



THE ECONOMIC IMPACT OF THE FOOD INDUSTRY IN SINGAPORE

FINAL REPORT: SEPTEMBER 2016

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Food Industry Asia (FIA) was founded in July 2010 by a group of leading food and beverage companies. From our base in Singapore, we seek to enhance the industry's role as a trusted partner in the development of science-based policy in the region.

We provide an important hub for advocacy and debate, bringing together the food industry's most senior business leaders to champion initiatives that promote sustainable growth and support regional policies that deliver harmonised results.

Our Philosophy

At the heart of FIA's philosophy lies a belief that the private sector can play a more positive role in civil society if it has a seat at the table. To this end, FIA is committed to building relationships with governments and policymakers – either directly or through existing local industry groups.

Our Vision

To be a trusted partner for businesses and governments – building a vibrant food & beverage industry for a healthy and prosperous Asia.

Our Mission

To represent the food & beverage industry in Asia – promoting a climate for sustainable growth and serving as a regional knowledge hub for science-based advocacy.

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EXECUTIVE SUMMARY

The food industry in Singapore, just as across South East Asia, is changing. Global shifts in the way markets are operating, patterns of economic and social development, and technological advances are all changing both the way that food is made and distributed, and way that consumers choose, purchase and communicate what they eat and drink.

In this report, Oxford Economics measures the contribution of the food and non-alcoholic beverage industry to the economy of Singapore in 2014. The study quantifies the industry's impact in three parts: the contribution of food manufacturers in terms of gross domestic product (GDP), employment, tax receipts and Central Provident Fund (CPF) contributions; the contribution of companies involved in the distribution of food, such as wholesalers, retailers and restaurants, across the same metrics; and the wider economic impact it makes, in particular through R&D, education and training, and other initiatives which improve the wellbeing of the Singapore population.

S\$14.4 bn
GDP contribution

Total contribution of the food industry to the GDP of Singapore in 2014.

In 2014 the food industry contributed S\$14.4 billion to the economy of Singapore and supported 296,400 jobs. These impacts represent the sum of four channels of impact: the direct contribution of Singapore food manufacturers' own activities; indirect activities within food manufacturers' Singapore supply chain; the induced effect as employees of food manufacturers, and within their supply chain spend their wages in the wider economy; and activity associated with the distribution of food and non-alcoholic beverages.

The overall impact of the food industry is dominated by food distribution. The wholesale and retail of food, along with activity linked to Singapore's 6,700 food service locations (which include restaurants, coffee shops, and street hawker stands) account for two-thirds of the food industry's GDP contribution, and four-fifths of the employment it supports.

The food manufacturing industry directly supports 38,800 jobs and makes a S\$3.2 billion contribution to GDP. Including the multiplier impacts of supply chain spending and the consumer spending impacts which occur as employees spend their wages, the manufacturing contribution increases to 58,000 jobs and S\$4.8 billion in GDP.

The economic impact of the food industry goes well beyond its immediate economic footprint. Many food industry companies undertake research and development work in Singapore. As well as creating healthier, safer and more environmentally friendly products, such activity can create spillover benefits for the wider economy. The majority of food industry companies we surveyed also reported that they offer various types of skills development programmes, and so help to build the capabilities of the Singapore labour force. Companies in the industry also lead a range of initiatives to promote healthier lifestyles amongst their workforce and the wider population, and to reduce the environmental impact of their activities.

Summary of economic impact results

	Employment	GDP (S\$ millions)	Tax (S\$ millions)	CPF (S\$ millions)
Manufacturing Direct	38,800	3,200	70	105
Manufacturing Indirect	6,100	610	31	37
Manufacturing Induced	13,100	960	58	90
Distribution Direct	243,100	9,800	405	710
Total Contribution of the Food Industry*	296,400	14,400	560	930

* The indirect and induced impacts of food manufacturing include a small amount of activity that is also captured within the food distribution industry estimates. The total impacts reported have been adjusted to avoid double counting of this activity, and so do not quite represent the simple sum of the values reported in the rows above.

1. INTRODUCTION

The food industry in Singapore, just as across South East Asia, is changing. Global shifts in the way markets are operating, patterns of economic and social development and technological advances are changing both the way that food is made and distributed, and way that consumers choose, purchase and communicate what they eat and drink. These changes bring opportunities but also challenges—from food safety, to provenance and waste, and from questions of international competitiveness to social and health outcomes. The landscape is complex and evolving.

