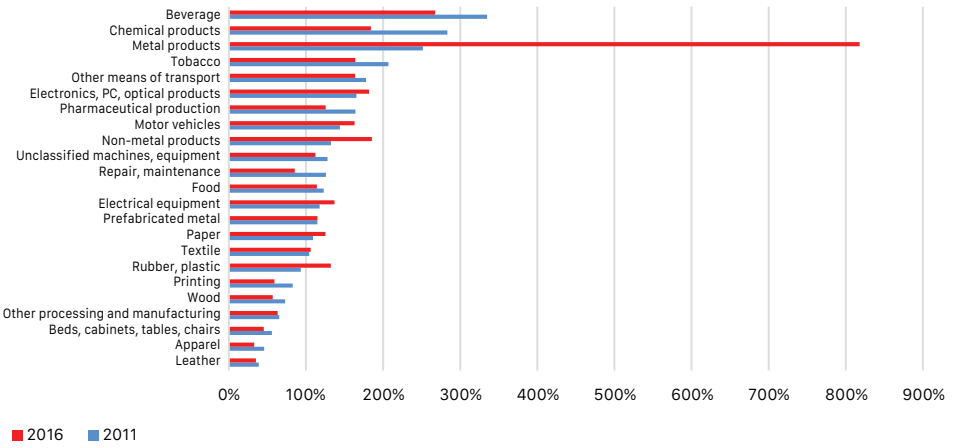


Source: Authors' calculation, 2017 Enterprise Census

Other fast-growing LP sub-sectors performing well relative to comparator countries included: electronics and other transport equipment. Electrical equipment and motor vehicles experienced high LP growth and remain in the group of sub-sectors that have been "slowly catching" comparator countries as sub-sector LP growth in these countries was even higher.

While some sub-sectors performed relatively well compared to comparator countries, their LP growth was consistently below Viet Nam's manufacturing average in 2005 and 2016 (wood excluding furniture, machinery and equipment n.e.c., furniture) or just slightly better than Viet Nam's manufacturing average (textiles, paper, food and beverages). Those underperforming (in terms of LP level and growth) were wearing apparel, leather and printing despite performing slightly better than Viet Nam's manufacturing average, while motor vehicles, electrical equipment and fabricated metals were in the group of less well-performing relative to comparator countries (Table 2.4). It should be noted that wearing apparel and leather are important manufacturing sub-sectors in terms of employment, revenue and exports in Viet Nam.

Figure 2.27a: Relative labour productivity (manufacturing = 1)

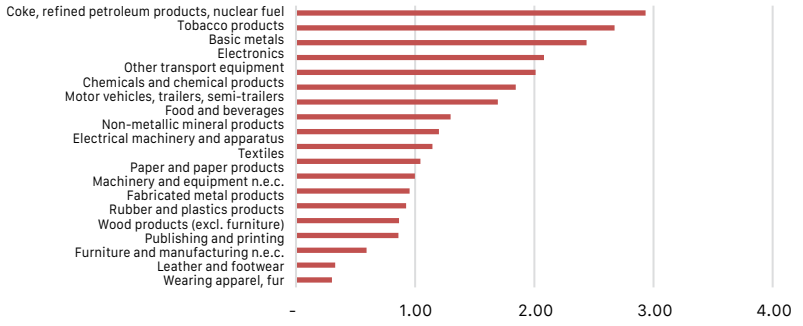


Source: Authors' calculation, 2017 Enterprise Census

Box 2.4: Relative labour productivity using UNIDO 2015 data

Figure 2.27b shows sub-sectors' relative labour productivity using UNIDO database for 2015 (the latest year for which Viet Nam's data is available on the UNIDO database). While the trend in ranking sub-sectors' relative LP is rather similar between Figures 2.17a and 2.17b, a few differences include: (i) in sub-sector classification: UNIDO database combined food and beverages into one sub-sector "food and beverages" as well as "office accounting and computers" and "medical, precision and optical equipment" into the "electronics" sub-sector and did not have "other manufacturing" and "repair and installation of machinery" compared to the VSIC sub-sector list used in this report, (ii) different years of data (2016 of Enterprise Census vs. 2015 of UNIDO database), and (iii) different sub-sector rankings in relative LP: if taking into account the differences in sub-sector classification, textiles ranked four places higher using UNIDO database than using Enterprise Census data, rubber-plastics - five places lower than using Enterprise Census data and non-metallic mineral products - six places lower than using Enterprise Census data. While differences in ranking "food" and "beverages" using Enterprise Census and UNIDO database were simply because of different classifications, the differences in rankings of textiles, rubber-plastics and non-metallic mineral products can be explained by many combined factors (besides the above-mentioned differences in sub-sector classification and year of data) such as methods of VA/LP estimation (as noted in Section 2.1), differences in treating the "outliers observations" and assigning weights to sub-sectors with different sizes, and most importantly the quality of the two datasets.

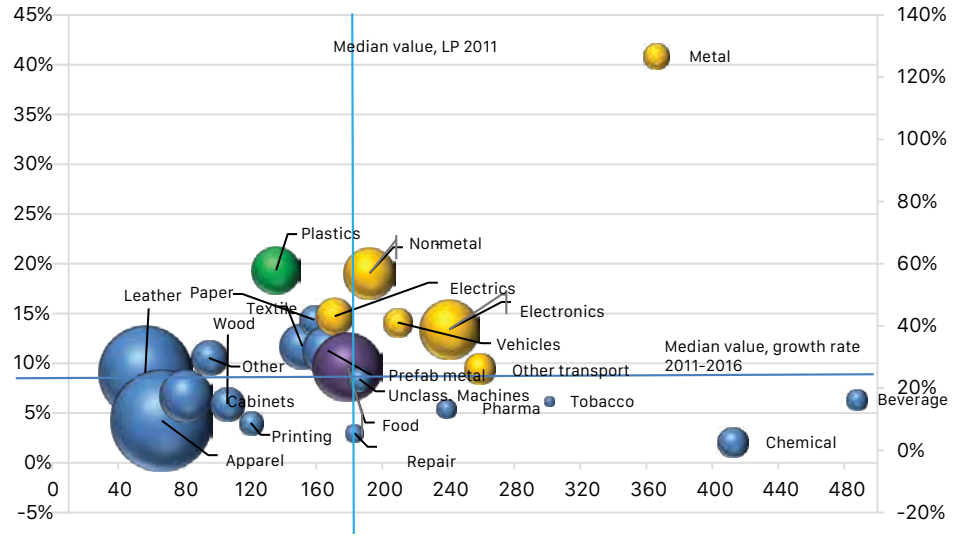
Figure 2.27b: Relative labour productivity (manufacturing = 1), 2015 (source: Authors' calculation using UNIDO database)



Box 2.5: LP growth and employment size of sub-sectors

Additional information on employment size in the assessment of sub-sector labour productivity shows the link between LP level, LP growth and the importance of manufacturing sub-sectors in terms of job creation in the economy (Figure 2.28). The figure illustrates that manufacturing sub-sectors with large employment sizes tend to sit in the left-bottom quadrant, i.e. with lower productivity levels in 2011. The non-metal products sub-sector stands out, with all three measures exceeding the respective median values.

Figure 2.28: Productivity level (2011), growth rate and average employment size (2011-2016) of manufacturing sub-sectors

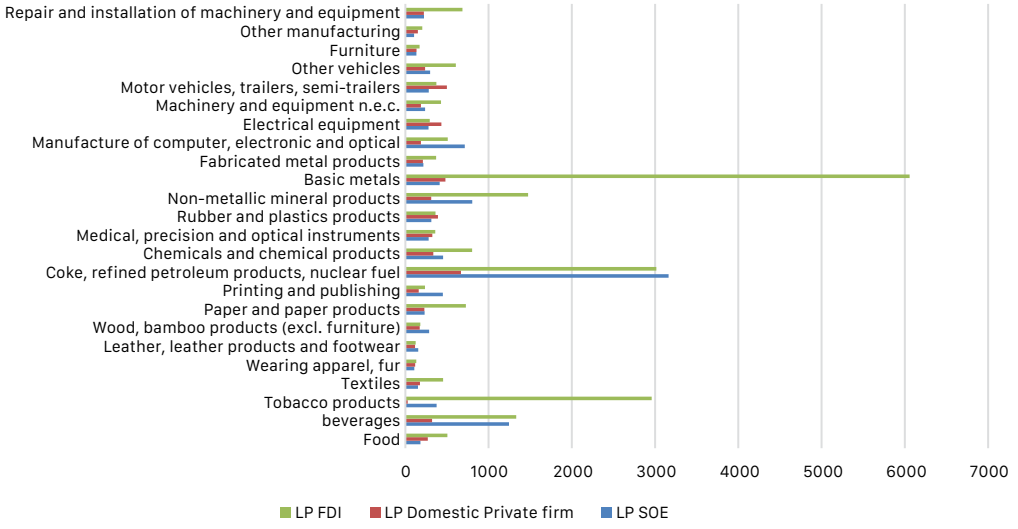


Note: The size of each bubble reflects the employment size of each respective manufacturing sub-sector.
Source: Authors' calculation, 2017 Enterprise Census

Đáng lưu ý là, ở hầu hết các tiểu ngành, năng suất lao động trung bình của doanh nghiệp FDI đạt mức cao nhất, tiếp theo là LP của SOE và doanh nghiệp tư nhân trong nước (Hình 2.29)

It is noted that average labour productivity of FDI is highest, followed by the LP of SOEs and domestic private firms in almost all sub-sectors (Figure 2.29).

Figure 2.29: SOE, FDI and domestic private firms' average labour productivity by sub-sector (VND million, 2016 prices)[21]



Source: Authors' calculation, 2017 Enterprise Census

21 In this figure, the average LP of SOE, FDI and domestic private firms in each sub-sector were calculated by dividing the total value added of each group (SOE, FDI and domestic private) by its number of workers for each sub-sector. This way, the sub-sector average LP of SOE, FDI and domestic private firm groups take into account the number of worker LP differences between the three groups in each sub-sector. If the average manufacturing LP of SOE, FDI and domestic private firms were calculated in the same way (i.e. dividing the total manufacturing value added of each group by its number of workers, which are the average numbers of workers of SOE, FDI and domestic private firms in the manufacturing sector), the results would have underestimated the number of worker differences between the three groups in each sub-sector resulting in the higher manufacturing LP of SOEs compared to FDIs.

Scope for future improvements in manufacturing LP

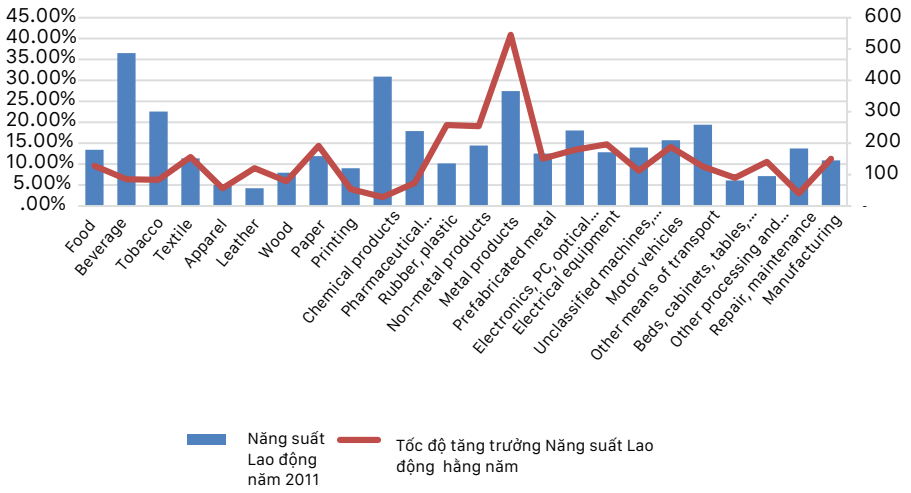
To examine the scope for structural change (from low to higher LP sub-sectors within manufacturing) to contribute to increased manufacturing LP (Table 2.5), Figure 2.30 looks at variations in LP, which declined between 2011-2016 as both commonly-used measures, coefficient of variation and maximum over the minimum ratio, dropped during this period (Table 2.5). This indicates reduced scope for structural change to contribute to future productivity improvements.

Table 2.5: Measures of variation in labour productivity (2011 and 2016)

	2011	2016
Coefficient of variation */	2,65	1,00
Max/Min	101,98	24,85

**/ Coefficient of variation is equal to standard deviation divided by the mean*
Source: Authors' calculation, 2017 Enterprise Census

Figure 2.30: Labour productivity level in 2011 and annual growth rate in 2011-2016 (%)

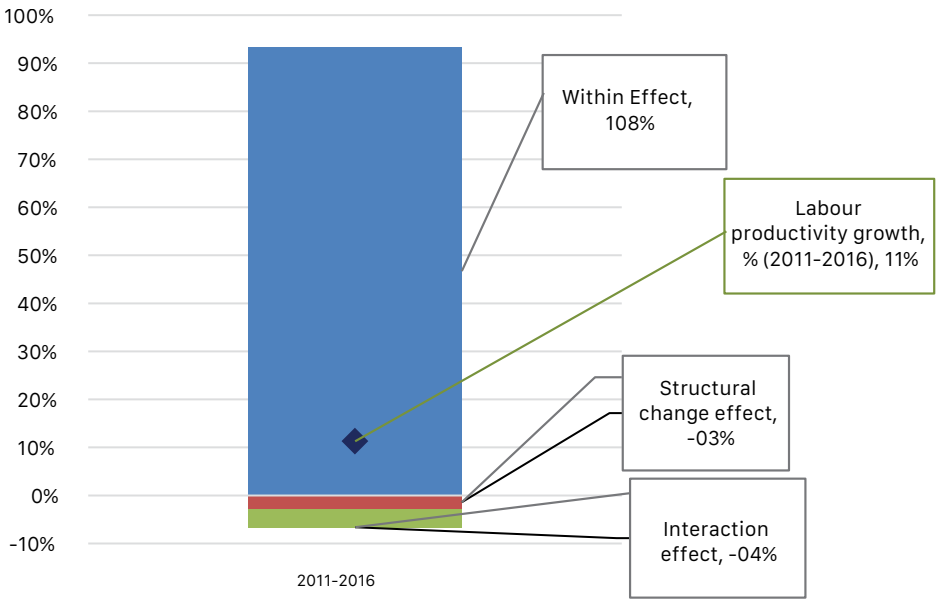


Source: Authors' calculation, 2017 Enterprise Census

It is important to know if sub-sectors with high levels of LP in 2011 also grew fast during 2011-2016. The correlation coefficient between these two variables is -0.71, indicating that sub-sectors with higher productivity in 2011 grew slower during 2011-2016. The correlation coefficient between LP level in 2011 and changes in employment shares for manufacturing sub-sectors is negative at -0.01. So is the correlation coefficient between LP growth rate and changes in employment shares (-0.06). All these reinforce the point made earlier that small, even negative contributions of structural change to LP improvements in manufacturing reiterate the reduced scope for structural change to achieve productivity improvements (implying efforts should focus on "within sub-sector" factors to improve manufacturing LP) in the future.

This is confirmed by results of a more rigorous shift share analysis. Figure 2.31 shows that LP grew by 11.3 percent during 2011-2016. Of a 100 percent change in LP, the 'reallocation effect' made up -3.3 percent, i.e. structural change adversely affected LP growth, presumably for the reasons above mentioned. The 'interaction effect' was also negative, at -4.3 percent. This means that during 2011-2016, labour tended to move away from sub-sectors with positive LP growth towards sub-sectors with declining LP growth (such as wearing apparel, leather-footwear, furniture). The 'within sector effect' was as high as 107.6 percent, which more than offset the adverse effects of structural change and interaction. As such, the results of the shift share analysis for manufacturing are broadly in line with those for the whole economy (as discussed in Section 1 and shown in Figure 1.8 - lower panel).

Figure 2.31: Decomposition of labour productivity growth in manufacturing (2011-2016)



Source: Authors' calculation, 2017 Enterprise Census

2.2.3 Firm-Level Determinants of Labour Productivity Growth in Manufacturing

This section examines the determinants of LP growth at firm level, important to LP growth within sub-sectors. The firm-level determinants of LP growth in manufacturing can be established through an econometric analysis of the GSO's Enterprise Census 2016, the latest dataset with detailed firm-level information in Viet Nam. Results are displayed in Section A.3.2, Appendix 3. As underlined in this section, the results for manufacturing are broadly consistent with those obtained for the whole economy, presented in the first section of this report.

Worker-related factors

The presence of foreign workers in a firm is beneficial to productivity. Raising their share by 1 percentage point boosts productivity by 91.7 percent($e^{0.651}$ - 1), indicating strong spill-over effects from foreign to Vietnamese workers.

With regard to human capital of workers as proxied by the level of educational attainment or training, compared to the base case of no training, if the ratio of workers with primary vocational certification rose by 1 percentage point, a firm's LP increased by 9.7 percent. If the ratio of workers with a secondary (vocational) degree or (vocational) college degree and the ratio of workers with other certification increased by 1 percentage point, LP would jump by 4.5 and 15.7 percent, respectively. This is slightly different from the same analysis at economy-wide level, which indicates only short-term education courses contributed to LP growth.

Age of workers also matters. If the ratio of workers aged 60 or over increased by 1 percentage point, LP jumped by 66.4 percent. This may imply that in the absence of quality information on experience, old-aged workers employed by firms may have special expertise in addition to experience. Firms with bigger shares of a younger workforce under 30 years of age were more productive than those with workers aged 31-60.

Firm-related factors

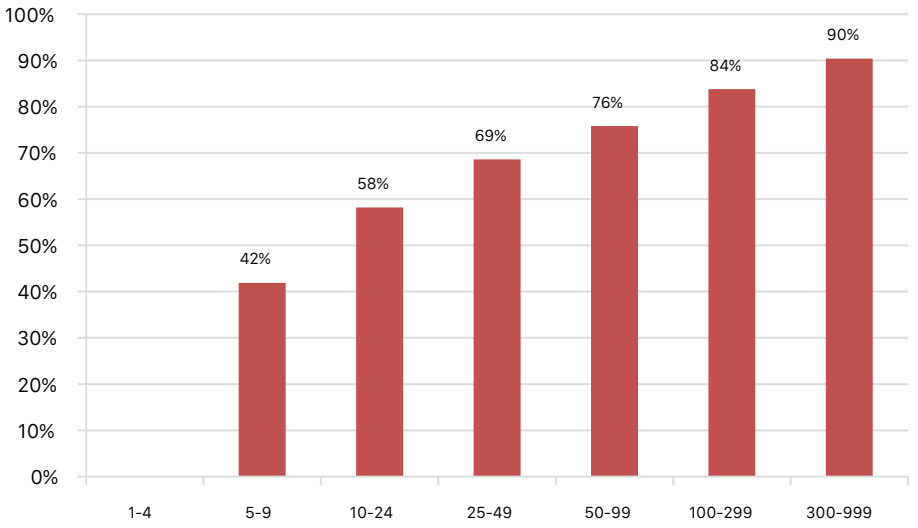
Capital deepening is important:

Raising the ratio of capital over labour, which measures how well workers are equipped, by 1 percent would increase LP by 0.38 percent if all firms having participated in 2012-2017 census surveys were taken into account (0.39 percent, if only firms in the 2012-2017 panel were included).

Firms' size matters:

A size premium, as measured by the productivity gap between different firm sizes over micro-firms with less than five workers as a reference group, exhibits a concave pattern with the premium diminishing from one size group to the next (Figure 2.32). In other words, as the size of firms became larger their productivity performances relative to micro-firms became greater. However, productivity increases declined as a firm's size grew.