Within this context, this study provides a robust assessment of the economic contribution of the food and non-alcoholic beverage industry (hereafter ‘the food industry’) in Singapore. It assesses the core economic impact of food manufacturing, as well as the activity supported by those companies who convey, distribute and prepare food for consumers throughout Singapore, such as wholesalers, retailers and restaurants. It also explores some of the wider ways in which the industry contributes to the economic and social development of Singapore, such as through its research and development activity, education and training, and through activities to promote environmental sustainability and healthy lifestyles.

The report aims to provide Food Industry Asia (FIA) and its members with a comprehensive document to inform their understanding of how the food industry supports economic activity in Singapore. The study will also provide an evidence base to support the Singapore government’s promotion of Singapore as a hub, gateway and thought leader within the Asian food industry.

INTRODUCING ECONOMIC IMPACT ANALYSIS

The economic impact of a company or industry is measured using a standard means of analysis called an economic impact assessment. The report quantifies four channels of impact that together comprise the industry's 'economic footprint':

- **Direct impact** - the economic benefit of the food industry itself;
- **Indirect impact** (supply chain) - the economic benefit and employment supported in the food industry's supply chain in Singapore as a result of the procurement of goods and services;
- **Induced impact** (consumer spending) - the wider economic benefits that arise when employees of the Singapore food industry and its supply chain spend their earnings, for example in local leisure and retail establishments; and
- **Distribution impacts** – the activity supported in Singapore among distributors, wholesalers, retailers, restaurants, cafes and street food vendors.

From these channels, the total economic footprint of the Singapore food industry is presented, using five key metrics:

- **GDP**, or more specifically, the industry's gross value added (GVA) contribution to GDP. **GVA** measures the contribution to the economy of each individual producer. When aggregated across all firms, gross value added sums to GDP.¹ GDP is one of the main summary indicators of a country's economic performance. Throughout the report 'gross value added contribution to GDP' is referred to as 'contribution to GDP'
- **Employment**, as the number of people employed, measured on a headcount basis;
- **Labour productivity** - the average value of output generated by each worker (measured in this study as GDP per job);
- **Tax**, representing the income and corporation tax payments made to the Singapore government; and
- **Central Provident Fund (CPF) contributions**, based on the mandated contributions of employers and employees to the fund.

In addition to the core economic impacts, this report examines the **wider effects** of the food industry's activities in supporting productivity and wellbeing in Singapore. These impacts represent the wider benefits that governments, consumers, society and other industries derive from the food industry's activities. For the food industry these are primarily captured in the contribution the industry makes to Singapore's development as a centre of advanced food manufacturing, and its broader economic and social development.

The modelling on which this report is based computes the economic footprint of the Singapore food industry in 2014, the latest year for which full economic data were available at the time of writing. Further detail about the economic impact methodology is included in the technical appendix.

¹ Technically, the link between GVA and GDP can be defined as: GVA plus taxes on products less subsidies on products equals GDP

2. THE CONTRIBUTION OF FOOD MANUFACTURING

First we examine the contribution of the food manufacturing sector itself in Singapore. As set out in the introduction, we do so by examining, in turn, the direct, indirect (supply chain) and induced (consumer spending) benefits that arise as a result of its activities. These are quantified in terms of the GVA contribution to GDP, the number of jobs sustained, the tax revenues that accrue to government as a result of these activities and employment, and the contribution to the CPF made by employers and employees in the food manufacturing sector.²

2.1 DIRECT IMPACT

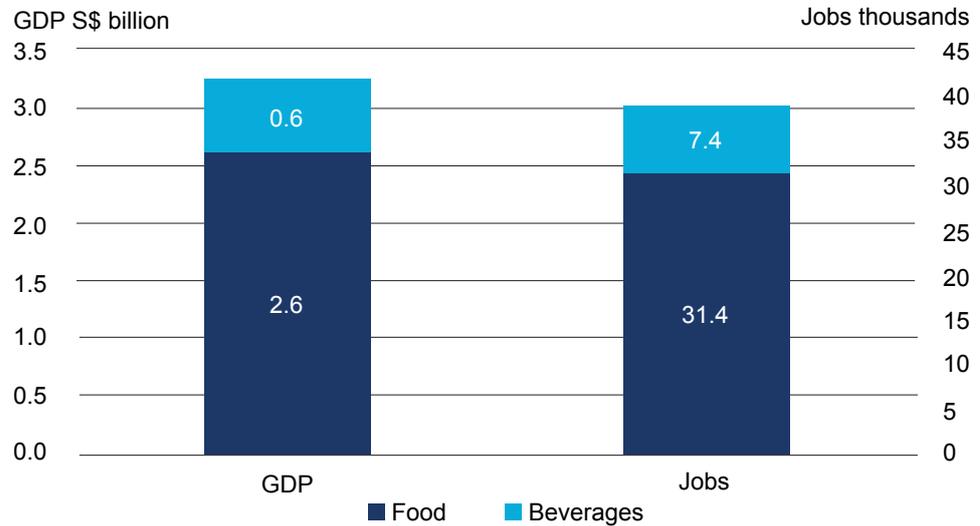
The direct impact of the food industry in Singapore arises from the economic activity that food manufacturers support at their sites across the city. In 2014, the food industry earned S\$9.8 billion from sales in Singapore. From those sales, and after accounting for input costs, the industry made a sizeable contribution to Singapore's GDP of S\$3.2 billion. That contribution was made up of around S\$1.4 billion in employee remuneration³ (43 percent) and the remainder (57 percent) of profits (measured as earnings before interest, taxes, depreciation and amortisation (EBITDA)).

Around 80 percent of the industry's GDP contribution came from food manufacturing, with the remainder from non-alcoholic beverage manufacturing. This direct contribution is not only quantified in terms of economic output. The industry, through its operations, directly supported almost 39,000 jobs, divided between the food and drink sectors in similar proportions to GDP.

² The Central Provident Fund (CPF) is a compulsory savings plan for working Singaporeans and permanent residents, primarily to fund their retirement, healthcare, and housing needs. It is an employment-based savings scheme with employers and employees contributing a mandated amount to the Fund.

³ Including basic wages, bonuses, employers' Central Provident Fund (CPF) contributions and other benefits in kind (e.g. medical costs and other insurance)

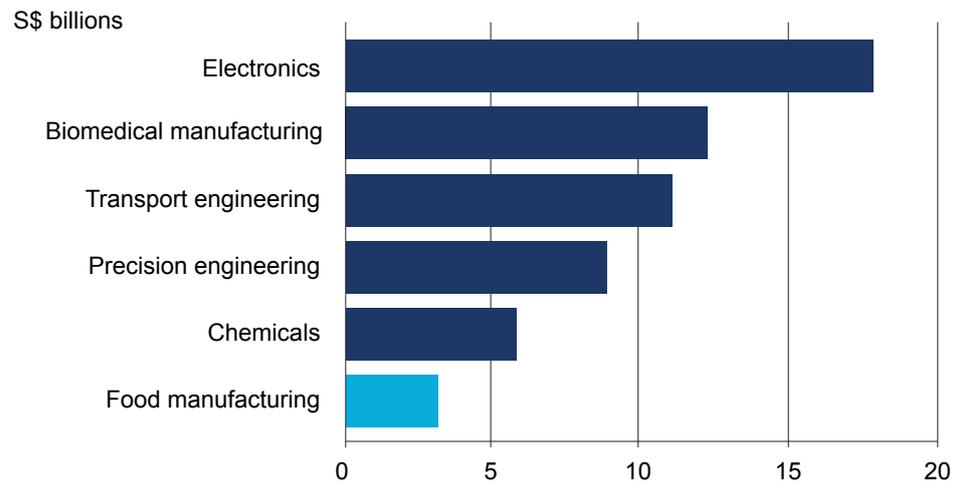
Fig. 1. GDP and jobs directly supported by the food manufacturing industry, 2014



Source: Singapore Statistics

To give a sense of the scale and importance of food manufacturing, its direct contribution to Singapore GDP is equivalent to around one-third of Singapore’s precision engineering cluster, and around one-sixth of the country’s electronics cluster.