Figure 2.32: Size premium



Source: Authors' calculation, 2017 Enterprise Census

Firms' managerial capabilities matter

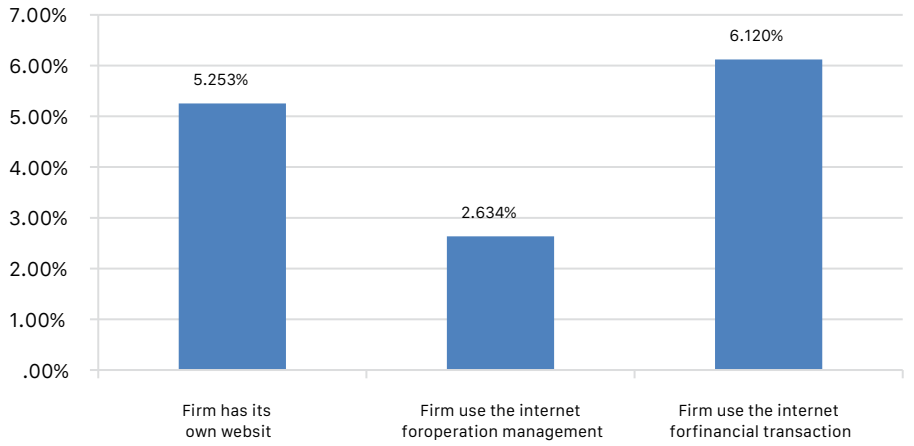
Examining the level of educational attainment of firms' top managers, if a manager held a master degree or higher, labour productivity increased by 5 percent from the base case, where the manager only had a junior college degree or lower.

Manager's experience as proxied by his/her age also matters, with experience premium having a non-linear form that declined as age increased.

Digitization makes a difference

Firms that used computers more intensively, have a website and use the internet in various activities were more productive (Figure 2.33). Specifically, firms with their own website, use the internet for operational management or for financial transactions have higher LP, by 5.3, 2.6 and 6.1 percent respectively, than firms that did not, other factors being equal.

Figure 2.33: Internet usage and labour productivity



Source: Authors' calculation, 2017 Enterprise Census

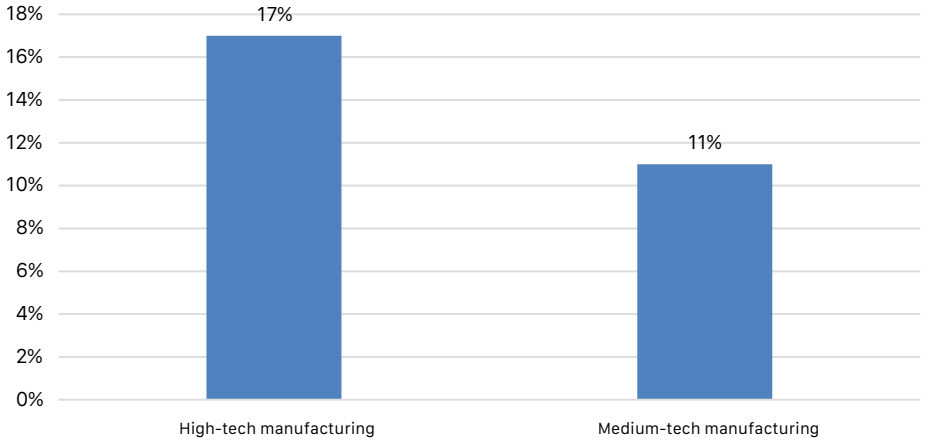
Global market participation helps

Firms engaged in export and/or import activities were 12.3 percent more productive than those did not.

Level of technological sophistication matters

With other factors being equal, firms in high-tech and medium manufacturing were more productive by 17 and 11.2 percent, respectively than those in low-tech manufacturing (Figure 2.34)

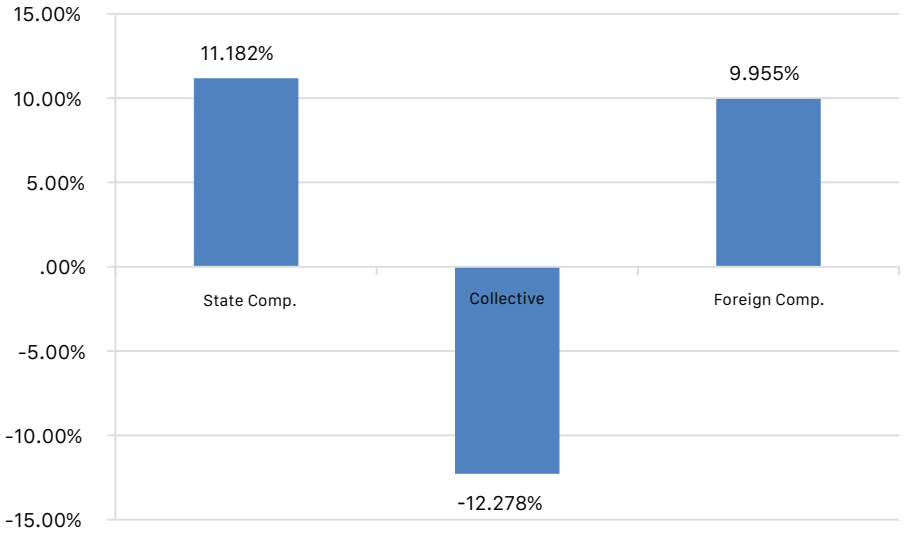
Figure 2.34: Labour productivity of firms in high- and medium-tech sectors relative to firms in low-tech manufacturing



Source: Authors' calculation, 2017 Enterprise Census

SOEs are most productive

Figure 2.35: Ownership and productivity of companies with different ownership forms (reference: private companies)

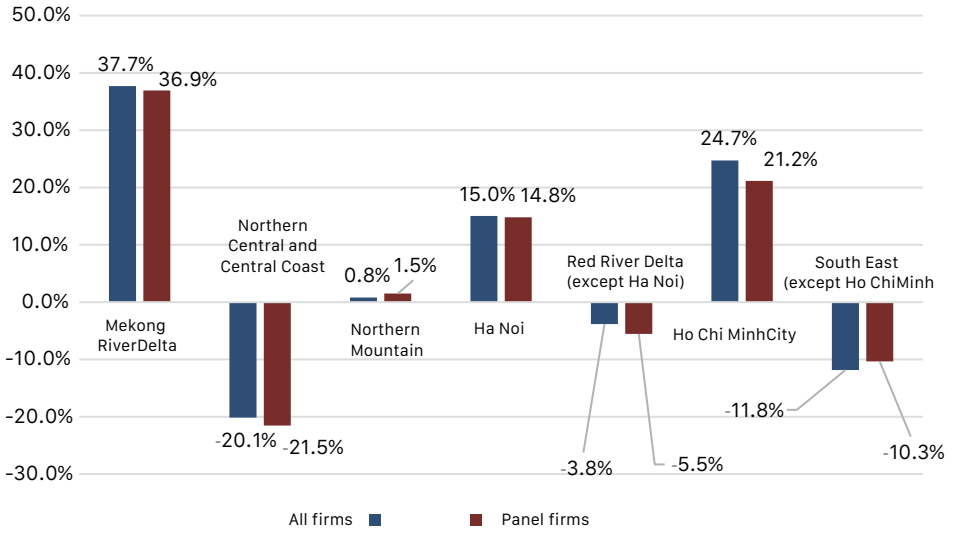


Source: Authors' calculation, 2017 Enterprise Census

SOEs were the most productive, 11.2 percent more than private firms with other factors being equal. They were closely followed by foreign firms, 10 percent more productive than private ones. Enterprises with collective ownership had the lowest level of productivity, 12.3 percent less than private firms (Figure 2.35). It must be noted that the regression result at first glance appears different (and counterintuitive) compared to the higher-than-average results of FDI sub-sector LP against SOEs' in many sub-sectors as shown in Figure 2.29. This is because Figure 2.29 shows the unconditional sub-sector average LP of SOEs and FDI (which, while working in the same sub-sectors, have different employment sizes, capital concentrations, managerial capabilities), while regression compares SOEs' and FDIs' LP differences with conditions that all other factors such as firm size, capital concentration, managerial capability are assumed as equal.

Location matters

Figure 2.36: Labour productivity of firms in different regions (reference: Ho Chi Minh City)



Source: Authors' calculation, 2017 Enterprise Census

With other factors being equal, firms in Ho Chi Minh City were the most productive, followed by Mekong River Delta, South East (excluding Ho Chi Minh City) and Ha Noi. Companies in other regions were considerably less productive than those in Ho Chi Minh City (Figure 2.36.).

2.2.4 Global Integration and International Competitiveness of Viet Nam's Manufacturing

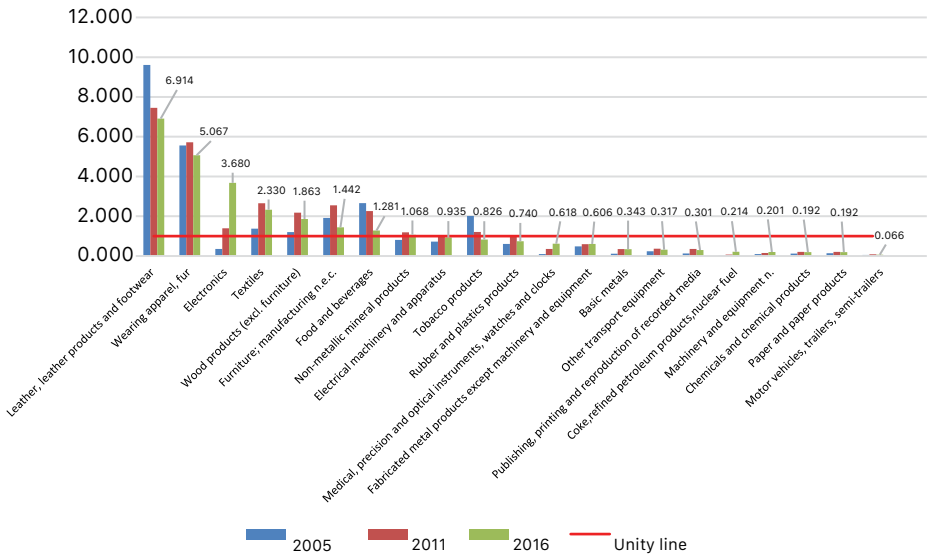
While LP is a core element of firms' (sub-sectors' and sector's) international competitiveness, competitiveness can also be measured by firms' (sub-sectors' and sector's) export-import activities, an important integration channel for manufacturing and Viet Nam's economy more broadly.

Performance measured by Revealed Comparative Advantage (RCA)

The link between exports of manufactured goods and LP and the international competitiveness of manufacturing sub-sectors is two-way. As indicated in the previous sections on factors determining LP in manufacturing and sub-sectors, firms engaged in exports and/or imports were more productive than those not, other factors being equal. On the other hand, Viet Nam's manufacturing through deepened global integration was aligning its manufacturing sub-sectors with their comparative advantages, measured by RCA, as a frequently-used measurement of international competitiveness.

Analysis of UN Comtrade database found that wearing apparel, leather-footwear, textiles, wood (excluding furniture), food and beverages and furniture were sub-sectors with RCAs higher than unity since 2005 and in 2016, electronics (driven by Samsung Corporation operations in Viet Nam) and non-metallic mineral products joined (while tobacco, rubber-plastics fell out from) this group (Figure 2.37).

Figure 2.37: RCA of manufacturing sub-sectors (2005, 2011 and 2016)



Source: Authors' calculations based on UN Comtrade data

Notably, almost all sub-sectors, except electronics (RCA>1) and fabricated metal (RCA<1), experienced declining RCA over the past five years (2011-2016). Recalling that RCA represents the ratio of sub-sector shares in Viet Nam's total manufacturing exports to the same sub-sector's share in total global manufacturing exports, declining RCA values of these sub-sectors (despite increased export volumes as shown in the section on characteristics of manufacturing sub-sectors, and Viet Nam's manufacturing RCA rises as shown in the section on manufacturing performance) may simply be the result of significant increases in export volumes of electronics, leading to the former sub-sectors' smaller shares in Viet Nam manufacturing exports.

The electronics sub-sector experienced the fastest RCA increase since 2011. It presumably benefited from the 'China Plus One Strategy' employed by multinational corporations, notably Japanese and Korean in developing countries including Viet Nam, as a response to the rapidly rising costs of labour and other production inputs in China. As a result, FDI (especially by Samsung Corporation) rapidly increased its presence in Viet Nam in this sub-sector (mainly smart phone assembling), as noted in the earlier analysis of this sub-sector's rapid growth in VA, workers and revenue share in Viet Nam's manufacturing sector and LP. As the FDI-dominated electronics sub-sector had solid performance in the level of LP and growth of LP but not among the highest in 2016, it may reflect the predominant assembling nature of production (using simple skills).

For medium-tech manufacturing sub-sectors (non-metallic mineral products, electrical equipment, rubber-plastics, fabricated metal, other transport vehicles and basic metals) as well as low-tech sub-sectors, the RCA index was low with no signs of improvement for many years. Besides the electronics sub-sector's increased export share in Viet Nam's total manufacturing exports as noted above, FDI enterprises in these sub-sectors were more inward-looking: producing goods for domestic consumption (to substitute imports) rather than for exports. Meanwhile, many domestic market-focused firms in these sub-sectors could not compete in international markets and grew slowly in size and LP (exception was the food and beverage sub-sector with: (i) high level of domestic private firm participation, (ii) substantially positive net exports and (iii) an RCA which declined significantly in the last five years, but remained higher than unity).

Figure 2.37 provides a comparison of Viet Nam's and comparator countries' RCAs in some sub-sectors where Viet Nam's RCA values were higher than unity. Besides the electronics sub-sector's climbing RCA (highest among comparator countries in 2016), RCA values were consistently high across these sub-sectors than only very high in a few sub-sectors (textiles and wearing apparel in Bangladesh and leather-footwear in Cambodia). This indicates Viet Nam's export portfolios may be more diverse than Bangladesh's and Camdodia's, a positive trend in terms of resilience against shocks in international demand for exports. It also indicates Viet Nam's lower RCA in each of these sub-sectors may be because its export share in total manufacturing export was smaller due to diversification (similar to Viet Nam's manufacturing RCA being lower than Bangladesh's and Cambodia's due to Viet Nam's significant exports in other sectors - Box 2.2).

Figure 2.38: Sub-sectors' RCA of Viet Nam and comparator countries

2.2.5 Participation in Global Value Chains: Domestic Content of Exports[22] of Sub-Sectors

Over the last few decades, at global level, dramatic changes have occurred in the nature of international trade, increasingly through GVCs. Production processes have involved sequential, vertical trading chains stretching across many countries with specific ones specializing in particular stages of a good's production sequence.

In modern times, GVCs shared in approximately two-thirds of global trade, according to recent estimates by David Dollar at the Brookings Institution[23]. In GVC-participating countries, increased participation in GVCs is associated with the rapid growth of trade in tasks (also termed "trade in value added"). "Vertical specialization", ''slicing up the value chain'', ''fragmentation'' are different terms used for this phenomenon in literature. As participating in GVCs is almost a must for a country or firm to engage in international trade, all participants want increased shares of the GVC pie.

In the context of Viet Nam accelerating its global integration, in addition to export values and RCA, the domestic content of exports can serve as a measure of Vietnamese firms' participation in GVCs in particular and international trade in general. With data from an input-output table, one can calculate it by using the following formula (De La Cruz et al (2013)):

$$DVS = Av[I-AD]-1 \quad (2.1)$$

of which:

DVS – domestic content (or domestic vertical specialization) of exports

AD = n x n domestic coefficient matrix;

Av – 1× n vector of each sector j ' s ratio of value-added to gross output;

Based on Equation (2.1), Pham Minh Thai et. al. (2018) used input-output 2012 to calculate foreign content of Viet Nam's exports, including manufacturing. Their results were used to derive domestic content of manufacturing exports, presented in Figure 2.38. It shows that variations in domestic content of manufacturing exports across sub-sectors are relatively small at 0.23 (coefficient of variation is 0.23 – meaning that standard deviation is equal to 23 percent of mean value). At the top are food processing and non-metallic mineral product sub-sectors with shares of domestic content in exports exceeding 65 percent. These two sub-sectors also displayed relatively good LP performances (Table 2.4, Figures 2.26 and 2.27), with significant positive net exports and high levels of domestic private firms' participation. Close to the bottom are electronics (FDI-led, large-sized and top exporting sub-sector), electrical equipment and rubber-plastics (high levels of FDI participation and negative net export values), also in the list of manufacturing sub-sectors with relatively good productivity performances (Table 2.4, Figures 2.26 and 2.27). Leather and wearing apparel present another group of sub-sectors with high levels of domestic content, led by FDI and leading in manufacturing exports, but low LP.

There appears to be no correlation between LP performance and domestic content of manufacturing sub-sector exports, instead the major inputs and level of technology used by firms in the sub-sectors seemed to "predict" the level of domestic content and LP of sub-sectors. In some high- and medium-tech sub-sectors (by Standard International Trade Classification (SITC) such as electronics, electrical equipment, motor vehicles, other vehicles, basic metals), firms tended to focus on assembling and/or processing imported components/materials in Viet Nam and as a result, the share of local content (mainly labour) in VA tended to be low, while LP was higher than the manufacturing average LP. In low-tech sub-sectors (such as wearing apparel, leather-footwear), the share of domestic content in labour (a

22 "Domestic content" measures Viet Nam's "participation" in GVCs through the share of (value of) domestic content in Viet Nam's exports (and through Viet Nam's share in global exports, it can measure Viet Nam's domestic share of the global export pie), at the same time it: (i) due to data issues, does not distinguish contributions of foreign firms based in Viet Nam and Vietnamese firms to domestic content and (ii) does not measure (changes in) Vietnamese firms' "trade in tasks"/"vertical specialization" or functions in GVCs.

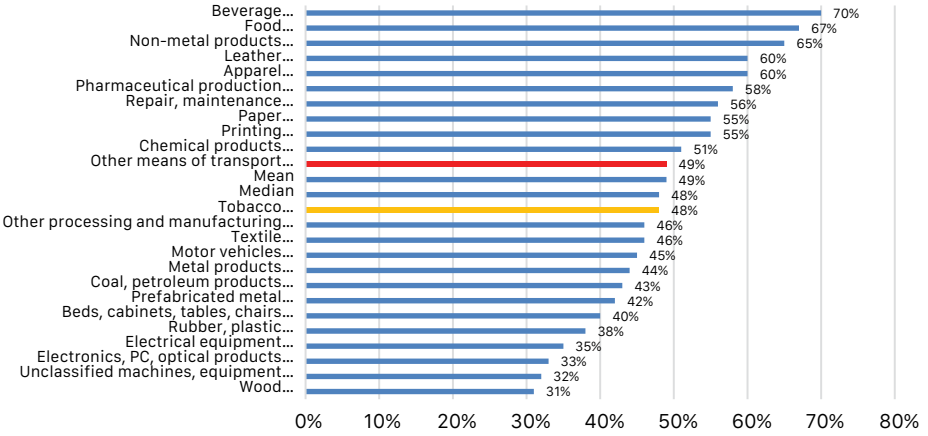
23 Source: https://www.brookings.edu/blog/order-from-chaos/2017/07/10/global-value-chains-shed-new-light-on-trade/

major share in sub-sector VA) in VA tended to be high with low LP. In some low-tech sub-sectors using imported materials (fabricated metal, furniture, rubber-plastics and wood excluding furniture), domestic firms (especially domestic private SMEs which dominate these sub-sectors) focused on labour-intensive processing and as a result domestic content and LP were low. Lastly, in sub-sectors that use locally-supplied materials (food, beverage, non-metallic mineral products), domestic content was high and LP higher than the manufacturing average LP (in these sub-sectors: LP levels were defined by labour or capital intensity of firms, such as the LP of the more capital-intensive beverage sub-sector exceeding that of the more labour-intensive food processing sub-sector). This is largely in line with the commonly agreed assessment that Viet Nam's growth model (and manufacturing, in particular) had been based on exploiting low cost/simple skilled labour and natural resources.