Fig. 2. GDP in food manufacturing and key manufacturing clusters, 2014⁴

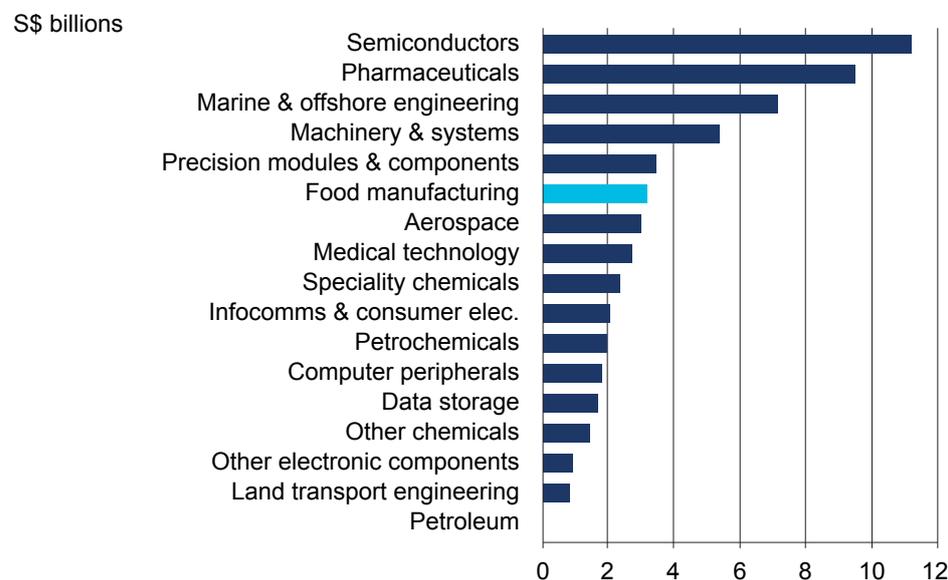


Source: The Census of Manufacturing Activities, 2014

However, comparing the individual industries within each of the five clusters against food manufacturing shows that the food manufacturing industry is equivalent in size to Singapore’s aerospace industry, and larger than industries such as speciality chemicals, petrochemicals, medical technology and land transport engineering.

⁴ Clusters are as defined in *The Census of Manufacturing Activities, 2014*.

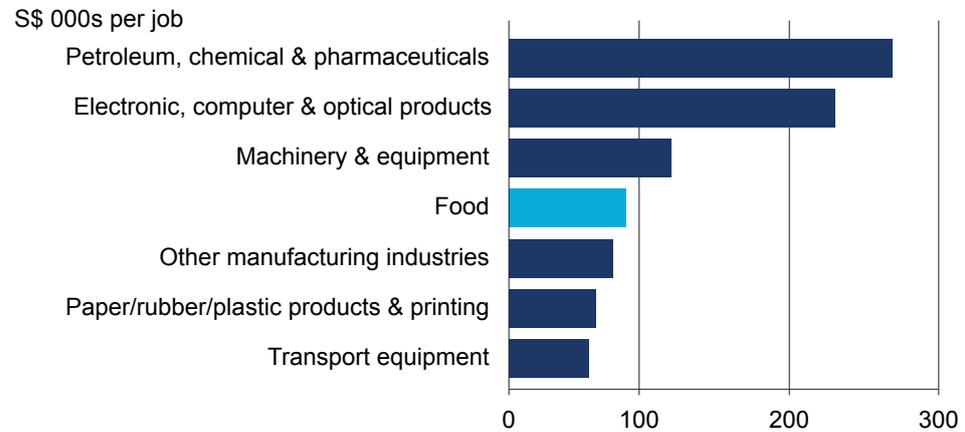
Fig. 3. GDP in food manufacturing and the components of Singapore's industry clusters, 2014



Source: The Census of Manufacturing Activities, 2014

By dividing the GDP contribution by the number of jobs supported it is possible to estimate the value created per job, a measure of productivity. This comes to S\$82,500, slightly below the economy-wide average of S\$96,000. The chart below compares productivity in the food industry to that in other Singapore manufacturing industries. This shows that productivity in the food industry is higher than in other traditional manufacturing industries, such as paper, rubber, and plastic products, and transport equipment. However, the food industry, not surprisingly, lags industries with a greater focus on high value-added products, such as petroleum, chemicals and pharmaceuticals, and electronics. The headway that the food industry is making in terms of advanced manufacturing, which is explored later in this report, would be expected to have an impact on productivity levels in the industry in future.

Fig. 4. Productivity in food and other manufacturing industries, 2014

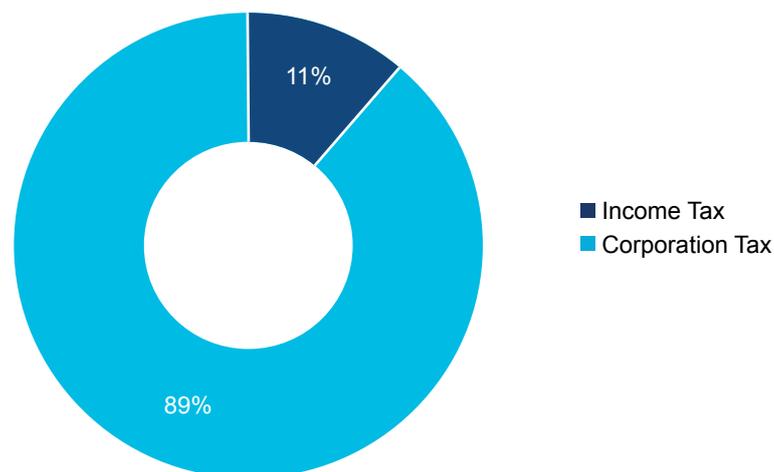


Source: Statistics Singapore

All of this economic activity generates a considerable fiscal contribution for the Singapore government. In 2014, the Singapore food manufacturing industry and its employees paid or collected almost S\$70 million in tax revenues.

The largest components of these revenues were corporation tax receipts, which accounted for 89 per cent of the total. Income tax receipts accounted for the remaining 11 per cent of the tax revenues generated.

Fig. 5. Composition of taxes paid or collected by the Singapore food manufacturing industry, 2014

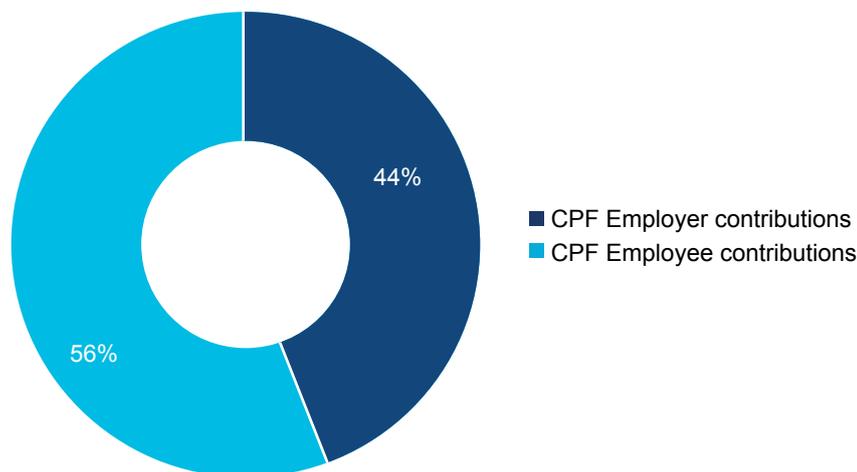


Source: Inland Revenue Authority of Singapore, Oxford Economics calculations

In addition, the food industry plays a crucial role in helping Singapore residents contribute towards their retirement, housing and healthcare needs, through contributions to the Central Provident Fund (CPF). This contribution has two aspects. First, the food industry itself makes mandatory contributions towards the CPF of their workers. Second, by paying its staff wages and salaries, the industry enables each worker to make their own mandatory contributions to the scheme.

In total, CPF contributions made by employers and employees in the food manufacturing industry totalled S\$105 million in 2014. The largest component of this payment was employee contributions, which accounted for 56 percent of the total. Employer CPF contributions accounted for the remaining 44 percent.