It should be noted that the correlation between domestic content of exports and share of VA out of revenue increased substantially, from 0.14 in 2011 to 0.31 in 2016. This means there is a positive association between increasing a firm's internal value and raising the country's domestic value addition and this association strengthened substantially during 2011-2016.

It is noted, however, that the analysis on domestic content in this section must be treated with a degree of caution. Firstly, the analysis used the GSO 2012 input-output table which may be outdated, despite being the most recent available in Viet Nam. Secondly, data on domestic content did not distinguish between and include "domestic" content produced by domestic and Viet Nam-based FDI firms. Therefore, the analysis in this sub-section cannot answer whether localized production of (increased domestic content in) exports meant increased participation of, and domestic content produced by, Vietnamese firms or Viet Nam-based FDI firms. The analysis of FDI participation, as shown in in the manufacturing sub-sector characteristics section, spotlights: (i) the higher shares of "domestic content" in textiles, wearing apparel, leather and footwear, chemicals, rubber-plastics, electronics, electrical equipment, machinery and equipment n.e.c, motor vehicles, other vehicles, furniture and other manufacturing are produced by Viet Nam-based FDI firms which dominate these sub-sectors in terms of employment size, revenue and VA share and (ii) the substantial shares of "domestic content" in beverages, basic metals and fabricated metal are produced by Viet Nam-based FDI firms which have medium employment and revenue, and large VA shares in these three sub-sectors. However, to fully answer this important question for policy formulation and adjustment, further analysis is needed and especially more granular research at sub-sector and firm levels, including in the next stage of this study.

Figure 2.39: Domestic content of exports of manufacturing sub-sectors



Source: Adapted from Pham Minh Thai et al (2018)

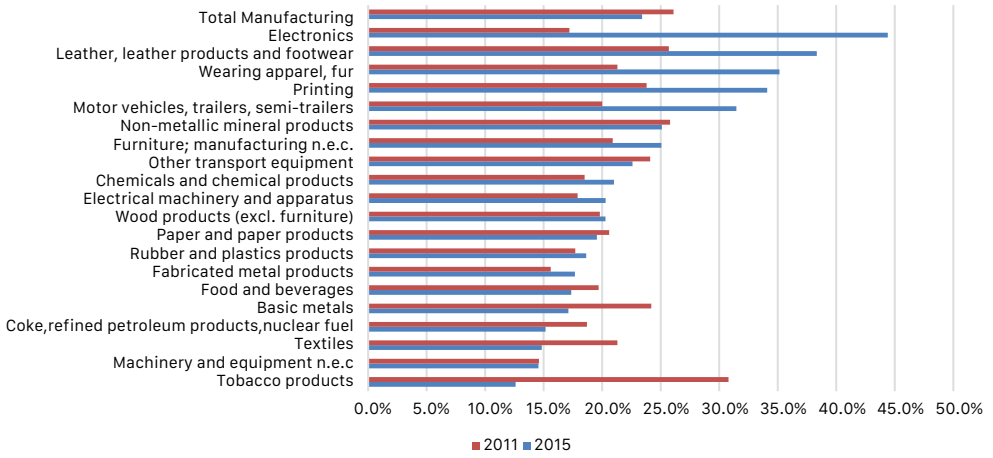
Performance measured by VA-to-output ratio

Figure 2.43, based on UNIDO database, shows that electronics, leather-footwear and wearing apparel were the top three in 2015. Other sub-sectors to post significant improvements in VA-to-output ratios between 2011-2015 included printing and motor vehicles and to a lesser extent furniture, chemicals, electrical equipment, wood (excluding furniture), rubber-plastics, fabricated metal and textiles. The remaining sub-sectors experienced VA-to-output ratio declines. Among the five top exporting sub-sectors, four (electronics, wearing apparel, leather-footwear and furniture) had VA-to-output ratios higher than the manufacturing average that substantially increased between 2011-2015. The only sub-sector with large positive net exports, but a VA-to-output ratio lower than the manufacturing average was food and beverages (noting UNIDO and UN Comtrade classification placed food and beverages in one sub-sector).

On the other side, sub-sectors with VA-to-revenue ratios lower than 20 percent included machinery n.e.c, tobacco, textiles, food and beverages, paper, basic metal, fabricated metal rubber-plastics. Chemicals, other vehicles and electrical equipment were also among the sub-sectors with VA-to-revenue ratios lower than the manufacturing average, but higher than 20 percent.

It should be noted that 2016 VA-to-revenue ratios were calculated using 2017 Enterprise Census data, which resulted in VA-to-revenue ratio calculations using two data sources and different estimation methods (described in Section 2.1) remaining consistent. However, there were some differences and thus, the report's analysis based on this ratio should be treated with caution (Box 2.6).

Figure 2.40: Value added-to-revenue ratio (%), 2011 and 2015

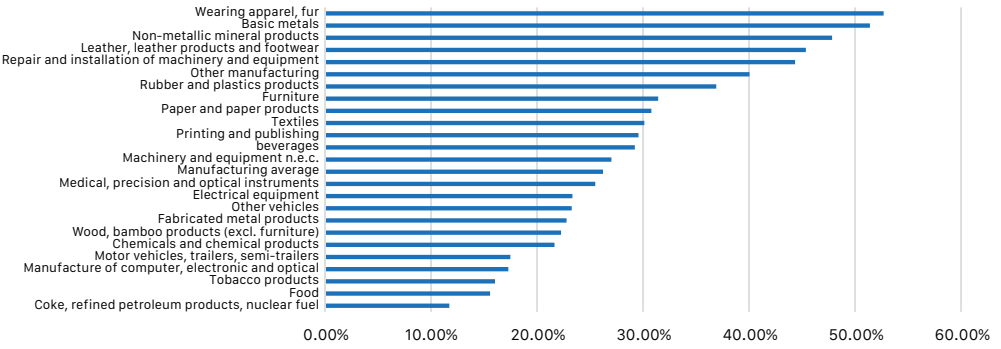


Source: Authors' calculation, UNIDO database

BOX 2.6: Value added-to-revenue ratio calculated using Enterprise Census data

Figure 2.41 shows the VA-to-revenue ratios of sub-sectors calculated using Enterprise Census data. While the key trend of VA improvement in sub-sectors remained similar to ratios calculated using UNIDO database, some differences were observed. Namely: (i) in many sub-sectors, VA-to-revenue ratios using Enterprise Census data were higher than VA-to-output ratios calculated using the UNIDO database, (ii) sub-sectors where large differences were observed included wearing apparel, non-metallic mineral products, paper, rubber-plastics, basic metal, textiles and electronics (noting differences in classification mentioned in Box 2.4).

Figure 2.41.: 2016 Value added-to-revenue ratio (%), using Enterprise Census data

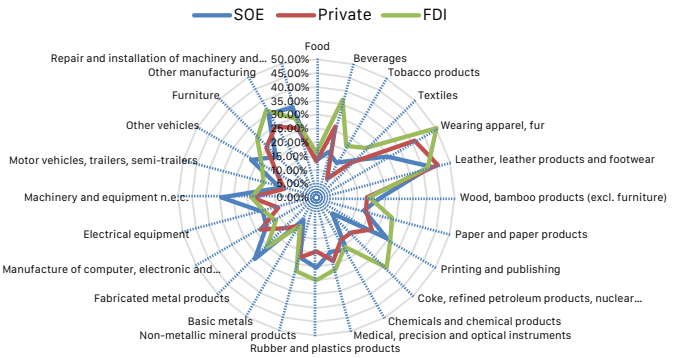


Source: Authors' calculation from Enterprise Census 2017

The differences are largely attributed to methods of VA estimation as well as other factors (and their combined effects), such as different definitions (output and revenue), different years of data, different classifications, data/level of depreciation and taxes used in VA estimations using Enterprise Census data in this report and the quality of Enterprise Census and UNIDO database.

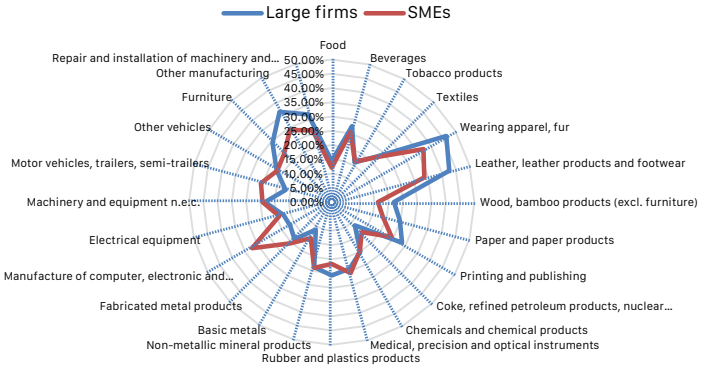
Across ownership forms, FDI firms tended to have higher VA to-revenue ratios than SOEs and domestic private firms. Similarly, large firms' VA-to-revenue ratios exceeded SMEs. The differences resembled those in LP as shown in the section on sub-sector LP performances (Figures 2.26,2.27.).

Figure 2.42a: Value added-to-revenue ratio by ownership (2016)



Source: Authors' calculation from Enterprise Census 2017

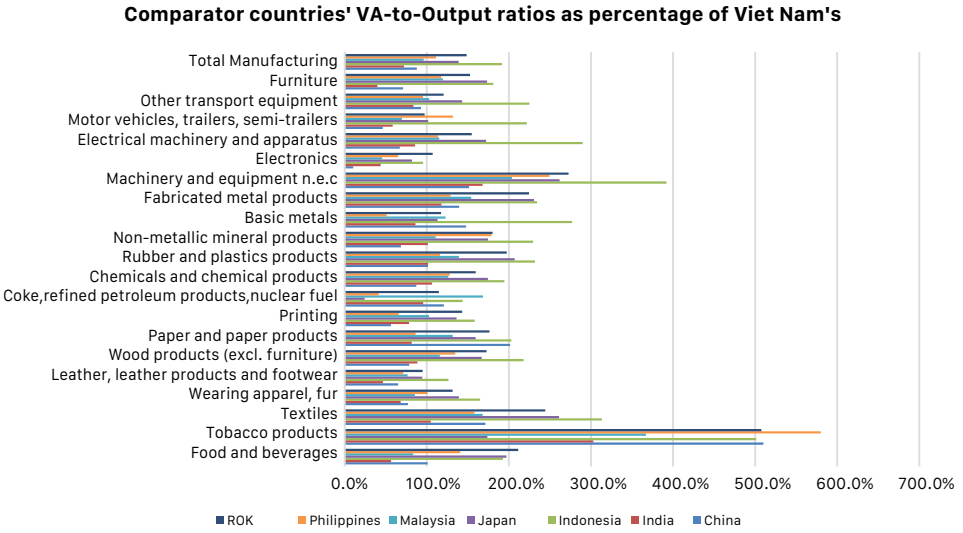
Figure 2.42b: Value added-to-revenue ratio by firm size (2016)



Source: Authors' calculation from Enterprise Census 2017

As international comparisons can shed light on Viet Nam's sub-sector competitiveness, the 2015 VA-to-output ratios of comparator countries as shares of Viet Nam's are presented in Figure 2.43 (constructed using data from UNIDO database[24], in 2015).

Figure 2.43: Comparator countries' VA-to-output ratios as percentage of Viet Nam's



Source: Authors' calculation, UNIDO database

Figure 2.43 shows that Viet Nam's ratios were higher than China's and India's in several sub-sectors (wearing apparel, leather-footwear, wood products excluding furniture, electronics, electrical machinery, motor vehicles, other transport equipment and furniture). While Viet Nam's electronics sub-sector VA-to-output ratio was higher than most comparator countries and its VA-to-output ratios were "within reach" of comparator countries in almost all sub-sectors, its VA-to-output ratio gaps with comparator countries remained wide in several sub-sectors (food and beverages, tobacco, textiles, wood products excluding furniture, paper, fabricated metal and machinery, equipment n.e.c., and coke-refined petroleum products-nuclear fuel).

24 *See the above footnote 9 on differences between revenue and output.*

Wage Growth and Competitiveness of Manufacturing

A topic of current hot policy debate in Viet Nam is wages and LP growth. Debate was initiated and fuelled by concern that wage growth is outpacing LP growth in favour of workers that results in erosion of international competitiveness of (Vietnamese and Viet Nam-based FDI) firms in the manufacturing sector, which is labour intensive and open to international competition.

Data from the ILO database indicates that during 2004-2015, real wages grew considerably faster than LP (Table 2.6) in Viet Nam (and modestly in Malaysia and Thailand).

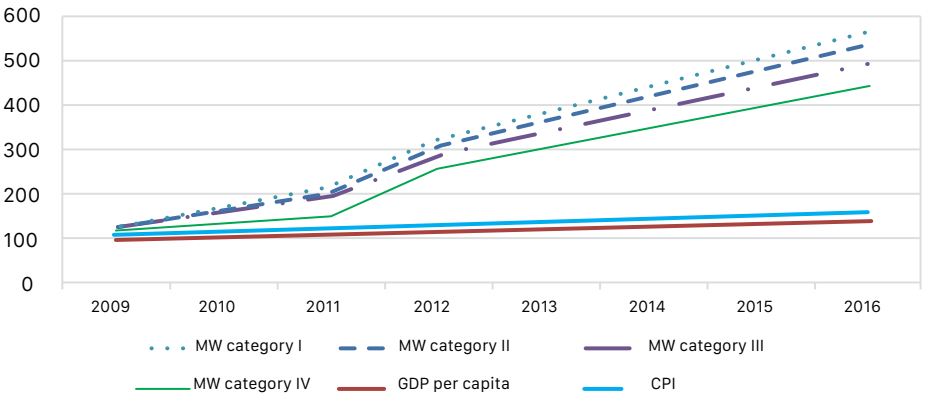
Table 2.6: Wage and productivity growth in Viet Nam and Asian countries 2004-2015 (average annual real wage growth deflated by the CPI, %)

Country	Productivity growth rates	Average wage growth rates
China	9.1	8.8
Indonesia	3.6	2.6
Malaysia	2.1	2.5
Philippine	2.6	0.4
Singapore	1.8	1.2
Thailand	2.7	3.5
Vietnam	4.4	5.8

Source: Nguyen Duc Thanh (2017), calculation from ILO database

Experts blamed minimum wages, adjusted too fast, that resulted in excessive upward pressure on real wages in Viet Nam (Figure 2.44)[25]. The World Bank's international comparison also revealed that Viet Nam's private sector minimum wage was high relative to other countries, with the average ratio of minimum to median wage at 58 percent[26].

Figure 2.44: Regional minimum wages[27], CPI and GDP per capita in Viet Nam, 2009-2016 (2008=100)



Note: Before October 2011, regional minimum wage qpplicable to domestic enterprises.

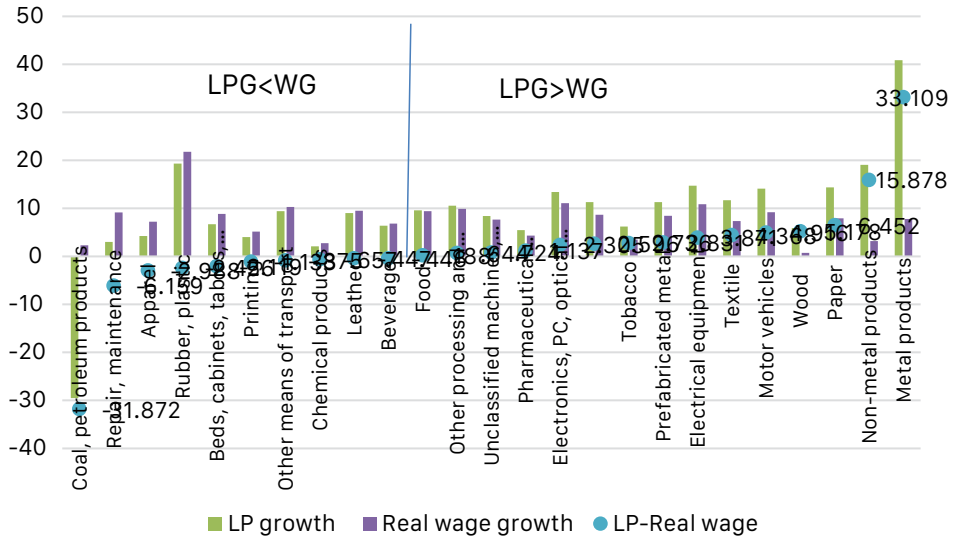
Source: VEPR (2017)

However, analysis of the Enterprise Census 2011-2016 dataset finds that during this period, manufacturing productivity growth (11.3 percent per annum) outpaced manufacturing real wage growth (8.7 percent per

25 *Source: VEPR (2017)*
26 *Source: World Bank (2016)*
27 *In Viet Nam, minimum wages differ across four regions considered to have different costs of living. Furthermore, up until 2011, there were two minimum wages applicable to domestic and foreign enterprises. Since 2007, to implement Viet Nam's WTO obligations on national treatment which do not allow dual pricing to discriminate against foreign firms, the minimum wage for domestic firms was adjusted up aggressively and the two have been unified since 2011.*

annum). Only less than half of manufacturing sub-sectors have annual rate of wage growth greater than that of LP growth (Figure 2.45, left of the vertical line), and amongst them, coke-petroleum products-nuclear fuel, printing, repair and installation of machinery were less open to international competition. The coefficient of correlation between these two variables is 0.4. Among the sub-sectors with annual LP growth outpacing wage growth, the largest gap was observed in the basic metals sub-sector (33 percentage points), followed by non-metallic minerals (15.78 percentage points).

Figure 2.45: Viet Nam's productivity (LPG) and wage growth in manufacturing, 2011-2016 (%)



Source: Authors' calculation, 2017 Enterprise Census

Furthermore, there should not necessarily be a one-to-one relationship between: (i) LP and wage growth and (ii) maintaining competitiveness (i.e. wage growth higher than LP should not necessarily lead to lower competitiveness). This nexus can be analyzed more rigorously through a simple economic model, which will show this relationship depends on technological change. Specifically, one can assume the production function has the Cobb-Douglas form with time varying technology $Y_t = A * K_t^{\alpha_t} * L_t^{\beta_t}$. Under the assumption of constant returns to scale (CRS), one have $\alpha t+\beta t=1$.

It can be shown (details are given in Section A.1.5, Appendix 1) that if workers' wage growth in real terms is proportional, by factor $\frac{\beta_{t+1}}{\beta_t}$, to LP growth, wage growth can be said to be competitiveness-neutral, as it is in line with technological change in the economy or sector. If the rate of wage growth is greater (smaller) than $\frac{\beta_{t+1}}{\beta_t}$, then wage growth is competitiveness-hurting (competitiveness-enhancing), both may not be sustainable in the long term, because they either hurt the owner of capital (the former case), or worker (the latter case).

To calculate $\frac{\beta_{t+1}}{\beta_t}$, one can estimate Cobb-Douglas production function with contant returns to scale (Table 2.7, columns 1, 2 and 3). This table shows that wearing apparel is the only sub-sector in the list where wage growth can be characterized as competitiveness-damaging, as the actual wage growth rate exceeded the competitiveness-neutral one by 11.8 percent (column 7). In the leather-footwear sub-sector, although real wage grew faster than LP by 0.45 percentage points (column 9), it is still seen as competitiveness-enhancing, as such a gap is more than justified by technological change in favour of labour[28]. In other sub-sectors electronics and textiles as well as in average manufacturing, wage growth is lower than productivity growth.

28 *In this simple production function, L integrates both quantity and quality of labour and therefore increases in labour share over time (i.e. $\beta t+1>\beta t$) may well be explained by the improvements of skills.*

Table 2.7: Productivity and wage growth and competitiveness in selected manufacturing sub-sectors

	Beta 2011	Beta 2016	Beta 2016/Beta 2011	Real wage growth 2011-2016 (ltime)	Productivity growth 2011 - 2016 (time)	Competitive - neutral wage growth	Deviation form competitive neutral wage growth	Annual rate of real wage growth	Annualrate of productivity growth	Difference between wage and productivity growth (per. points)
	(1)	(2)	(3)=(2)/(1)	(4)	(5)	(6)=(3)*(4)	(7)	(8)	(9)	(10)=(8)-(9)
Manufacturing	0.623	0.652	1.032	1.517	1.707	1.761	-13.90%	8.70%	11.30%	-2.6%
Textile	0.605	0.614	1.015	1.425	1.739	1.765	-19.30%	7.30%	11.70%	-4.37%
Apparel	0.767	0.79	1.03	1.417	1.231	1.267	11.80%	7.20%	4.20%	2.99%
Leather Footwear	0.752	0.774	1.029	1.574	1.542	1.587	-0.80%	9.50%	9.00%	45.0%
Electronics	0.637	0.615	0.965	1.693	1.876	1.812	-6.50%	11.10%	13.40%	-2.31%

Source: Authors' calculation, 2017 Enterprise Census

2.2.6 Summary and performance assessment of sub-sectors

While the manufacturing sector experienced remarkable productivity and competitiveness improvements during recent years, gaps to middle-income and developed comparator countries remain large.

The analysis in this section shows Viet Nam's manufacturing productivity and competitiveness performance, measured by different indicators (MVA-to-GDP ratio, VA-to-output ratio, RCA, CIP and LP rankings) have improved. In recent years, Viet Nam's industrial competitiveness index, manufacturing of exports and RCA have continuously improved compared to other countries in the region. In some indicators, such as VA-to-output ratio and RCA, Viet Nam outperformed India and Indonesia. In other manufacturing performance indicators, especially LP, Viet Nam lagged behind comparator countries with narrowing gaps still remaining large between Viet Nam and middle-income countries in the region (China, Indonesia and Malaysia) and very large to industrialized countries (Japan and RoK). While IR4.0 accelerates and leaves simple skilled and repetitive manufacturing jobs at risk to automation, the majority of Viet Nam's manufacturing firms have low levels of IR4.0 readiness.

Within this overall manufacturing sector trend, the analysis at sub-sector level summarized in Table 2.8, shows a much more nuanced picture that implies different challenges and opportunities as well as suggests policy implications to improve productivity and competitiveness across different sub-sectors.

Table 2.8: Summary of manufacturing sub-sector characteristics and performance

VSIC code	Subsectors	Subsector size	Net export (2016)	Large Firm paricipation level (2016)	SME paricipation level (2016)	FDI participation level (2016)	SOE participation level (2016)	Domestic Private participation level (2016)	Labor Productivity(2016, VND million, 2016 price)	RCA (2016)	Domestic contents (%)	VA-to-output ratio (%), 2015 (UNIDO databse)	Wage growth vs. LP growth (LP growth minus wage growth)
10	Food	Large		High	low (medium in employment)	Medium	Low	High	283 (medium level among VN manufacturing subsectors)		67%		Positive
11	Beverages	Medium (low in employment)	Large positive net export	High	low (medium in employment)	Medium (high in VA)	Low	Medium (high inemployment)	manufacturing subsectors) - food and beverage: is catching up with comparator countries	1.281	70%	17.4% low level, big gaps with comparators	Negative but competitiveness enhancing
12	Tobacco products	Small	Medium positive net export	High	low	Medium (low in employment)	High	Low	407 (high level among VN manufacturing subsectors) - gaps with comparators widened	Less than unity	48%	12.6% low level, big gaps with comparators	Positive
13	Textiles	Large (medium in revenue)	Negative net export	High	Medium (low in revenue)	High	Low	Medium	263 (medium level among VN manufacturing subsectors), catching up with comparator countries	2.33 (within reach to comparators)	46%	14.8% low level, big gaps with comparators	Positive
14	Wearing apparel, fur	Large	Large net positive export	High	Low	High	Low	Medium	81 (low level among VN manufacturing subsectors) - gaps with comparators widened/slowly narrowed	5.067	60%	35.1% - high level, within reach to comparators	Negative and competitiveness damaging
15	Leather, leather products and footwear	Large	Large net positive export	High	Low	High	Low	Low (medium in VA)	manufacturing subsectors) - large gaps with comparators widened/slowly narrowed	6.941	60%	38.3% high level, higher/ within reach to comparators	Negative, ompetitiveness enhancing
16	Wood, bamboo products (excl. furniture)	Small (medium in employment)	Medium positive net export	Medium	High	Low	Low	High	141 (low level among VN manufacturing subsectors) - gaps with comparators fast narrowing	1.863	31%	20.3% medium level, narrow gaps with comparators	Positive
17	Paper and paper products	Small (medium in VA)	Negative net export	High (medium in employment)	Medium (high in employment)	Medium (high in VA)	Low	High	VN's manufacturing subsectors, (large gaps with comparators narrowing fast)	Less than unity	55%	19.5% low (high EC data), big gaps with comparators	Positive
18	Printing and publishing	Small	Medium positive net export	Medium	High	Medium	Low	High	146 - low level among VN's manufacturing subsector - gaps with comparators slowly narrowing	Less than unity	55%	34.1%, high level, narrow gaps with comparators	Negative but competitiveness enhancing
19	Coke, refined petroleum products, nuclear fuel	Small	Negative net export	High	Low (medium in employment)	Low	High (medium in employment)	Medium (high in employment and low in revenue)	998 - high level among VN's manufacturing subsectors (within reach to comparators)	Less than unity	43%	15.2% low level, big gaps with comparators	Negative
20	Chemicals and chemical products	Medium (low inemployment, high in revenue)	Negative net export	High	Medium	High (medium in employment)	Low	Medium (high in employment)	457 - high level among VN's manufacturing subsectors, large gap with comparators narrowing fast	Less than unity	51%	21% medium level, big gaps with comparators	Negative but competitiveness enhancing
21	Medical, precision and optical instruments	Small	Negative net export	High	Low (medium in employment)	Medium	Low	High	311 medium level among VN's manufacturing subsectors, NA int. comparisons	Less than unity	58%	NA	Positive
22	Rubber and plastics products	Large	Negative net export	High	Medium	High	Low	High	328 medium level among VN's manufacturing subsectors (large gaps narrowing slowly)	Less than unity	38%	18.6% low level (high EC data), big gaps with comparators	Negative but competitiveness enhancing
23	Non-metallic mineral products	Large	Medium positive net export	High	Medium (low in VA)	Medium (low in employment)	Low	High	460 - high level among VN's manufacturing subsectors, (large gaps narrowing slowly)	1.068	65%	25.1% medium level (high EC data), big gaps with comparators	Positive
24	Basic metals	Large (low in employment)	Negative net export	High	Low (medium in employment)	Medium (high in VA)	Low	High (low in VA)	2031 High level among VN's manufacturing subsectors (within reach to comparators)	Less than unity	42%	17.1% low level (high EC data), medium gaps with comparators	Positive
25	Fabricated metal products	Large	Negative net export	High (medium in employment)	High (medium in revenue)	Medium (high in VA)	Low	High	285 medium level among VN's manufacturing subsectors, (largte gaps with comparators narrowed slowly)	Less than unity	44%	17.7% low level, big gaps with comparators	Positive
26	Electronics	Large	Large net positive export	High	Low	High	Low	Low	451 high level among VN's manufacturing subsectors (within reach to comparators)	3.68	33%	44.4% high level (low EC data), higher or within reach to comparators	Positive
27	Electrical equipment	Medium	Negative net export	High	Low (medium in VA)	High	Low	Medium	340 medium level amon VN's manufacturing subsectors, (large gaps with comparators narrowed slowly)	Less than unity	35%	20.3% medium level, medium gaps with comparators	Positive
28	Machinery and equipment n.e.c.	Small	Negative net export	High	Medium (high in employment)	High	Low	Medium (high in emplovmment)	278 medium level among VN's manufacturing subsectors, Large gaps with comparators narrowing fast	Less than unity	32%	14.6% low level, big gaps with comparators	Positive
29	Motor vehicles, trailers, semi-trailers	Medium (high in revenue)	Negative net export	High	Low	High	Low	Medium (low in emplovmment)	404 high level among VN's manufacturing subsectors, (largte gaps with comparators narrowed slowly)	Less than unity	45%	31.5% high level, within reach to comparators	Positive
30	Other vehicles	Medium (low in employment)	Medium positive net export	High	Low	High	Low	Low (medium in empployment)	406 High level among VN's manufacturing subsectors, small gaps with comparators narrowed fast)	Less than unity	49%	22.6% medium level, medium gaps with comparators	Negative but competitiveness enhancing
31	Furniture	Medium (high in employment)	Large net positive export	High	Medium	High	Low	High	112 low level among VN's manufacturing subsectors (gaps narrowing fast.	Less than unity	40%	25.1% medium level, medium gaps with comparators	Negative but competitiveness enhancing
32	Other manufacturing	Small (medium in employment)	NA	High	Low (medium in revenue)	High	Low	Low (medium in employment)	156 low level among VN's manufacturing subsectors, NA int. comparison	1.442	46%	NA	Positive
33	Repair,installation of machinery and equipment	Small	NA	Medium	High	Low	Medium (high in VA)	High (medium in VA)	212 medium level amongf VN's manufacturing subsectors, NA int. comparison	Less than unity	56%	NA	Negative
	Manufacturing	NA	NA	High	Low (medium in employment)	High	Low	Medium	248 (large gaps narrowing slowly)	1.02	49%	23.4% medium gaps with comparators	Positive

Notes:

Subsector size, FDI/SOE/Domestic firm participation level are measured by their employment, revenue and VA shares in manufacturing/subsectors.

Color coding

large/high/fast: (1) subsector share in total manufacturing employment, revenue and VA above 4%, (2) FDI, SOE and domestic private firm share in subsector employment, revenue and VA above 45%, (3) LP higher than VND350million; (4) Domestic contents>60%; (5) VA/output>30%, (6

Medium: (1) subsector share in total manufacturing employment, revenue and VA 2-4%; (2) FDI, SOE and domestic private firm share in subsector employment, revenue and VA 20-45%; (3) LP >200 and <350 VND million; (4) Domestic contents>40% and <60%; (5) VA/ouput<30% and >20%,

Small/low/slow: (1) subsector share in total manufacturing employment, revenue and VA less than 2%; (2) FDI, SOE and domestic private firm share in subsector employment, revenue and VA less than 20%; (3) LP<200VND million; (4) Domestic contents<40%; (5) VA/output<20%, (6) net

Manufacturing sub-sectors differ by importance to the economy

Manufacturing sub-sectors differ in size and contributions to exports, measured by sub-sector employment, revenue and VA shares in the manufacturing sector and net export values indicating levels of importance to the manufacturing sector and economy as a whole.

- Food and beverages, furniture (medium-tech), textiles and wearing apparel[29], leather-footwear (low-tech) and electronics (high-tech) are large-sized sub-sectors (except beverages and furniture are medium-sized) making important contributions to the manufacturing sector and economy in terms of job creation, revenue, value addition and exports.
- Wood (excluding furniture), printing and tobacco are small-sized (and low-tech), other vehicles (high-tech) is medium-sized and non-metallic mineral products is (medium-tech) a large-sized sub-sector contributing to manufacturing exports (with RCA>1).
- Sub-sectors with high and medium technology, large and medium-sized, negative net exports (import substitution) and RCA<1 include: (rubber-plastics, basic metal, fabricated metal), large-sized sub-sectors (chemicals, electrical equipment and motor vehicles), medium-sized sub-sectors (coke-petroleum-nuclear fuel, paper products, medical precision-optical equipment, machinery and equipment n.e.c.) and small-sized sub-sectors (repair and installation of machinery and other manufacturing).

SOEs, FDI and domestic private firms differ in sub-sector participation levels, sizes and operate with weak linkages

FDI is the biggest player in manufacturing, dominating the majority of sub-sectors with large sizes and net export values as well as in high- and medium-technology import substitution sub-sectors, but has weak linkages to domestic firms.

FDI was the biggest employer (hiring 55.52 percent of workers) in manufacturing, had the largest share in manufacturing revenue (58.46 percent) and MVA (64.44 percent) in 2016. FDI participation levels (measured by employment, revenue and VA shares in manufacturing) was high in 12 out of 24 manufacturing sub-sectors (taking into account sub-sectors where FDI's VA share was high, the number of sub-sectors FDI dominated was 16 out of 24). FDI also had a high participation level in four out of the top five manufacturing exporting sub-sectors (textiles and wearing apparel, leather-footwear, electronics and furniture), and a medium participation level in food and beverages - the fifth-largest exporting manufacturing sub-sector (FDI had a high VA share in beverages, while domestic private firms have high participation levels in food processing and medium levels in beverages). FDI had high and medium participation levels in other vehicles and non-metallic mineral products, respectively – two of the remaining four sub-sectors with positive net exports. Among import substitution (with negative net exports) sub-sectors, FDI had high and medium participation levels in large sub-sectors (rubber-plastics, basic metals and fabricated metals), medium-sized sub-sectors (electrical equipment, motor vehicles, chemicals) and small-sized sub-sectors (medical precision-optical equipment, machinery n.e.c, other manufacturing, paper, printing). FDI only had low participation in three small-sized sub-sectors: wood and bamboo products (excluding furniture), coke-petroleum-nuclear fuel and repair and installation of machinery.

It is important to note that despite FDI's major employment, revenue and VA shares in many sub-sectors, its linkages with domestic firms remain weak and especially so in high and medium-tech sub-sectors. Its resource-based sub-sector linkages tend to be slightly stronger.

SOEs are the smallest player in manufacturing, dominating in only two small-sized sub-sectors.

SOEs are a minor manufacturing employer (only 3.6 percent workers), with the lowest shares in manufacturing revenue (6.07 percent) and MVA (4.77 percent). SOEs only dominate in two small-sized manufacturing sub-sectors: coke-refined petroleum products (negative net exports) and nuclear fuel and tobacco (positive net exports). SOEs also have "significant" VA shares in the small-sized repair installation of machinery sub-sector (24.96 percent) and in medium-sized beverages (24.18 percent). In the remaining sub-sectors, SOEs have low participation levels.

29 The textile sub-sector had negative net exports, but as noted earlier it produced inputs for wearing apparel's exports so taking textiles and wearing apparel together in one "sub-sector", the combined sub-sector was large-sized and a positive net exporter.

Domestic private firms (commonly SMEs) are the second biggest player in manufacturing, dominating in two sub-sectors with large positive net export values, high participation levels in several sub-sectors with large-sized and positive net exports and limited participation in export-led sub-sectors where FDI and SOEs dominate.

Domestic private firms are the second biggest manufacturing employer (40.88 percent), with the second highest revenue shares in manufacturing revenue (35.47 percent) and MVA (30.79 percent). Food and beverages and furniture are only two (of five top exporting) sub-sectors that domestic private firms have high levels of participation in (medium participation and high employment in beverages). Domestic firms also dominate in non-metallic mineral products (large-sized with medium positive net exports), wood and bamboo (excluding furniture) and printing (small-sized and medium positive net exports) and medium participation in wearing apparel and textiles (large-sized and positive net exports). In the remaining large and medium-sized sub-sectors with positive net exports where FDI (and SOEs) dominate, domestic firms only have low participation. In import substitution sub-sectors, domestic firms have high participation levels in basic metals (with low VA), fabricated metal, rubber-plastics, medical precision-optical equipment, repair and installation of machinery. This contrasts with FDI firms and SOEs that tend to be large-sized, while domestic private firms are often SMEs.

Productivity and competitiveness performance varies substantially across manufacturing sub-sectors

Top exporting sub-sectors

- Electronics

Is the (high-tech) sub-sector with the highest VA and revenue shares, large employment share and positive net exports[30] among Viet Nam's manufacturing sub-sectors. Its high RCA has risen exponentially since 2010 and reached 3.68 in 2016, higher than electronics RCA values of almost all comparator countries. Electronics' LP - the fourth-highest among Viet Nam manufacturing sub-sectors in 2016 with rises between 2011-2016 (while wage growth was lower than LP growth) - was assessed as "within reach" of comparator countries' levels. The VA-to-output ratio was 44.4 percent (UNIDO database) (17.29 percent - EC data), the highest compared to Viet Nam's other manufacturing sub-sectors and higher/"within reach" of comparator countries, while LP growth outstripped wages.

It is noteworthy that: (i) with FDI's VA share at 98.41 percent, most electronics output and exports were generated by big foreign corporations largely from Japan and RoK, such as Canon, LG, Nidec, Panasonic and Samsung (attracted by Viet Nam's cheap labour and preferential policies to set up assembly plants), (ii) electronics FDI firms almost exclusively focused on the assembling component stage (mostly imported by FDI enterprises and the remainder produced by other FDI enterprises or self-produced, World Bank, 2017) and packaging final products in Viet Nam, with low backward-forward linkages. Electronics exports had low domestic content (mainly labour) levels of 33 percent among the lowest compared to other manufacturing sub-sectors despite signs of improvement (Box 2.7) and (iii) key products contributed most to the sub-sector's revenue and exports, including smartphones and computers. TVs and other electronics products were also for the domestic market.

30 The electronics sub-sector's export value reached USD22.9 billion in 2012 and doubled to USD57 billion by 2015, accounting for 30.7 percent of Viet Nam's total exports. Viet Nam became the 12th largest electronics exporter in the world and ranked third in ASEAN within five years (DBS Research Group: 2015). In particular, Viet Nam is becoming a hub for electronics production and the second largest exporter of smartphones in the world behind China (BDG, 2016). Currently, computers and electronic products exported from Viet Nam are presented in more than 30 countries and regions. The EU remains the largest importer of this product group from Viet Nam, followed by the US. China and RoK are also two major export markets for electronic goods in Viet Nam. Because FDI firms almost exclusively focus on the stage of assembling imported components and packaging the final products in Viet Nam, exports go hand-in-hand with imports in the electronics sub-sector. According to the General Department of Customs, the value of electronic goods imports has increased steadily and by 2015, the import value of the electronics industry was estimated at USD36.39 billion, about 22 percent of Viet Nam's total imports. Imports of parts and components mainly came from major countries such as RoK (29.1 percent), China (22.5 percent) and ASEAN (15.4 percent), Japan, Taiwan and the US.

Box 2.7: Signs of strengthening linkages between Samsung and domestic firms

As Samsung's presence in Viet Nam grows it allows domestic firms to accumulate experience and build necessary capacity to meet the stringent requirements of Samsung. Its Vietnamese suppliers have grown from four first-tier vendors in 2014 to 29 first-tier vendors in 2017[31]. Similarly, the number of second-tier suppliers has also increased to nearly 300 enterprises[32]. Samsung plans to increase the number of Vietnamese suppliers to 500 by 2020 (Minh Duc, 2017). Samsung Viet Nam made great strides in increasing its localization rate, from 35 percent in 2014 to 51 percent in 2016[33]. Domestic supplier-firms such as Minh Nguyen company (established in 2015 and in 2018 became a first-tier Samsung supplier of plastic components), Goldsun (started cooperation with Samsung in 2010 and supplies 20 percent of Samsung smartphone cases) and others engaged in producing Samsung smartphone components (such as 3D lenses, metallic cases, displays and batteries) have contributed to Samsung's localization rate of 58 percent in 2018[34]. This presumably provides an important explanation for the substantial reduction in Viet Nam's trade deficit with China, as the large flows of exports and imports between the two countries are through the Samsung-led GVC.

Such encouraging developments are largely attributed to joint efforts of the Government of Viet Nam and Samsung to strengthen the corporation's linkages with Vietnamese firms. Specifically, the MOIT and Samsung Viet Nam signed a memorandum of understanding in March 2018 on training 200 qualified Vietnamese consultants to advise and train Vietnamese supporting enterprises to participate more deeply in Samsung's GVC. As part of this programme, on 10 July 2018, Samsung Viet Nam in cooperation with the MOIT completed the First Supporting Industry Consultant Training Course, in which the first 25 Vietnamese experts spent three months with Korean experts in the field of manufacturing innovation and quality improvement[35].