Fig. 6. Composition of CPF contributions by the Singapore food manufacturing industry, 2014



Source: Inland Revenue Authority of Singapore, Oxford Economics calculations

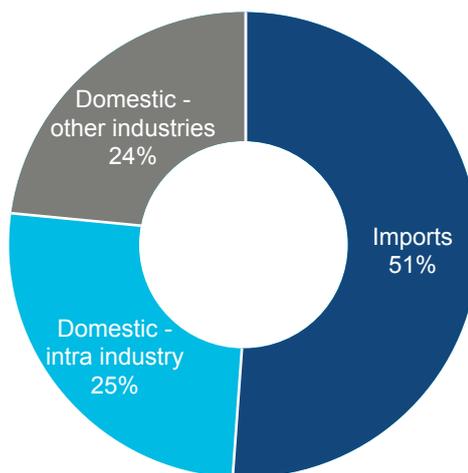
2.2 INDIRECT IMPACT

As well as directly employing people in their operations, food manufacturers support a substantial amount of further economic activity by purchasing inputs of goods and services from Singapore-based suppliers. Those suppliers hire people to fulfil the industry’s demand, and this constitutes the first round of indirect impact on the Singapore economy. In turn, the industry’s suppliers go on to purchase their own inputs of goods and services from other suppliers. The Singapore-based output and employment stimulated from this expenditure constitutes subsequent rounds of the food industry’s indirect impact. The total economic activity associated with the first and subsequent rounds of supply chain spending within Singapore determines the food industry’s ‘indirect’ economic impact.

In 2014, the food industry spent S\$6.6 billion on inputs of goods and services from all over the world. Perhaps unsurprisingly for a country with a largely urbanised economy and little space for agriculture, 51 percent of food

manufacturers' inputs were imported. This is a much higher proportion than observed in Malaysia (17 percent), Thailand (17 percent) and in developed economies, such as the UK (16 percent) or France (12 percent).

Fig. 7. Procurement of goods and services by food manufacturers, 2014



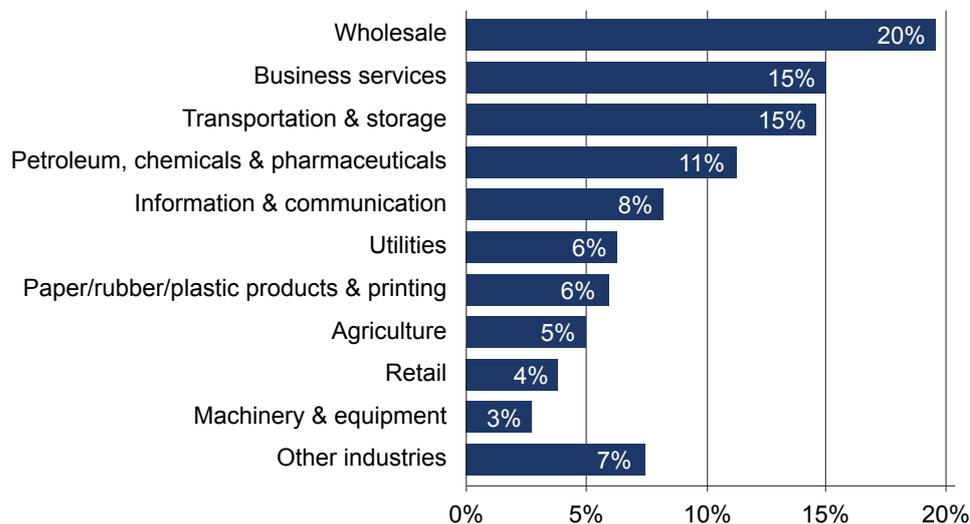
Source: Singapore Input Output Tables

The S\$3.2 billion of supply chain purchases made by the industry from Singapore-based suppliers was split between purchases from other Singapore food manufacturers (S\$1.7 billion) and firms in other industries (S\$1.6 billion).⁵

Fig.8 shows how the latter was distributed across other industry sectors. Over 90 percent of spending occurs in 10 sectors, particularly wholesale, business services and transportation and storage. About half of spending on business services relates to real estate services.

⁵ To avoid double counting, only the \$1.6 billion of purchases from other industries are analysed through the input-output model.

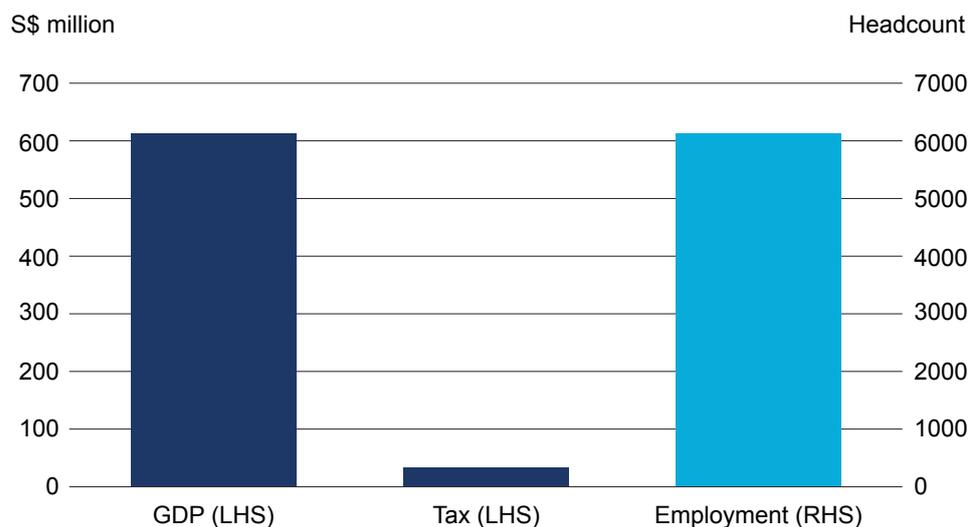
Fig. 8. Singapore food manufacturers' supply chain spending within Singapore, by sector, 2014⁶



Source: Singapore Supply and Use, and Input-Output Tables

Our modelling suggests that the S\$1.6 billion of domestic procurement spending supported S\$610 million of GDP, 6,100 jobs, S\$31 million in tax revenues, and S\$37 million in CPF contributions in 2014.

Fig. 9. The indirect impact of the food manufacturing industry, 2014

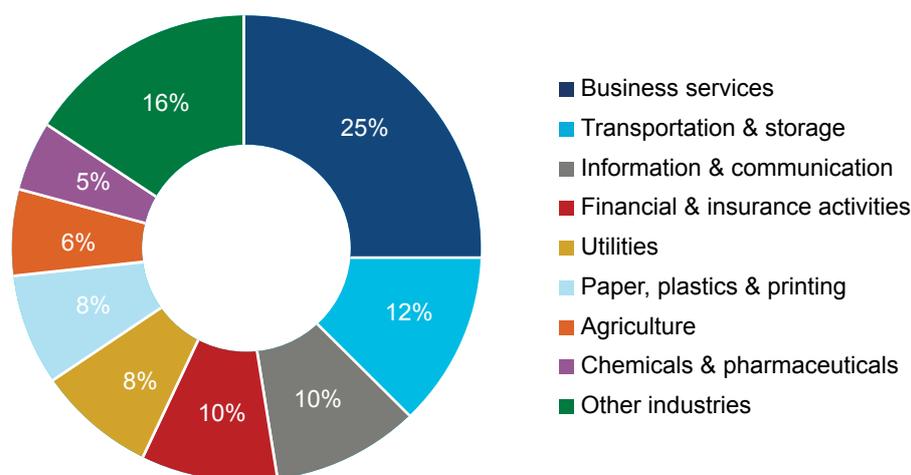


Source: Oxford Economics

⁶ Purchases from the wholesale sector could relate to either domestic or imported goods, but no data are available to estimate this split

The impact of the food industry extends far beyond the most closely related sectors. All across the Singapore economy companies and employees benefit from the activities of the food sector as its impact ripples through the economy. The chart below shows that 25 percent of the indirect GDP impact accrues to the business services sector, and a further 12 percent to the transportation and storage sector. Ten percent of the indirect GDP supported accrues to both the information and communication sector and the finance sector.