Vietnamese firms, however, face challenges when attempting to move up the value chain to upgrade technological capabilities, increase value addition and sustain long-term growth. Interviews with Vietnamese firms supplying parts and components or receiving technical assistance from Samsung as potential suppliers revealed that although working with Samsung was rewarding, it posed considerable risks and barriers which many Vietnamese firms found difficult to overcome. Notably, Samsung's orders are in large volume with short lead times, among the biggest challenges for Vietnamese firms. This contrasts with Japanese firms that often place orders well in advance, sometimes a year before actual delivery. Besides "traditional" barriers such as access to capital and land, weak linkages between local (often SME) firms, weak capacity of the ecosystem to support local firms in application of new technology and innovation (especially in high-quality technology universities and research centres to support domestic firms with necessary human resources), R&D, technology and innovation-related inputs remain key challenges to strengthen local firms' participation in (Samsung-led in the case of Samsung smartphones and in general) GVCs.

Overall, Viet Nam's (FDI-dominated) electronics sub-sector (especially computers and smartphones) can be assessed as "competitive" at the stage of final product assembling with a "promising" increase in domestic suppliers of components, as long as: (i) foreign firms can maintain competitiveness of products, (ii) Viet Nam's sub-sector LP and wages remain competitive amid high risks of losing repetitive assembling jobs to automation and (iii) Viet Nam's domestic firms can accelerate participation as major

31 *https://news.samsung.com/vn/29-doanh-nghiep-viet-la-nha-cung-cap-cap-1-cho-samsung*
32 *http://nhipcaudautu.vn/thuong-truong/samsung-nham-toi-muc-tieu-nang-ty-le-noi-dia-hoa-len-57-3324291/*
33 *https://news.samsung.com/vn/khao-sat-doanh-nghiep-viet-nam-tao-co-hoi-tham-gia-chuoi-cung-ung-toan-cau-cua-samsu*
34 *http://cafef.vn/hanh-trinh-cua-thuong-hieu-viet-tien-vao-chuoi-gia-tri-samsung-mitsubishi-vi-tu-ai-20190202090256359.ch*
35 *https://news.samsung.com/vn/be-giang-khoa-dao-tao-chuyen-gia-tu-van-cong-nghiep-ho-tro-lan-thu-nhat*

suppliers in domestic and global value chains. Electronics sub-sector industries that focus on assembling electronic home appliances for the domestic market (to substitute imports) also risk FDI firms moving assembling plants to other countries if Viet Nam is no longer competitive compared to other countries as a result of trade agreements. Looking forward, strengthening backward-forward linkages between FDI and domestic firms, accelerating domestic firms' linkages in GVCs and moving to higher value chain stages will need prioritization.

- Wearing apparel and textiles, leather-footwear

Labour intensive and low-tech wearing apparel is Viet Nam's biggest sub-sector employer, with the fifth largest revenue and VA shares among manufacturing sub-sectors, while the more capital-intensive textiles ranked ninth in employment and 11th in VA. The labour intensive and low-tech leather-footwear was the second-largest sub-sector employer, yet ranked seventh and sixth in revenue and VA, respectively. The wearing apparel and leather-footwear sub-sectors were the second and third largest exporting manufacturing sub-sectors, while textiles had negative net exports and provided important inputs for the export-oriented wearing apparel sub-sector. All three sub-sectors were among the few manufacturing sub-sectors that have RCAs higher than unity: leather-footwear had the highest RCA 6.94 (only lower than Cambodia's), followed by wearing apparel at 5.07 (only lower than Bangladesh's and textiles ranked fourth) after electronics with an RCA of 2.33 (lower than Bangladesh's, China's and India's) in 2016.

All three sub-sectors have high participation levels of FDI firms, the VA share of which in leather-footwear was 82.4 percent, textiles (71.42 percent) and wearing apparel (58.5 percent), while SOE participation was low and domestic private firms' participation was medium. Domestic private sector firms: (i) consisted mainly of SMEs, the largest employment share in wearing apparel, a sub-sector with productivity less sensitive to firm size and (ii) are small employers, despite the medium VA share in leather-footwear. In these sub-sectors, like in many others, FDI firms' backward-forward linkages with domestic firms were very weak: backward linkages in wearing apparel were only 7 (of 100) and almost zero in leather-footwear, while higher in textiles (56.8). Forward linkages in leather-footwear were (30), apparel (24) and textiles (13).

Despite being leaders in terms of exports, employment, revenue, VA and dominated by FDI, the LP of wearing apparel, leather-footwear were the lowest among Viet Nam's manufacturing sub-sectors and LP gaps with comparator countries either widened or narrowed very slowly. More capital-intensive textiles had medium LP and the gap with comparator countries had narrowed, its VA-to-output ratio was low and gaps with comparator countries were wide. The VA-to-output ratios of leather-footwear, and wearing apparel were high and gaps with comparator countries were closing fast. It should be noted that in leather-footwear, and wearing apparel wage growth was higher than LP growth (while the gap between LP and wage growth remained "competitiveness enhancing" in leather-footwear, in wearing apparel it was assessed as "competitiveness damaging" reflecting the stronger competition for simple skilled and young workers within Viet Nam and weaker international competitiveness of the sub-sector). Textiles had LP growth higher than wage growth.

Overall, Viet Nam's wearing apparel, textiles and leather-footwear sub-sectors mainly focused on the final stage of physical production in value chains (producing final products based on foreign firms' orders) and can be assessed as competitive in the short term. However, this "competitiveness" was weakening based on widening or slowly-narrowing LP gaps with comparator countries (except textiles) and wearing apparel's damaging competitiveness wage growth in addition to its long struggle to move vertically up value chains (Box 2.8). These sub-sectors' future competitiveness depends on several factors: (i) foreign firms' ability to maintain competitiveness of products, (ii) Viet Nam's sub-sector LP and VA-to-output ratio's ability to continue growing and (iii) how the high risk of losing repetitive jobs to automation will unfold. Given these sub-sectors' large sizes and importance to Viet Nam's economy in terms of GDP, exports and employment, the impacts of not effectively increasing productivity and competitiveness

as well as managing automation risks to jobs will be highly significant for Viet Nam's socio-economic development. In the short-term, the leather-footwear, textiles and wearing apparel sub-sectors will benefit from CPTTP, which will: (i) allow a 95-98 percent tax reduction on Viet Nam's exports and (ii) have stricter product of origin requirements for Viet Nam's garment and leather-footwear exports, which in principle will lead to higher demand for made-in-Viet Nam products. As such, CPTTP will offer significant opportunities for leather-footwear, textiles and wearing apparel sub-sectors for growth and development of local value chains, including local firms to climb value chains. However, as noted above, challenges in realizing such opportunities remain significant. Viet Nam's wearing apparel and leather-footwear sub-sectors heavily depend on textile inputs imported from China and India, the key question is how domestic textile firms (large and capital intensive, and especially producing synthetic fibers) will grow in number and size to seize the new demand. If Viet Nam's domestic firms fail to grasp these opportunities, Viet Nam-based FDI firms will swoop and build on their current VA dominance in the textile sub-sector (as experienced in wearing apparel and leather-footwear sub-sectors, many FDI firms have already increased investment in Viet Nam-located textile plants in anticipation of CPTTP approval).

Box 2.8: Increasing local content and VA-to-output ratio via development of local value chain — motorcycle and garment and textile cases

"Local value chain" is defined as the chain of production that involves a network of interconnected local enterprises that generate domestic value within the chain. The policy aim is to develop a value chain that improves local firms' technical capabilities, competitiveness and market integration within and across local industries first in the local market and then in the global market. It is expected that as local firms move along the value chain, more value is added to their component production and final outputs. Table 2.9 provides typical stages of textile and garment (upper panel) and motor vehicles (lower panel) industries that can also be generally applied for other industries such as electronics, food and beverages, and electrical equipment.

Table 2.9: Value chain stages (textiles and garments (upper panel) and motor vehicles (lower panel))

Stage 1: Raw material suppliers (cotton, wool, silk, hemp, oil/gas)	Stage 2: Textile companies (thread, yarn, fabric, polymers, synthetic fibres, cloth)	Stage 3: Clothing manufacturers (cutting, assembling, finishing)	Stage 4: Wholesalers and exporters (labelling, packaging, shipping)	Stage 5: Retailers (marketing, sales)
Stage 1: Local assembling	Stage 2: Suppliers to local or foreign assemblers	Stage 3: Suppliers to first-tier foreign suppliers	Stage 4: Suppliers to foreign-led firms	Stage 5: Local lead firms with domestic-branded products

Development processes require capability development of local firms, especially from a technological standpoint. Capability building of local firms takes time and goes through stages within the value chain.

In Stage 1, foreign lead firms relocate assembling facilities to developing countries and hire local workers to assemble all components imported from abroad (or cutting and assembling cloth) into final products with foreign bands. There is little technology diffusion at this stage, as assembling does not require a transfer of technology from advanced to developing countries. In addition, a number of foreign component suppliers, especially those with established relationships with lead firms in their home countries, move production to developing countries to provide components for foreign lead firms.

These suppliers are regarded as first-tier suppliers, implying they sell components directly to lead firms. In Stage 2, local firms move to produce basic and low-tech components for local and foreign assemblers. In Stage 3, local firms become second-tier suppliers. They establish relationships and supply specific and more complex components to first-tier suppliers. The local second-tier suppliers benefit from collaboration with first-tier suppliers and lead firms. At this stage, many foreign firms transfer technology and expertise to support technical learning to these local suppliers.

Technology adoption and technical learning also speed up, corresponding to the component's level of complexity. In the final two stages, local firms become first-tier suppliers, supplying complex parts directly to foreign lead firms (Stage 4) and become the lead firms themselves (Stage 5). As lead firms, they produce Vietnamese-branded products. From a developing country's perspective, Stages 4 and 5 indicate high levels of technological upgrading, especially when local firms become capable of designing, manufacturing, and branding final products using local components and labour. This local value chain does not distinguish whether local firms supply for local industries or foreign buyers.

In the motorcycle industry, during 1995-2000, Vietnamese firms mainly engaged in the first stage, and Viet Nam failed to achieve significant technology transfers. Although there were numerous local firms (mainly SOEs that entered into joint ventures with Japanese firms) engaged in the production of replacement parts, these firms were largely outside the procurement networks of foreign lead firms. As the result of "China shock" (cheap Chinese motorcycles penetrating and capturing the low-end Vietnamese market), local content and movement of (domestic and foreign Viet Nam-based firms) firms to Stages 2, 3 and 4 accelerated. As a result: prior to 2005, this industry accounted for 3.1 percent of the total industrial production value of the country, which grew to 23.9 percent by 2007 and starting in 2010, the major foreign motorcycle-makers in Viet Nam started to export production surplus to other markets (in 2011, Honda exported 300,000 motorcycles to the Philippines, Cambodia, Laos and Afghanistan) and by 2012 the local content ratio, measuring the percentage of domestic parts in each motorcycle, was between 70 and 95 percent (for instance, Honda's local content ratio reached nearly 95 percent on some of its models). The motorcycle industry provides an exemplary case study of industrial upgrading predominantly driven by FDI starting in the early 1990s. This industry also offers an example of how market competition among Japanese and Chinese manufacturers led to significant technical learning and capability building for local firms, despite the Vietnamese Government's failure to effectively implement policies.

In the (labour intensive and less economy-of-scale sensitive) garment and (more capital intensive and economy-of-scale sensitive) textile industry, despite the fast-growing volume of garment exports, the average profitability was only 5-8 percent and the rate of value addition was about 20 percent in 2010 as Vietnamese firms, largely engaged in Stage 3 – clothing manufacturing, failed to pursue upgrading strategies to move up the value chain due to the sector's heavy dependence on imported materials (as supply of raw materials and textile production shrank) and production and local abilities in design, branding, and product differentiation are still very limited.

Sources: "Local Value Chain Development in Viet Nam: Motorcycles, Technical Learning and Rents Management", Christine Ngoc Ngo, JOURNAL OF CONTEMPORARY ASIA, 2017, VOL. 47, NO. 1, 1–26, http://dx.doi.org/10.1080/00472336.2016.1214744, and Ngo, Ngoc Thai Hong (2013) Technology adoption in rent seeking economies: the case of Viet Nam. PhD Thesis. SOAS, University of London, http://eprints.soas.ac.uk/17838.

Recently, with Vinfast's USD3.5 billion project becoming operational, Viet Nam's motor vehicle industry for the first time has a local lead firm with domestic-branded cars and electric bikes. Learning from past experience, it is important for policy-makers to work closely with Vinfast and Vietnamese firms to develop local value chains by providing support to improve Vietnamese firms' technical capabilities, competitiveness and market integration within and across local industries, first in the local market and then in the global market.

More recently, the garment industry experienced a significant increase in VA-to-output ratio (23 percent in 2011 to more than 35 percent in 2015 – UNIDO database). This can be attributed to: (i) efforts of Vietnamese producers in active marketing and sales (Stage 5) largely in the domestic market, especially in promoting medium- to high-end apparels, a stepping-stone to eventually penetrating the international market, (ii) some improvement in the textile industry (Stages 1 and 2 in garment and textile value chain in Table 2.9) resulting in less dependency by the garment industry on imported materials and (iii) some technical process and product upgrading undertaken by garment firms (while functional upgrading, moving up value chains remains modest: out of 108 firms surveyed in 2018 only one had functionally upgraded) source: Economic Upgrading in global value chains – opportunity for social upgrading: a case study of Viet Nam's apparel and electronics sectors – CAF/VASS and JustJobs network, November 2018 (source: CAF-VASS 2018). It is noted, however, that: (i) the garment sub-sector's LP remains low and slowly catching comparator countries, (ii) despite improvements, the textile sub-sector has negative net exports (with a high level of (Viet Nam-based) FDI participation and low VA-to-output ratio) and (iii) the garment sub-sector still heavily depends on imported materials and firms are still largely engaged in Stage 3 (manufacturing cloth using designs and materials supplied by foreign partners). This indicates more effort is needed to accelerate Vietnamese firms into higher stages of the local value chain, such as in supplying textile materials and developing and marketing Vietnamese brands for local and export markets (extremely difficult due to Vietnamese firms' ability to design and brand remain limited).

- Food and beverages, and furniture

(Low-tech) furniture, food processing and (medium-tech) beverages are the fourth and fifth largest of Viet Nam's manufacturing export sub-sectors, noting that food processing contributes most to "food and beverage" exports (while beverages mainly serve the domestic market), with RCA values larger than unity at 1.44 and 1.28, respectively. Food processing ranked second in revenue share, third in VA and fourth in employment, while beverages (a medium-sized sub-sector) had a low rank in employment (fifth from bottom), revenue and VA (10th from bottom). Furniture is a medium-sized manufacturing sub-sector with a lower-middle ranking in revenue and VA shares, while fifth in employment.

FDI firms dominated in beverages and furniture with VA shares of 57 and 58.3 percent respectively, (noting that recently a foreign company took a controlling stake from an SOE in Sabeco, Viet Nam's largest beverage company. The new board decided to remove the 49 percent cap on foreigners' share of company capital, hence FDI domination in beverages will increase further). Notably, backward linkages between FDI and domestic firms are very low in furniture (12.5 percent), beverages (10.4 percent) and food processing (2 percent).

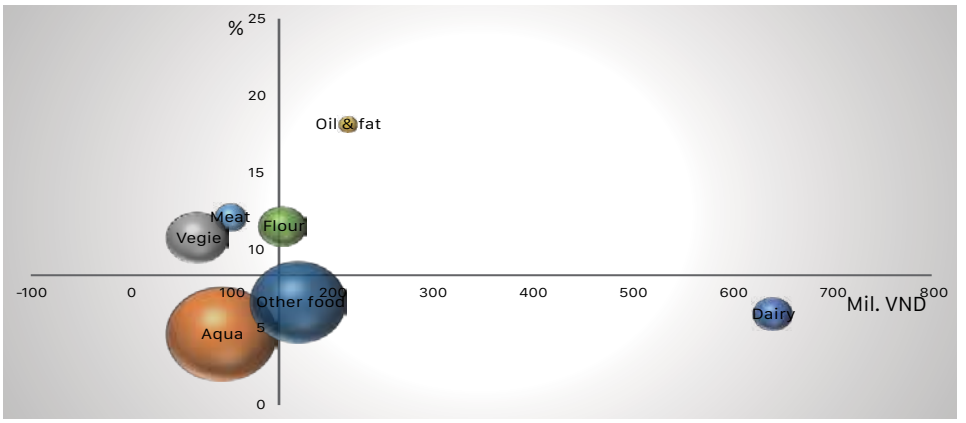
While SOEs have low participation levels, domestic private firms have medium VA and high employment shares in beverages and rather high VA, employment and revenue shares in furniture. Food processing was the only large-sized and large positive net export sub-sector in which domestic firms dominated with a VA share of 62.2 percent (FDI participation was at medium level).

Labour productivity of food processing was at medium level, while high in beverages and low in furniture. The LP gaps with comparator countries were: (i) medium and narrowing in food processing, (ii) small and narrowing in beverages and (iii) large and slowly narrowing in furniture. VA-to-output ratios were low and gaps with comparator countries were large in food processing and beverages, while furniture featured a medium ratio and narrower gap. Wage growth was lower than LP growth in food processing, but higher (though remaining competitiveness enhancing) in beverages and furniture.

Overall, Viet Nam's food processing sub-sector was assessed as "competitive" based on performances measured by indicators used by this report and especially due to the comparative advantages (and good performance) of Viet Nam's agriculture production in many commodities (cashews, catfish, coffee, pepper, rice and shrimp). Domestic private firms (mostly SMEs and applying labour intensive and simple labour skills) dominating this sub-sector were export-oriented and aggressively expanded (due to recent fast production growth and exports of some agriculture produce such as tropical fruits and vegetables) their shares in global markets and diversified export markets to move up GVCs. Accelerating capacity in branding, marketing and playing lead roles in GVCs (given Viet Nam is a big global player in many agriculture products) and especially in local value chains (by increasing the economy of scale for higher efficiency of agriculture production and ensuring international standards in quality, food safety and environment, promoting organic farming/green production methods and application of IR4.0 technologies) will be key to enhancing this sub-sector's productivity and competitiveness.

Box 2.9: Deeper look at food processing industries' labour productivity

Figure 2.46: Labour productivity of food processing industries



Note: Horizontal axis – value of labour productivity in 2011, vertical axis – growth rate of labour productivity in 2011-2016, bubble size – number of labour involved.

Source: Authors' calculation using Enterprise Census data

Within the food processing sub-sector, production of oil, animal fat, meat and vegetables experienced higher than the average LP growth, but industries were modest in employment and LP of vegetables and meat processing were low. Milk and dairy products had exceptionally high LP, though with modest growth and employment. Processing and preservation of aquatic products experienced relatively lower LP growth and LP levels were lower, but (given the predominant use of labour intensive technologies in the aquatic product processing industry) the industry was the biggest employer. Noting the important contribution of aquatic products (and recently vegetables and fruits) to Viet Nam's exports and job creation improving its competitiveness and productivity performance would contribute to broad-based growth. In general, given important roles in improving value added (and enhancing food safety) of agricultural products, leading the local value chains and connecting Viet Nam's farmers to GVCs, food processing industries (with high participation levels of domestic private firms) should be a prioritized sub-sector for policy interventions to enhance productivity and competitiveness. A more detailed assessment of current technologies and foresight of IR4.0 technology progress is needed to guide domestic firms for technology upgrading.

Furniture and beverage sub-sectors were assessed as "competitive" with risks. The furniture sub-sector's low LP (as production is based on intensive labour and simple skills) and widening/slowly narrowing LP gaps with comparator countries and dependency on imports of wood (while CPTPP requires higher export content from origin countries) present key risks. FDI domination in the sub-sector (while domestic firms and SOEs only have low levels of participation), negative (though still competitiveness enhancing) wage-labour productivity growth and the risk of automation swallowing up simple and repetitive jobs heighten the likelihood of FDI relocating production elsewhere, resulting in significant impacts to Viet Nam's exports and socio-economic development.

In the beverage sub-sector, which mainly serves the domestic market while FDI (with its global brands) increases its participation level (also in the retail sub-sector), smaller-sized and fragmented domestic firms will face stronger competition in the near future. It is important to note that this sub-sector's FDI attraction policy has been very "open": anecdotally Viet Nam has a higher number of beer brands than many countries and this has contributed to a fragmented market (small-sized firms have slimmer market shares than nations with less brands). Within this context, some domestic firms' efforts to sharpen their competitive edge, develop brands and new products is remarkable and should be recognized. While demand from wealthier Vietnamese will grow, public health concerns related to consumption of alcohol[36] and sugar-rich drinks may eat into demand. This together with stronger competition from FDI firms will demand domestic firms make extra efforts, including increasing linkages with domestic suppliers to enhance productivity and competitiveness in the domestic market in the next five years, greater efforts to penetrate international markets.

Other export contributing sub-sectors

Though not top-five manufacturing exporters, the net exports of wood (excluding furniture), tobacco, other vehicles and non-metallic mineral products was positive.

Other vehicles, the only high-tech (medium-sized in terms of employment, revenue and VA) sub-sector in this group was dominated by FDI firms with a VA share of 82.21 percent and (similar to sub-sectors where FDI firms dominate) almost zero backward linkages and low (17 percent) forward linkages

36 *According to the Minister of Health, in a presentation of the draft Law on Prevention of Negative Impacts of Alcohol Drinks to the National Assembly on 9 November 2018, Vietnamese people in 2017 consumed around 305 million litres of liquor and 4.1 billion litres of beer (with spending on beer of USD4 billion). An average Vietnamese consumes 42 litres of beer annually, making Viet Nam the highest beer consumer in ASEAN and third in Asia (after Japan and China). In Viet Nam, the estimated economic cost of six cancers to which alcohol consumption is among the leading causes was 0.25 percent of GDP and the cost of traffic accidents caused by alcohol consumption was 0.5 percent GDP in 2017.*

with domestic firms. Labour productivity was high compared to other manufacturing sub-sectors in Viet Nam and "within reach" of comparator countries. With a medium-level VA-to-output ratio, gaps with comparator countries have narrowed. Notably within the sub-sector, the motorcycle industry experienced significant improvements in "local" value chains and very high levels of "domestic" content (not necessarily produced by Vietnamese firms, but Viet Nam-based FDI ones). The strong penetration of "cheap" Chinese motorcycles into Viet Nam during the 1990s could be a key reason for other foreign (mainly Japanese) firms to increase "domestic" content as a successful strategy to remain competitive and expand export production (Box 2.8). The sub-sector, mainly motorcycles (as well as production of bicycles/parts), was assessed as "competitive" with scope for enhancement and stronger linkages between FDI and Vietnamese firms to lift domestic content and allow the latter to progressively move up to stages (2, 3 and 4) in the local value chain. With Vinfast's car and electric bicycle plant in Dinh Vu – Cat Hai Economic Zone having become operational in late 2018, Viet Nam for the first time has a leading firm to produce branded electric bicycles (Stage 5 in the local value chain). Vinfast's strong linkages with domestic suppliers and robust domestic market competition to build export capacity will be the key to Vinfast's and the local electric bicycle industry's success.

Other sub-sectors in this group: wood (excluding furniture), printing and tobacco (small-sized and low-tech) and non-metallic mineral products (large-sized and medium-tech) are dominated by domestic private firms (tobacco by SOEs). The RCA of wood (excluding furniture) and non-metallic mineral products were higher than unity (1.86 and 1.07, respectively), while RCA for the remainder was less than unity. Gaps between Viet Nam and comparator countries in VA-to-output ratios of wood (excluding furniture) and printing narrowed, while remained large in tobacco and non-metallic mineral products. Labour productivity gaps between Viet Nam and comparator countries were high and slowly narrowing. These sub-sectors were assessed as having "low competitiveness". Within these sub-sectors, given they are dominated by domestic firms and large domestic markets, scope for policy interventions to enhance productivity and competitiveness remain significant. Applying stricter permission of foreign brands, control of smuggling, marketing as well as a higher tax on tobacco (similar to alcoholic drinks in beverage sub-sector) may be helpful. Tailored support to build stronger linkages between wood (excluding furniture) and local firms in the oil refinery and chemicals sub-sectors as well as suppliers of bamboo, rattan and other related materials available in Viet Nam and for sub-sector firms to upgrade technologies, branding and marketing capabilities must be explored.

Sub-sectors with negative net exports

The last group of sub-sectors had high and medium technology with negative net exports and RCA<1 (classified as import-substitution), namely: basic metals, fabricated metals, rubber-plastics (large-sized sub-sectors), chemicals, electrical equipment, motor vehicles (medium-sized sub-sectors), other manufacturing, paper products, machines and equipment n.e.c., coke- petroleum-nuclear fuel, repair and installation of machinery and equipment, and medical precision-optical equipment (small-sized sub-sectors).

In 2016, FDI firms had high VA shares in almost all sub-sectors in this group: basic metals (83.6 percent), electrical equipment (62.4 percent) and motor vehicles (73.7 percent), other manufacturing (82.7 percent), paper products (57.7 percent), machines and equipment n.e.c. (69.15 percent), chemicals (49.4 percent, domestic private firms' VA share was 32.5 percent) and fabricated metals (49.52 percent, domestic private firms' VA share was comparable: 48.57 percent). Besides the substantial VA share in chemicals and fabricated metal, domestic private firms also have significant VA shares in rubber-plastics (50.82 percent, while FDI's VA share was 46.63 percent) and medical precision-optical equipment (74.53 percent) in 2016. SOEs had medium employment and high VA shares in coke-petroleum-nuclear fuel and repair and installation of machinery and equipment. As noted earlier, FDI in resource-based industries tended to have higher backward-forward linkages with domestic firms, with backward linkages in basic metals and chemicals at 96 percent and 62 percent, respectively and backward-forward linkages in rubber and plastics at 25 percent and 24 percent respectively. Linkages in other sub-sectors were small

across 2011-2015.

Basic metals, paper, chemicals, coke-petroleum-nuclear fuel, motor vehicles sub-sectors have high LP with narrowing gaps with comparator countries. However, the performance measured by VA-to-output revenue showed only motor vehicles had a high ratio and declining gaps with comparator countries, while paper, coke-petroleum-nuclear fuel, rubber-plastics, chemicals and basic metals have low/medium VA-to-output ratios and large gaps to other countries.

Motor vehicle sub-sector was assessed as "competitive" as long as FDI car-assembling plants in Viet Nam remained competitive. The key risk involved trade agreements (including ASEAN) rewarding tax incentives for products with higher (20 percent and more) local content and fluid movement of goods that may encourage FDI firms to relocate car-assembling plants abroad if Vietnamese firms fail to supply leading FDI firms. As noted, with Vinfast operational in late 2018 the development of local value chains and its ability to compete in local markets will raise the sub-sector's productivity and competitiveness.

Basic metals, paper, rubber-plastics, chemicals, coke-petroleum-nuclear fuel sub-sectors were assessed as having "medium competitiveness" if the supply of local resource-based (as well as electricity supplies for energy-intensive basic metal sub-sector) inputs continued. Key challenges included: (i) accelerating LP and VA-to-revenue ratios, (ii) improving logistics and linkages with other sub-sectors in local value chains and (iii) applying higher environmental standards and changing competition rules towards application of more environment-friendly technologies. Moving up value chains in plastics (with oil refineries supplying the plastics industry and fibres for textile industry) and the rubber industry moving away from exporting rubber raw materials to producing high-quality plastics and rubber products for other sub-sectors (cars, bikes and motorcycles and electronics or high-quality rubber-plastics products for healthcare) is necessary for the rubber industry to become more competitive. Notably, within the chemicals sub-sector, some local firms producing washing detergent and toothpaste have maintained brands and competed with FDI giants such as P&G and Unilever (especially in markets for lower-end products)[37] in Viet Nam. Also within chemicals, Viet Nam's pharmaceutical industry is fragmented with a high number of SMEs operating under management of local governments and decentralized drug-procurement systems. A more detailed case study on these chemicals and pharmaceutical industries may be needed to identify tailored support to enhance productivity and competitiveness of local firms.

Fabricated metal, electrical equipment, other manufacturing, machinery and equipment n.e.c., medical-precision equipment and installation of machinery have medium or low LP and VA-to-output ratios, with large LP and VA-to-output ratio gaps with comparator countries. These sub-sectors were assessed as "low competitive". More in-depth analysis at ISIC/VSIC 3- and 4-digit level is required to define opportunities and challenges of industries within these sub-sectors.

Recommendations

- Enhancing Vietnamese firms' productivity and competitiveness must be at the heart of Viet Nam's growth strategy and achieved through implementing a wide range of integrated and concerted policy actions

As lower middle-income Viet Nam, in its next stage of development, pursues an inclusive growth pathway to generate more productive jobs for its workers, enhance productivity and competitiveness, Vietnamese firms in manufacturing must be at the centre of Viet Nam's growth strategy. This should be a common prioritized goal within a wide range of national policies, from industrialization, SOE reforms and private sector/enterprise development to trade, FDI attraction, R&D, skills training and public investment.

Learning from the past and international experiences, these policies must be formulated and implemented in an integrated and coordinated manner with optimum synergies to achieve this common goal. Clear

37 Given the low-tech and import substitution nature of production of these commodities, many countries often apply measures to protect local firms. As FDI companies already operate in Viet Nam, support could be provided to local firms (especially SMEs) in R&D, employee training, branding and marketing (still allowed by trade agreements) as well as eliminate price transfers by FDI firms.

targets within these policies must be aligned towards achieving improved capacity of domestic firms in terms of: (i) linkages and upward movements in local and global value chains, (ii) increased productivity, value addition and (iii) local market shares and especially export volumes and values.

- Trade policies and domestic enterprise development

The commonly understood weakness of limited linkages between trade negotiations, industry policies and programmes supporting enterprise development require urgent remedial action. The assessments of weaknesses and potential of Vietnamese firms could underpin (i) industrial policies and programmes building firms' capacity and competitiveness and (ii) international trade negotiations. New opportunities for Vietnamese firms created by trade negotiations/agreements, such as access to new markets with lower tariffs (raising demand for products and services with important incentives for firms to expand production capacity and competitiveness), legitimate protection and time for firms to become compliant with new trade rules, must be accompanied with appropriate policies and action to help firms build production capacity, connect with local and global value chains and better compete in domestic and international markets.

- SOE reforms, public investment and domestic enterprise development

SOE reform efforts must focus on: (i) enhancing SOEs' (especially those at higher stages or leading local value chains with relatively high productivity and competitiveness) effectiveness and efficiencies, plus backward-forward linkages with domestic firms and (ii) accelerated equitization of SOEs in industries/sub-sectors where domestic private firms have capacity and readiness to take over leading roles from SOEs (with equitization going hand-in-hand with building capacity of domestic private firms).

Public investment should aim to crowd-in domestic private sector investment. Public investment could help create demand for domestic private firms' products and services, and thus incentives to invest in business and technology upgrades. Public investment could also provide domestic private firms with opportunities to build capacity, including through learning-by-doing and receiving technology transfers through public investment from ODA loan projects.

Public investment in development of IT/telecommunications infrastructure (cloud computing, network and data security as well as e-commerce platforms, including for intermediate goods), e-payments and e-banking (similar to e-tax, e-customs and e-government payments), will not only help private firms (especially SMEs) improve IR4.0 readiness and efficiency, but also value chain connections. While public services (R&D and skills training) will benefit SMEs, special services such as testing and certification (and perhaps radiation and cold storage) have strong potential to enhance access and competitiveness of food and agriculture processing firms in global markets.

- Attracting higher-quality FDI and enhancing linkages between FDI and domestic firms

Within the overarching goals of sustainable development and creation of productive jobs for Vietnamese workers, Viet Nam must shift its focus from quantity to attraction of higher-quality FDI firms with technological sophistication, that are green, energy efficient and leaders in GVCs. The most important element of higher-quality FDI firms is long-term partnerships with local firms (as key players in production chains) as the core of their international competition strategy. Following this strategy, FDI firms must go beyond exploiting natural resources and cheap labour to establish strong and long-term linkages with domestic firms by using higher levels of local content (less expensive than imported components for simple assembling) and utilization of local workers' skills and innovations in products. Such FDI firms, in "win-win" cooperation with government programmes to support capacity development of domestic firms, would be better positioned to engage in technology transfers with domestic firms and connect with them as first-tier suppliers to leading FDI firms and GVCs.

To attract higher-quality FDI, attraction policies must be formulated and implemented as an integral part of Viet Nam's socio-economic development strategy, industrial policies, economic restructuring,

accelerated domestic private sector development and the country's and its firms' IR4.0 readiness. Within this integrated framework, it is important to establish clear international standards and requirements in terms of technology requirements, domestic content, technology transfers to domestic firms and linkages to GVCs, together with compliance requirements for stricter energy efficiency and environmental safety standards, work conditions and social protection. Strengthening the legal framework, institutional capacity and systems for rigorous screening, appraising and approval of FDI projects is important to ensure adherence to international standards and requirements.

It is also essential for Viet Nam to limit harmful competition between provinces and nationally in use of tax and other incentives to attract FDI[38]. Instead, Viet Nam should focus on creating other (more fundamental) incentives to capture high-quality and long-term FDI, namely: high capacity and skilled human resources, large population purchasing power, investment regulation stability, consistent application of the rule of law, political stability, quality infrastructure (notably transportation and utilities) and competitive domestic support services and supplies. Government and FDI firms, those planning to locate and present in Viet Nam, should work together with domestic firms to: (i) define domestic support services and supplies for FDI to underpin international competition strategies and (ii) formulate and implement "win-win" plans to build domestic firms' capacity to become suppliers in (FDI-led) GVCs. Such a mutually beneficial approach could be applied in high and medium technology and export-led sub-sectors/industries where FDI firms have high participation levels (motorcycles, electronics, furniture and non-metallic mineral products). It could also be applied in large domestic market-focussed sub-sectors with high FDI participation levels (rubber-plastics, electrical equipment, fabricated metals and textiles) for improved linkages between FDI and domestic firms in local value chains to mutually enhance productivity, competitiveness and export production.

- Accelerate development of local value chains and capacity of domestic private firms to achieve upward movement in value chains

Given that domestic private investment in Viet Nam is low compared to other sources (FDI and public investment) and ASEAN countries (source: UNDP Development Finance Assessment report, UNDP 2018) as well as policy-makers' expectation the private sector will be a "growth engine" in the country's next development stage, domestic sector development must be prioritized in the Socio-Economic Development Strategy (2021-2030) and Plan (2021-2025). Key policy objectives should support domestic private firms to grow in size, accelerate transition to formalization and enhance productivity and competitiveness through development of local value chains, improved linkages within and upward movement in domestic and global value chains.

It is important to continue creating a level playing field for the domestic private sector by removing obstacles (access to credit, land or tax reductions and exemptions) for it to compete on an equal footing with SOEs and FDI enterprises. As noted, reforms to SOEs and FDI policies should facilitate private firms to enter markets and enhance linkages in domestic and global value chains, create "win-win" policies and incentives for FDI enterprises to generate more spillovers in terms of connecting domestic firms to GVCs and achieving technology transfers.

In addition to continued efforts to nuance the business environment and support domestic private enterprises to access land and credit, more tailored support is needed for SMEs to elevate their: (a) capacity for business management and marketing, (b) linkages in domestic and international value chains and (c) technical capacity to adopt new technologies and readiness to grasp opportunities unlocked by IR4.0 and a new wave of higher quality FDI. Establishment of independent (para-governmental) institutions (similar to Fraunhofer Foundation, Germany) specialized in providing training and R&D support to Vietnamese firms (impeded by their small-sizes, limited linkages in value chains and inability to afford

38 Given the strong competition between countries attracting FDI, it is important Viet Nam strengthens its active participation in international initiatives (such as Tax Inspectors Without Borders and Base Erosion and Profit Shifting Inclusive Framework) that provide opportunities for countries to jointly develop and apply codes of conduct to address harmful tax practices related to attracting FDI as well as "price transfers" and other tax avoidance practices.

investment in R&D and training) is necessary. As domestic private firms improve integration and upward movement in local and global value chains, technology upgrades must follow. Besides access to credit, guidance for technology upgrades (based on assessment of sub-sector/firm level current technologies and foresight of future IR4.0 technological progress) will be necessary for domestic firms (especially SMEs) to make appropriate investment decisions.

The emergence of big domestic firms to lead local value chains and become significant players in GVCs must be facilitated. Domestic food processing firms' growth based on Viet Nam's comparative advantages in producing key agriculture commodities for export (catfish, coffee, pepper and shrimp) not only adds value and contributes to exports, they lead development of local value chains (connecting micro, small, medium-sized farming units in value chains, increasing application of quality/food safety standards, facilitating branding and marketing, expanding access to international markets). Learning from the past, further action is needed to accelerate development of more (newly-emerging agriculture export commodities such as fruit and vegetables) as well as bigger and longer value chains in food and food processing – the fifth largest exporting manufacturing sub-sector (with large VA, employment and revenue shares) that domestic (private) firms dominate. The government's facilitation, incentives (including development of e-commerce platforms for sale of agriculture, intermediate products and connecting value chain players) and especially support to (small) farmers is needed to: (i) apply production practices that meet standards of food processing/export firms leading local value chains and (ii) organize farmers in cooperatives or other formal forms to gain greater efficiency from higher economies of scale.

The recent entry of Vingroup into Viet Nam's automobile and electric bike industry and a planned smartphone production project present an encouraging case for developing local value chains. For the first time in these industries, there is a Vietnamese firm at the highest value chain stage to be an aspirational leader. Similar to facilitating FDI and domestic firm linkages, with support of the Government of Viet Nam, Vingroup should work with domestic firms to: (i) define domestic support services and suppliers for Vinfast according to its (international) competition strategy and (ii) formulate and implement "win-win" plans to build capacity of domestic firms to become suppliers in Vingroup-led value chains.

5. Conclusions

Viet Nam is entering its next development stage as a lower middle-income country in the context of IR4.0's acceleration, significant changes in GVCs and international trade. Embarking on a more inclusive development pathway and a new growth model based on higher productivity is essential for Viet Nam to create greater volumes of decent work for its people and achievement of the SDGs.

The assessment of productivity and competitiveness performance of the manufacturing sector and its sub-sectors presented in this report identified challenges and opportunities for Viet Nam to greatly enhance domestic firms' competitive edge through capturing more value added from a bigger local and global value chain footprint. With the recommended enhancement of domestic firms' productivity and competitiveness as a central tenet in Viet Nam's growth strategy for its next development stage, the interlinked policy actions outlined in this section of the report should be formulated and implemented within an integrated policy framework with concerted efforts by different stakeholders from government and business sectors.

Now is the time for all stakeholders to act in a concerted and synergized manner on the identified challenges to realize Viet Nam's aspirations to achieve its ambitious SDG agenda and lift human development to new heights.

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Appendix 1. Technical Notes on Productivity Analysis

A.1.1. Labour productivity: Concept and international comparison

Concept

Among other productivity measures such as multi-factor productivity or capital productivity, labour productivity is particularly important in the economic and statistical analysis of a country. Labour productivity is equal to the ratio between a volume measure of output and a measure of input use (OECD, 2011). The volume measure of output, which reflects the goods and services produced by the workforce, is normally measured by gross domestic production (GDP). The measure of input use, which reflects the time, effort and skills of the workforce, is measured either by the total number of hours worked of all persons employed or total employment (head count). There are both advantages and disadvantages associated with the different input measures that are used in the calculation of labour productivity. It is generally accepted that the total number of hours worked is the most appropriate measure of labour input because a simple headcount of employed persons can hide changes in average hours worked, caused by the evolution of part-time work or the effect of variations in overtime, absence from work or shifts in normal hours. In contrast, total employment is easier to measure than the total number of hours worked.

It is noticeable that labour productivity changes reflect the joint influence of changes in capital, as well as technical, organizational and efficiency change within and between firms, the influence of economies of scale, varying degrees of capacity utilization and measurement errors. Labour productivity only partially reflects the productivity of labour in terms of the personal capacities of workers or the intensity of their effort. The ratio between output and labour input depends to a large degree on the presence of other inputs, as mentioned above.

International comparison

The comparison of labour productivity across countries requires Purchasing Power Parity (PPP) data for GDP. A purchasing-power-parity exchange rate is an exchange rate estimated on the assumption that the same set of (international) prices prevail for the same goods, quality adjusted, in all economies. While it is reasonable to assume that with free trade, the prices of tradable goods should have a tendency to converge, the same cannot be said of non-tradable goods and services. Therefore, the GDP data will be converted to international dollars using PPP for GDP rates.

A.1.2. Sources of Labour Productivity: Shift Share Analysis

One way to analyze sources of productivity growth is to study the impact of the difference in sectoral structure on aggregate labour productivity growth in the different countries (Wolff 2000; Rao and Tang 2001). Sectoral differences could be due to either differences in labour productivity growth or changes in relative size, which is decomposed by a shift-share analysis. This analysis is widely used to measure the contribution of different sectors to aggregate productivity growth (see, for example, Dekle and Vandenbroucke 2006, IMF 2006, and Usui 2011). The underlying assumption of this formula is that real output is calculated in constant prices using fixed-base Laspeyres quantity and Paasche price indexes at both the aggregate and sectoral levels.

The economy's real ouput X^*_t is equal to the sum of sectoral real ouput X^{*i}_t where i = 1, ... N denotes the industry and t = 1, ... T denotes the time period. Defining aggregate labour productivity as $Z^*_t = \frac{X^*_t}{L_t}$ and sectoral productivity $Z^{*i}_t = \frac{X^{*i}_t}{L^i_t}$ where L_t and L^i_t represent labour input used in the aggregate economy and in sector i(respectively) such that $L_t = \sum_i L^i_t$. In this case, since real output is additive:

$$Z_t^* = \frac{X_t^*}{L_t} = \frac{\sum_i X_t^{*i}}{L_t} = \frac{\sum_i Z_t^{*i} L_t^i}{L_t} = \sum_i Z_t^{*i} l_t^i$$

where $l_t^i = \frac{L_t^i}{L_t}$.

Sectoral contributions to aggregate labour productivity growth can be computed by looking at productivity changes between two periods of time:

$$G_t^* = \frac{Z_t^* - Z_{t-1}^*}{Z_{t-1}^*} = \frac{\sum_i (Z_t^{*i} l_t^i - Z_{t-1}^{*i} l_{t-1}^i)}{Z_{t-1}^*} = \frac{\sum_i [(Z_t^{*i} - Z_{t-1}^{*i}) l_t^i + Z_{t-1}^{*i} (l_t^i - l_{t-1}^i)]}{Z_{t-1}^*}$$

Defining $G_t^{*i} = \frac{Z_t^{*i} - Z_{t-1}^{*i}}{Z_{t-1}^{*i}}$, so that: $G_t^* = \sum_i \frac{Z_{t-1}^{*i}}{Z_{t-1}^*} [G_t^{*i} l_t^i + \Delta l_t^i] = \sum_i \frac{Z_{t-1}^{*i}}{Z_{t-1}^*} [G_t^{*i} l_{t-1}^i + G_t^{*i} \Delta l_t^i + \Delta l_t^i]$

Therefore, $G_t^* = \sum_i \left(\frac{X_{t-1}^{*i}}{X_{t-1}^*} G_t^{*i} + \frac{Z_{t-1}^{*i}}{Z_{t-1}^*} \Delta l_t^i + \frac{Z_{t-1}^{*i}}{Z_{t-1}^*} G_t^{*i} \Delta l_t^i \right)$ (A1.2.1)

According to this formula, sectoral contributions to aggregate productivity growth can be broken down into three effects. The first term of the equation (1) represents the 'within sector effect'. If sectorallabour shares remain unchanged over time ($\Delta l_t^i = 0$), the second and third terms of the equation equal 0 and the contribution of each sector collapses to the first term, which is the sectorallabour productivity growth weighted by the sector's real share in aggregate real output.

The second term of the equation (A2.1) captures the 'structural change effect'. Aggregate labour productivity can increase even when sectoral labour productivity remains constant, as long as labour moves from sectors with below average labour productivity levels towards sectors with above average labour productivity levels (Denison, 1962). This effect is positive when $\Delta l_t^i > 0$ and the magnitude of the effect is scaled by the ratio between the sector's labour productivity level and the aggregate labour productivity level.

The third term of the equation (A2.1) is the 'interaction effect'. This effect will be positive either when labour has moved toward a sector with positive labour productivity growth ($\Delta l_t^i > 0$ and $G_t^{*i} > 0$) or when labour has moved away from a sector with negative labour productivity growth ($\Delta l_t^i < 0$ and $G_t^{*i} < 0$) (see Baumol 1967 and Baumol et al. 1985). The magnitude of this effect is also scaled by the ratio between the sector's labour productivity level and the aggregate labour productivity level.

A.1.3. Sources of Total Factor Productivity Growth: Decomposition Exercise

Stochastic frontier production function for a sector has the following form:

$$Y_{it} = f(X_{it}, t) e^{-u_{it}} e^{\varepsilon_{it}} \quad \text{(A.1.3.1)}$$

of which

i denotes the sector ;

t time;

Y – output;

X – capital and labour inputs;

ε – error term ~ iid N (0,1);

f(.) - production frontier);

e-u measure technical efficiency (TE), u ≥ 0, normal distribution (truncated), TE takes value in range (0.1].

Taking logarithm of (A.3.1):

$$\frac{\partial lnY_{it}}{\partial t} = \frac{\partial \ln f(X_{it},t)}{\partial t} + \sum_{j=1}^{2} \frac{\partial lnf(X_{itj},t)}{\partial lnX_{itj}} \frac{\partial lnX_{itj}}{\partial t} + \frac{\partial lne^{-u_{it}}}{\partial t} + \tau_{it} \quad \text{(A.1.3.2)}$$

of which:

j = 1, 2 – capital and labour inputs;

$\frac{\partial lnf(X_{itj},t)}{\partial lnX_{itj}} = \alpha_{itj}$ – elasticity of output with respect to input j;

$TC_{it} = \frac{\partial \ln f(X_{it},t)}{\partial t}$ – technological progress

$TEC_{it} = \frac{\partial lnTE_{it}}{\partial t}$ – technical efficiency change

Therefore: $$\dot{Y}_{it} = TC_{it} + \sum_{j=1}^{2} \alpha_{itj}\dot{X}_{it} + TEC_{it} + \tau_{it} \quad \text{(A.1.3.3)}$$

TFP is defined as $T\dot{F}P_{it} = \dot{Y}_{it} - \sum_{j=1}^{2} s_{itj}\dot{X}_{it}$ (A1.3.4)

of which $s_{itj} = \frac{w_{itj}X_{itj}}{\sum_{j=1}^{2} w_{itj}X_{itj}}$, witj price of factor j in sector i at time t. sitj – share of factor j in total cost[39]

From (A.1.3.3) and (A.1.3.4):

$$T\dot{F}P_{it} = TC_{it} + TEC_{it} + (RTS_{it} - 1)\sum_{j=1}^{2} \rho_{itj}\dot{X}_{it} + \sum_{j=1}^{2}(\rho_{itj} - s_{itj})\dot{X}_{it} + \tau_{it} \quad \text{(A.1.3.5)}$$

of which: $RTS_{it} = \sum_{j=1}^{2} \alpha_{itj}$ returns to scale in sector i, therefore $\rho_{itj} = \frac{\alpha_{itj}}{RTS_{it}}$ share of factor j or elasticity of output with respect to factor j in the case of constant returns to scale (CRS).

Under the CRS assumption, the third term in equation (A.3.5) expresses the degree of productivity growth induced by raising scale of sector i, or alternatively, scale efficiency (SEC).

Therefore, from equation (A.1.3.5), TFP growth can be decomposed into 4 components:

$$T\dot{F}P_{it} = TC_{it} + TEC_{it} + SEC_{it} + FAEC_{it} + \tau_{it}$$

Estimation

Stochastic frontier production function in translog form can be expressed as follows:

lnYit = β0 + tt + 0.5βttt2 + βKlnKit + βLlnLit + 0.5βKK(lnKit)2 + 0.5βLL(lnLit)2 + βKLlnKitlnLit + βtKtlnKit+ βtLtlnLit – uit + εit (A.1.3.6)

Assume: uit = uie-ηt ~ N+(μ, σu2), εit ~ N(0, σε2), cov(uit, εit) = 0

Equation (A.1.3.6) cannot be estimated by OLS because of the endogeneity problem (output depends on capital and labour in the production function, but capital and labour are determined by output in factor demand functions. Therefore, IV estimation will be applied, with lagged values of capital and labour being used as instruments. These instruments are available thanks to the availability of panel data of Enterprise Census.

Technological progress (TC) and technical efficiency change (TEC) can be calculated as follows :

TCit = βt + βttt + βtKlnKit+ βtLlnLit

39 *Total cost of capital and labour is the sum of total wage bill and depreciation*

TECit = ηuie-ηt = ηuit

Change in scale efficiency and change in allocative efficiency can be calculated as follows:

$$SEC_{it} = (RTS_{it} - 1)(\rho_{itK}\dot{K}_{it} + \rho_{itL}\dot{L}_{it})$$

$$FAEC_{it} = (\rho_{itK} - s_{itK})\dot{K}_{it} + (\rho_{itL} - s_{itL})\dot{L}_{it}$$

of which

Elasticity of output with respect to capital and labour can be calculated as follows:

itK = βK + βKKlnKit + βKLlnLit + βtKt

αitL = βL + KLlnKit + βLLlnLit + βtLt

Returns too scale of sector i, at time t: RTSit = αitK + αitL

Capital and labour shares: ρitK = αitK/RTSit, ρitL = αitL/RTSit

Analysis of determinants of technical efficiency – a component of TFP, using the stochastic frontier production method, is available in Stata.

A.1.4. Estimation of sector-level FDI's forward and backward linkages

Horozontaljt is to measure the presence of foreign firms in sector j at time t, defined as follows:

$$Horizontal_{i,t} = \frac{\sum_{\forall j \in i} y_{j,t}}{Y_{i,t}} \qquad \text{(A.1.4.1)}$$

where:

$Y_{i,t}$ gross output/labour of foreign-invested firm j of the sector i at time t

$Y_{i,t}$ total gross output/labour, of the sector i at time t.

Usually, the conventional measure of horizontal presence of FDI in a sector will be calculated using the output measure of FDI firms within this sector at a point of time. However, one can calculate two measures of horizontal effects, namely (i) the horizontal output measure of FDI presence; and (ii) the horizontal employment measure of FDI presence. By including the horizontal employment measure of FDI presence together with the horizontal output measure of FDI presence, one can disentangle the effect of labour mobility, i.e. labour turnover from other spillover effects such as the competition effect or the demonstration effect.

Following Javorcik (2004) and others, we define Backwardjt as

$$Backward_{i,t} = \sum_{j \ if \ j \neq i} a_{ij} Horizontal_{j,t} \qquad \text{(A.1.4.2)}$$

where aij is taken directly from input-output table.

Forwardjt is defined as $Forward_{j,t} = \sum_{i \ f \ i \neq j} a_j \frac{\sum_{\forall j \in i}(y_{j,t} - e_{j,t})}{Y_{i,t} - E_{i,t}}$ (A.1.4.3)

where aij is the direct IO coefficient. Since IO table does not allow one to calculate the value of $e_{j,t}$, one should assume that the proportion of foreign export within sector is linear correlation with the equity share of foreign firms. Hence it can be approximated as follows:

$$J, \iota$$

(A.1.4.4)

where $k_{j,t}$ is capital stock of foreign firm of sector i at time t and $K_{i,t}$ is total sectoral capital stock of sector i at time t.

A.1.5. The Wage Growth and Firm's Competitiveness Nexus: A Simple Model

Assume that the production function has the Cobb-Douglas form with time varying technology as follows: $Y_t = A * K_t^{\alpha_t} * L_t^{\beta_t}$ (A.1.5 1).

Under the assumption of constant returns to scale (CRS), we have t+βt=1.

$$\frac{Y_t}{L_t} = A\left(\frac{K_t}{L_t}\right)^{\alpha_t} \quad \text{(A.1.5.2)}$$

with $y_t = \frac{Y_t}{L_t}$ - labour productivity, per hour; $\left(\frac{K_t}{L_t}\right)$ - capital intensity; A – TFP

Labour demand is derived from firm profit maximizing behavior:

$$\pi_t = P_t * Y_t - R_t * K_t - W_t * L_t \quad \text{(A.1.5.3)}$$

where Pt – nominal output price, Wt – nominal wage, Rt – nominal rental price

First order condition of profit maximization with respect to labour yields:

$$w_t = \beta_t y_t \quad \text{(A.1.5.4)}$$

where $w_t = \frac{W_t}{P_t}$ - real wage

Therefore, real wage growth in the period from time t to t+1 is calculated as follows:

$$\frac{w_{t+1}}{w_t} = \frac{\beta_{t+1}}{\beta_t} * \frac{y_{t+1}}{y_t} \quad \text{(A.1.5.5)}$$

From (A.1.5.5), if worker's wage growth in real terms is proportional, by factor $\frac{\beta_{t+1}}{\beta_t}$, to labour productivity growth, wage growth can be said to be competitiveness-neutral, as it is in line with technological change in the economy or sector. If the rate of wage growth is greater (smaller) than $\frac{\beta_{t+1}}{\beta_t}$, then wage growth is competitiveness-hurting (competitiveness-enhancing), both may not be sustainable in the long term, because they either hurt owner of capital (the former case), or worker (the latter case).

If βt+1=βt = β (for example, in the short run, technology does not change), one can expect a one-to-one relationship between wage growth and productivity growth. In the longer run, this may no longer be valid. In other words, if technology changes in favour of capital (i.e. capital-biased technology), wage growth is expected to fall behind productivity growth and vice verse. Importantly, such a relationship may not be uniform, because the rate of technological change may vary across sectors. One can expect that this rate is higher in sectors with higher degree of global integration in general and GVC integration in particular, as technological spillovers along GVCs tend to be more rapid.

Deviations from the competitiveness-neutral wage growth rate (i.e from $\frac{\beta_{t+1}}{\beta_t}$) should be explained by non-technological factors including labour market regulations and the country's political economy landscape (interaction between players such as FDI, domestic firms, trade unions, non-governmental organizations, which to a large extent depends on their respective market and bargaining powers). The former binds behavior of the latter and vice verse, the latter interact with one another to shape up the former.

Source: Adapted from Tran Ngo Minh Tam et al. (2018)

A.1.6. Miscellaneous

- Market power

An indicator that measures monopoly level of an industry at 3-digit level is as follows

$$CRi = S21i + S22i + ... + S2ni \qquad (A.1.6.1)$$

where: Ski – ratio between number of workers in firm k and that in industry i (k=1,2...n)

When Ski is market share of firm k in industry i (k=1,2...n), this is the Herfindahl index (also known as Herfindahl–Hirschman Index, HHI, or sometimes HHI-score), which is a measure of the size of firms in relation to the industry and an indicator of the amount of competition among them.

As such, it can range from 0 to 1.0, moving from a huge number of very small firms to a single monopolistic producer.

- Firm specialization index

A similar index can be calculated to measure the degree of firm's specialization

$$CRi = S21i + S22i + ... + S2ni \qquad (A.1.6.2)$$

where: Ski – revenue share of activity k out of total revenue of firm i (k=1,2...n)

Clustering

One can estimate the clustering effect by calculating the industry concentration ratio at 3- or 2-digit level by district:

$$LQij = Lij/Li./(L.j/L..) \qquad (A.1.6.3)$$

where: Lij – Number of workers of industry i in district j
Li. – Number of workers of industry in the country
L.j – Number of workers in district j
L.. – Number of workers in the country

- Revealed Comparative Advantage Index (RCA)

The RCA indicates whether a country is in the process of extending the products in which it has a trade potential, as opposed to situations in which the number of products that can be competitively exported is static. It can also provide useful information about potential trade prospects with new partners. Countries with similar RCA profiles are unlikely to have high bilateral trade intensities unless intra-industry trade is involved. RCA measures, if estimated at high levels of product disaggregation, can focus attention on other nontraditional products that might be successfully exported.

The RCA index of country I for product j is often measured by the product's share in the country's exports in relation to its share in world trade:

$$RCAij = (xij/Xit) / (xwj/Xwt) \qquad (A.1.6.4)$$

where xij and xwj are the values of country i's exports of product j and world exports of product j and where Xit and Xwt refer to the country's total exports and world total exports. A value of less than unity implies that the country has a revealed comparative disadvantage in the product. Similarly, if the index exceeds unity, the country is said to have a revealed comparative advantage in the product.

- Screening for best performing (outstanding) sub-sectors within manufacturing, services and agriculture

in the period 2011-2016, subject to the availability of GDP deflators) in terms of:

- productivity performance: breaking down manufacturing into four sub-groups (quadrants): (i) low initial level, low growth (laggard); (ii) low level, high growth (emerging); (iii) high level, low growth (mature); and (iv) high level, high growth (outstanding), with the average productivity level and average productivity growth rate are used to divide the XY space into the four quadrants.

The third dimension – the sub-sector share of employment is integrated into the analysis and depicted by a circle.

Quadrant 2: Low level, high growth - emerging	Quadrant 4: High level, high growth - OUTSTANDING
Quadrant 1: Low level, low growth - laggard	Quadrant 3: High level, low growth - mature

- pro-worker characteristics (employment and income generation): breaking down manufacturing into four sub-groups (quadrants): (i) low productivity (in 2016, captured by the Enterprise Census 2017), low average income[40]; (ii) low productivity, high average income; (iii) high productivity, and (iv) high productivity, high average income - best performing
- Position in the value chain (proxy): breaking down manufacturing into four sub-groups (quadrants) by the value added over revenue ratio: (i) low level, low growth; (ii) low level, high growth; (iii) high level, low growth; (iv) high level, high growth

Services: similar to manufacturing as discussed above

Agriculture: similar to manufacturing as discussed above, but built on the World Bank's ISPARD work on variation of labour productivity across agricultural sub-sectors, highlighting high

It should be noted that the average labour productivity of a sub-sector is calculated as the sum of value added by all firms in the sub-sector divided by the sum of workers of all firms in the same sub-sector. The growth rate of labour productivity of the sub-sector is calculated by dividing the average labour productivity of the sub-sector in the final year over the same figure in the initial year.

The screening process will be conducted in two steps. In step 1, it will be done for two-digit sub-sectors. In step 2, sub-sectors in quadrant 4 (high level, high growth) will be selected for further screening, but at four-digit level. Sub-sectors in quadrant 4 as identified in the second step will be selected for international comparison, and for the construction of detailed sector profiles (average size, age, spatial distribution, FDI share, human capital, R&D spending etc.).

40 The average income can be calculated directly from the dataset of Enterprise Census (the first best solution) or from data of the Labour Force Survey 2017

Appendix 2. NACE Industrial Classification

Industries are classified according to the Statistical Classification of Economic Activities in the European Community (NACE) as follows:

Sector	Name of sector
Agriculture, forestry, and fishing	Agriculture and related service activities
	Forestry and related service activities
	Fishing and aquaculture
Mining, electricity, and water	Mining of coal and lignite
	Mining of metal ores
	Other mining and quarrying
	Mining support service activities
	Electricity, gas, steam and air conditioning supply
	Water collection, treatment and supply
	Sewerage and sewer treatment activities
	Waste collection, treatment and disposal activities; materials recovery
Construction	Construction of buildings
	Civil engineering
	Specialized construction activities
High-tech manufacturing	Manufacture of pharmaceuticals, medicinal chemical and botanical products
	Manufacture of computer, electronic and optical products
	Manufacture of chemicals and chemical products
	Manufacture of electrical equipment
	Manufacture of machinery and equipment n.e.c
	Manufacture of motor vehicles; trailers and semi- trailers
	Manufacture of other transport equipment
Medium-tech manufacturing	Manufacture of coke and refined petroleum products
	Manufacture of rubber and plastics products
	Manufacture of other non-metallic mineral products
	Manufacture of basic metals
	Manufacture of fabricated metal products, except machinery and equipment
	Repair and installation of machinery and equipment

Low-tech manufacturing	Manufacture of food products
	Manufacture of beverages
	Manufacture of tobacco products
	Manufacture of textiles
	Manufacture of wearing apparel
	Manufacture of leather and related products
	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
	Manufacture of paper and paper products
	Printing and reproduction of recorded media
	Manufacture of furniture
	Other manufacturing
	Air transport
	Legal and accounting activities
	Activities of head office; management consultancy activities
	Architectural and engineering activities; Technical testing and analysis
	Advertising and market research
	Other professional, scientific and technical activities
	Employment activities
	Security and investigation activities
High-tech knowledge-intensive services	Motion picture, video and television programme activities; Sound recording and music publishing activities
	Broadcasting and programming activities
	Telecommunication
	Computer programming, consultancy and related activities
	Information service activities
	Scientific research and development
Knowledge-intensive financial services	Financial service activities (except insurance and pension funding)
	Financial service activities (except insurance and pension funding)
	Other financial activities
Other knowledge-intensive services	Publishing activities
	Travel agency, tour operator and other reservation service activities
	Education
	Human health activities
	Residential care activities
	Creative, art and entertainment activities
	Libraries, archives, museums and other cultural activities
	Lottery activities, Gambling and betting activities
	Sports activities and amusement and recreation activities
	Activities of other membership organizations

Less-knowledge intensive market services	Wholesale and retail trade and repair of motor vehicles and motorcycles
	Wholesale trade (except of motor vehicles and motorcycles)
	Retail trade (except of motor vehicles and motorcycles)
	Land transport, transport via railways, via pipeline
	Warehousing and support activities for transportation
	Postal and courier activities
	Accommodation
	Food and beverage service activities
	Real estate activities
	Renting and leasing of machinery and equipment (without operator); of personal and household goods; of no financial intangible assets
	Services to buildings and landscape activities
	Office administrative and support activities; other business support service activities
	Repair of computers and personal and households goods
	Other personal service activities

Appendix 3. Results of Econometric Analysis of Enterprise Census 2012 and 2017

A.3.1. Brief Description of Enterprise Census

Since 2001, GSO has conducted census on enterprises of the economy annually. The census covers all enterprises of different types of ownerships as well as industries with more than 10 labourers. Enterprises with less than 10 labourers have been sampled. However, for every 5 years, firms with less than 10 labourers are all surveyed. The censuses ask for information of the entire year before the surveyed years. For example, the census in 2012 asked for information of the entire 2011.

The contents of questionnaires include two parts. The core part covers basic information of operation of firms such as products, labourers, capital and their cost as well as revenues. From this set of information, one can calculate value added of firms and the production function can be estimated as a consequence. The specialized part, or also called rotating modules vary from year to year, collects information on special topics, for example, technology, environment etc.

With annual censuses, one can construct panel data of enterprises over time, for specific periods as well as for the whole period of 2001-2017. Panel data can in particular help researchers to take into account fixed effects, or also called time-invariant unobserved characteristics of firms.

In this study, we focus on the period of 2011-2016 (censuses conducted in 2012 and 2017 respectively) for two reasons: (1) The censuses in the two years cover all enterprises including ones with less than 10 labourers; (2) they have detailed information on labour composition in terms of qualifications and ages as well as the use of computer and the Internet. The very large number of observations, over 200,000 panel firms in the two years of 2011 and 2015 allows us to do various regressions at the firm level.

A.3.2. Results of Econometric Analysis of Determinants/Associates of Firm-Level Labour Productivity

Appendix 3 Table 1. OLS regressions - Determinants of productivity

	(1)	(2)	(3)	(4)
	All firms, 2016	**All matched firms between 2015-2016**	**All Manufacturing firms, 2016**	**All Matched Manufacturing matched firms, 2015-2016**
Ln(K/L)	0.368***	0.382***	0.377***	0.388***
	(237.03)	(219.38)	(95.14)	(87.18)
1-4 workers	Base			
5-9 workers	0.465***	0.423***	0.419***	0.382***
	(86.31)	(70.63)	(30.00)	(24.19)
10-24 workers	0.649***	0.599***	0.582***	0.533***
	(105.68)	(88.89)	(39.66)	(32.35)
25-49 workers	0.730***	0.673***	0.686***	0.627***
	(82.87)	(71.64)	(37.76)	(31.22)
50-99 workers	0.785***	0.724***	0.758***	0.699***
	(68.67)	(60.00)	(36.35)	(30.20)
100-299 workers	0.794***	0.715***	0.838***	0.771***
	(59.74)	(51.03)	(37.50)	(30.52)
300-999 workers	0.809***	0.708***	0.904***	0.825***
	(39.80)	(33.51)	(31.72)	(26.15)
From 1000 workers	0.826***	0.706***	0.975***	0.893***
	(24.85)	(20.88)	(24.51)	(21.18)
Female worker ratio	-0.00469	0.00636	-0.0332*	-0.0429*
	(-0.54)	(0.66)	(-1.65)	(-1.95)
Foreign worker ratio	0.779***	0.934***	0.651***	0.416**
	(13.29)	(13.70)	(3.96)	(2.14)
Ratio of workers without training	Base			
Ratio of workers with training of less than 3 months	0.00568	0.00107	0.0204	0.0178
	(0.52)	(0.09)	(1.14)	(0.93)
Ratio of workers with primary Vocational certificate	-0.0304**	-0.0318**	0.0924***	0.0802***
	(-2.52)	(-2.43)	(3.99)	(3.26)
Ratio of workers with Secondary (Vocational) Degree or (Vocational) College Degree	-0.0193**	-0.00315	0.0442**	0.0512**
	(-1.98)	(-0.30)	(2.04)	(2.19)
Ratio of workers with Bachelor degree or higher	-0.0217**	0.00663	-0.00993	0.0450
	(-2.00)	(0.56)	(-0.36)	(1.47)

Ratio of workers with Other certificates	0.146***	0.102***	0.146***	0.122***
	(11.52)	(7.39)	(6.64)	(5.18)
Ratio of workers aged 16-30	Base			
Ratio of workers aged 31 to 45	-0.108***	-0.127***	-0.135***	-0.157***
	(-13.76)	(-14.64)	(-7.54)	(-8.02)
Ratio of workers aged 46 to 55	-0.151***	-0.167***	-0.248***	-0.252***
	(-11.62)	(-11.93)	(-7.93)	(-7.49)
Ratio of workers aged 56 to 60	-0.119***	-0.148***	-0.268***	-0.334***
	(-4.90)	(-5.73)	(-3.91)	(-4.54)
Ratio of workers aged over 60	0.468***	0.274***	0.509***	0.249***
	(18.39)	(10.13)	(7.20)	(3.34)
Education level of manager	0.0212***	0.00939	0.0484***	0.0401***
	(3.99)	(1.63)	(4.45)	(3.43)
Manager's age	0.0293***	0.0190***	0.0143***	0.00277
	(18.65)	(10.95)	(4.26)	(0.75)
Manager's age squared	-0.000337***	-0.000233***	-0.000193***	-0.0000807**
	(-19.81)	(-12.60)	(-5.44)	(-2.10)
Ln(Agglomeration index)	0.00541***	0.00134	-0.000504	-0.00177
	(3.39)	(0.76)	(-0.17)	(-0.56)
Industrial ratio of workers from foreign firms in a district	-0.0107	-0.0219	0.112***	0.120***
	(-0.71)	(-1.34)	(5.83)	(5.72)
Share of workers often use computer	0.000505***	0.000570***	0.000650**	0.000821**
	(3.72)	(3.87)	(2.08)	(2.46)
Share of workers often use internet	0.000247*	0.000190	-0.000566*	-0.000800**
	(1.91)	(1.37)	(-1.92)	(-2.53)
Firm has computers	0.0874***	0.0861***	-0.0345	-0.0241
	(5.30)	(4.79)	(-0.95)	(-0.61)
Firm has its own website	0.0556***	0.0465***	0.0512***	0.0410***
	(11.48)	(8.92)	(4.88)	(3.67)
Firm use the internet for operation management	0.0278***	0.0274***	0.0260**	0.0222*
	(5.32)	(4.84)	(2.23)	(1.78)
Firm use the internet for transaction	-0.0199***	-0.0190***	-0.0209**	-0.0285**
	(-4.34)	(-3.79)	(-2.04)	(-2.57)
Firm use the internet for financial transaction	0.0924***	0.0884***	0.0594***	0.0521***
	(16.82)	(14.97)	(5.00)	(4.12)
Agriculture, Forestry and Fishery	-0.271***	-0.245***	0	0
	(-13.57)	(-10.98)	(.)	(.)
Mining and Electricity	-0.0444**	-0.0153	0	0
	(-2.33)	(-0.73)	(.)	(.)
Construction	0.0455***	0.0651***	0	0
	(4.84)	(6.37)	(.)	(.)

High-tech Manufacturing	0.135***	0.101***	0.157***	0.135***
	(8.71)	(6.16)	(10.98)	(8.89)
Medium-tech Manufacturing	0.110***	0.123***	0.106***	0.116***
	(10.11)	(10.51)	(10.24)	(10.42)
Low-tech manufacturing	Base			
Knowledge-intensive service	0.0670***	0.112***	0	0
	(6.99)	(10.72)	(.)	(.)
Less knowledge-intensive service	0.131***	0.146***	0	0
	(16.20)	(16.83)	(.)	(.)
Private firms	Base			
State Comp.	0.280***	0.273***	0.106**	0.0940*
	(10.68)	(10.21)	(2.01)	(1.76)
Collective	-0.199***	-0.188***	-0.131***	-0.149***
	(-12.85)	(-11.10)	(-3.24)	(-3.34)
Mixed Comp.	0.170***	0.149***	0.00636	-0.000397
	(4.71)	(4.09)	(0.11)	(-0.01)
Foreign Comp.	0.445***	0.352***	0.0949***	0.0723***
	(29.10)	(21.35)	(4.47)	(3.11)
region==Central Highlands	-0.342***	-0.240***	-0.425***	-0.360***
	(-26.39)	(-16.46)	(-11.55)	(-8.79)
region==Mekong River Delta	-0.0971***	0.00177	-0.105***	-0.0456**
	(-11.61)	(0.19)	(-5.73)	(-2.31)
region==Northern Central and Central Coast	-0.351***	-0.273***	-0.330***	-0.288***
	(-50.97)	(-36.19)	(-20.17)	(-16.29)
region==Northern Mountain	-0.299***	-0.219***	-0.322***	-0.273***
	(-28.96)	(-18.94)	(-13.77)	(-10.42)
region==Ha Noi	-0.172***	-0.111***	-0.182***	-0.135***
	(-28.63)	(-17.48)	(-12.80)	(-9.08)
region==Red River Delta (except Ha Noi)	-0.298***	-0.218***	-0.221***	-0.192***
	(-39.53)	(-25.76)	(-14.45)	(-11.49)
Ho Chi Minh City	Base			
region==South East (except Ho Chi Minh)	-0.0620***	-0.0116	-0.126***	-0.109***
	(-7.66)	(-1.27)	(-7.93)	(-6.25)
Involvement in export and import, lag		0.259***		0.116***
		(30.64)		(7.57)
Constant	0.984***	1.117***	1.482***	1.722***
	(25.06)	(25.45)	(17.19)	(17.89)
No. of Obs.	331591	265375	54128	44637
Adjusted R2	0.233	0.245	0.256	0.263
F-Statistics	2051	1728	425	356
Prob > F	0.000	0.000	0.000	0.000

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Appendix 3 Table 2. OLS regressions - Determinants of productivity

	(1)	(2)	(3)	(4)
	All service firms, 2016	**All matched service firms,2015-2016**	**All agriculture firms, 2016**	**All matched agriculture firms, 2015-2016**
Ln(K/L)	0.368***	0.381***	0.279***	0.266***
	(194.40)	(179.71)	(29.39)	(25.21)
1-4 workers	Base			
5-9 workers	0.469***	0.415***	0.215***	0.266***
	(72.55)	(58.49)	(5.30)	(5.53)
10-24 workers	0.684***	0.616***	0.123***	0.162***
	(88.86)	(73.96)	(2.75)	(3.14)
25-49 workers	0.759***	0.684***	0.154***	0.198***
	(61.88)	(53.47)	(2.74)	(3.16)
50-99 workers	0.809***	0.734***	0.321***	0.371***
	(46.08)	(40.67)	(3.76)	(4.10)
100-299 workers	0.843***	0.766***	0.104	0.0861
	(37.30)	(33.25)	(1.01)	(0.81)
300-999 workers	0.842***	0.770***	-0.217	-0.142
	(20.21)	(18.36)	(-1.57)	(-1.01)
From 1000 workers	0.786***	0.681***	-0.159	-0.344*
	(9.43)	(8.19)	(-0.86)	(-1.79)
Female worker ratio	-0.0146	0.00217	0.0563	0.0173
	(-1.40)	(0.19)	(0.85)	(0.23)
Foreign worker ratio	0.492***	0.606***	0.189	2.903*
	(7.13)	(7.56)	(0.29)	(1.67)
Ratio of workers without training	Base			
Ratio of workers with training of less than 3 months	-0.0198	-0.0231	0.169***	0.200***
	(-1.20)	(-1.29)	(2.75)	(3.01)
Ratio of workers with primary Vocational certificate	-0.118***	-0.126***	0.181***	0.287***
	(-7.33)	(-7.22)	(2.59)	(3.83)
Ratio of workers with Secondary (Vocational) Degree or (Vocational) College Degree	-0.0885***	-0.0737***	0.385***	0.488***
	(-7.00)	(-5.33)	(6.04)	(7.03)
Ratio of workers with Bachelor degree or higher	-0.0943***	-0.0769***	-0.0517	0.162
	(-6.76)	(-5.04)	(-0.59)	(1.62)
Ratio of workers with Other certificates	0.140***	0.0858***	0.0731	-0.0242
	(7.88)	(4.45)	(0.77)	(-0.23)
Ratio of workers aged 16-30	Base			

Ratio of workers aged 31 to 45	-0.0895***	-0.108***	-0.310***	-0.236***
	(-9.23)	(-10.08)	(-4.27)	(-2.86)
Ratio of workers aged 46 to 55	-0.114***	-0.137***	-0.455***	-0.378***
	(-7.09)	(-7.91)	(-5.67)	(-4.22)
Ratio of workers aged 56 to 60	-0.0778***	-0.122***	-0.561***	-0.431***
	(-2.66)	(-3.94)	(-5.59)	(-3.98)
Ratio of workers aged over 60	0.448***	0.248***	-0.396***	-0.342**
	(14.57)	(7.58)	(-2.91)	(-2.31)
Education level of manager	0.0256***	0.0112	0.110***	0.0863**
	(3.68)	(1.48)	(3.06)	(2.20)
Manager's age	0.0326***	0.0216***	0.0344***	0.0264**
	(16.41)	(9.92)	(2.96)	(2.00)
Manager's age squared	-0.000368***	-0.000256***	-0.000338***	-0.000270**
	(-16.99)	(-10.89)	(-2.85)	(-2.02)
Ln(Agglomeration index)	0.00659***	0.00134	0.0226***	0.0209***
	(3.05)	(0.55)	(3.26)	(2.69)
Industrial ratio of workers from foreign firms in a district	-0.0158	0.0255	0.115	-0.0365
	(-0.62)	(0.94)	(0.72)	(-0.21)
Share of workers often use computer	0.000490***	0.000482***	-0.00101	-0.000521
	(2.91)	(2.64)	(-1.04)	(-0.48)
Share of workers often use internet	0.000317**	0.000256	0.00170*	0.00122
	(1.98)	(1.49)	(1.91)	(1.22)
Firm has computers	0.150***	0.147***	0.0139	0.0652
	(7.14)	(6.47)	(0.21)	(0.85)
Firm has its own website	0.0550***	0.0442***	0.0501	0.0461
	(9.08)	(6.78)	(1.22)	(1.08)
Firm use the internet for operation management	0.0178***	0.0176**	-0.0107	0.00409
	(2.73)	(2.51)	(-0.27)	(0.09)
Firm use the internet for transaction	-0.0215***	-0.0162**	0.0514*	0.0485
	(-3.71)	(-2.55)	(1.86)	(1.62)
Firm use the internet for financial transaction	0.0988***	0.0929***	0.0505	0.00228
	(14.43)	(12.63)	(0.93)	(0.04)
	(.)	(.)	(.)	(.)
Knowledge-intensive service	-0.0627***	-0.0237***	0	0
	(-9.20)	(-3.17)	(.)	(.)
Less knowledge-intensive service	Base	0	0	0
	(.)	(.)	(.)	(.)
Private firms	Base			
State Comp.	0.342***	0.318***	0.289***	0.243***
	(8.41)	(7.69)	(3.58)	(2.98)
Collective	-0.181***	-0.176***	-0.303***	-0.330***
	(-8.12)	(-7.36)	(-7.44)	(-7.15)

Mixed Comp.	0.242***	0.207***	-0.394	-0.524**
	(4.26)	(3.62)	(-1.61)	(-2.03)
Foreign Comp.	0.772***	0.702***	0.535***	0.308
	(33.38)	(28.62)	(3.12)	(1.51)
region==Central Highlands	-0.373***	-0.242***	-0.193*	-0.0178
	(-22.84)	(-13.06)	(-1.76)	(-0.15)
region==Mekong River Delta	-0.0882***	0.0378***	0.304***	0.454***
	(-8.24)	(3.16)	(2.78)	(3.87)
region==Northern Central and Central Coast	-0.399***	-0.293***	-0.0612	-0.00781
	(-45.90)	(-30.60)	(-0.60)	(-0.07)
region==Northern Mountain	-0.352***	-0.247***	-0.0675	0.0371
	(-25.19)	(-15.66)	(-0.62)	(0.32)
region==Ha Noi	-0.187***	-0.109***	-0.119	-0.0609
	(-25.59)	(-14.08)	(-1.13)	(-0.55)
region==Red River Delta (except Ha Noi)	-0.341***	-0.228***	-0.114	-0.0567
	(-34.95)	(-20.64)	(-1.09)	(-0.51)
Ho Chi Minh City	Base			
region==South East (except Ho Chi Minh)	-0.0220**	0.0556***	0.121	0.427***
	(-2.08)	(4.61)	(1.07)	(3.44)
Involvement in export and import, lag		0.360***		0.517***
		(33.38)		(5.27)
Constant	1.012***	1.164***	1.215***	1.254***
	(20.88)	(21.56)	(4.16)	(3.75)
No. of Obs.	223785	178352	5638	4250
Adjusted R2	0.229	0.244	0.339	0.381
F-Statistics	1546	1308	70	62
Prob > F	0.000	0.000	0.000	0.000

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.010

Appendix 4. List of Manufacturing Sub-sectors and VSIC codes

Mã VSIC	Manufacturing sub-sectors
10	Food
11	Beverage
12	Tobacco
13	Textile
14	Apparel
15	Leather
16	Wood
17	Paper
18	Printing
19	Coal, petroleum products
20	Chemical products
21	Pharmaceutical production
22	Rubber, plastic
23	Non-metal products
24	Metal products
25	Prefabricated metal
26	Electronics, PC, optical products
27	Electrical equipment
28	Unclassified machines, equipment
29	Motor vehicles
30	Other means of transport
31	Beds, cabinets, tables, chairs
32	Other processing and manufacturing
33	Repair, maintenance