Fig. 10. Food manufacturers' indirect GDP impact by sector, 2014



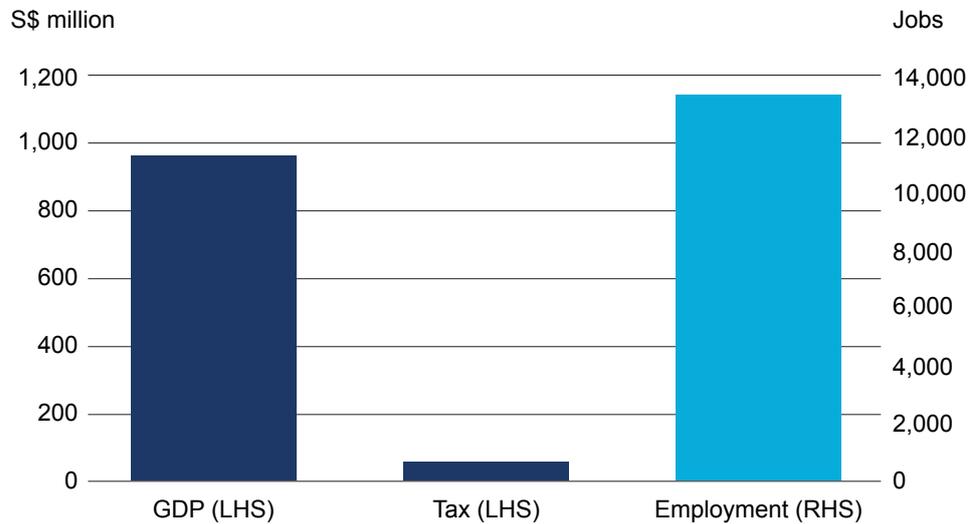
Source: Statistics Singapore, Oxford Economics

2.3 CONSUMER SPENDING IMPACT

The food industry's wage payments to its employees stimulate further economic activity as those employees spend a proportion of their disposable income at leisure and retail outlets across the city. In addition, the industry's suppliers employ people in order to fulfil supply chain needs, and these employees also spend money in the Singapore economy. These effects comprise the industry's 'induced' or consumer spending impact.

In 2014, the food industry paid the 38,800 people it employed in Singapore a total of S\$1.4 billion in wages and other remuneration. Of that, an estimated S\$1.3 million was disposable income (assuming an effective tax rate of 10 percent). The spending of this income, along with spending by those employed in the food industry's supply chain, is estimated to have supported S\$960 million of GDP, 13,100 jobs, S\$58 million in tax revenue, and S\$90 million of contributions to the CPF in 2014.

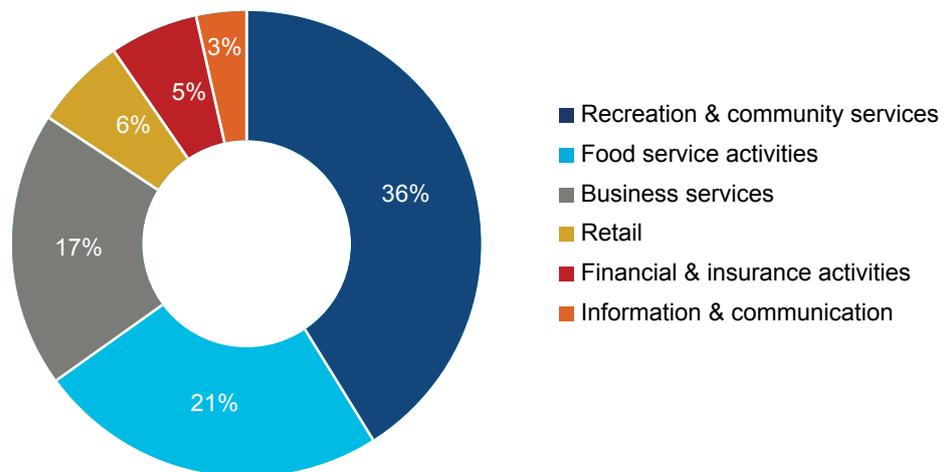
Fig. 11. The consumer spending impact of the food manufacturing industry, 2014



Source: Oxford Economics

As with the indirect impacts, a wide range of sectors benefit from the ripple effects of consumer spending by those employed in the food industry and its supply chain. Of the jobs supported by the consumer spending impact, 36 percent were in recreation and community services (which include sports events, hairdressers, health and education, repair and maintenance). A further 21 percent were in food service activities (which includes restaurants and coffee shops).

Fig. 12. Food manufacturers' induced employment impact by sector, 2014



Source: Statistics Singapore, Oxford Economics

3. THE IMPACT OF THE SINGAPORE FOOD DISTRIBUTION SECTOR

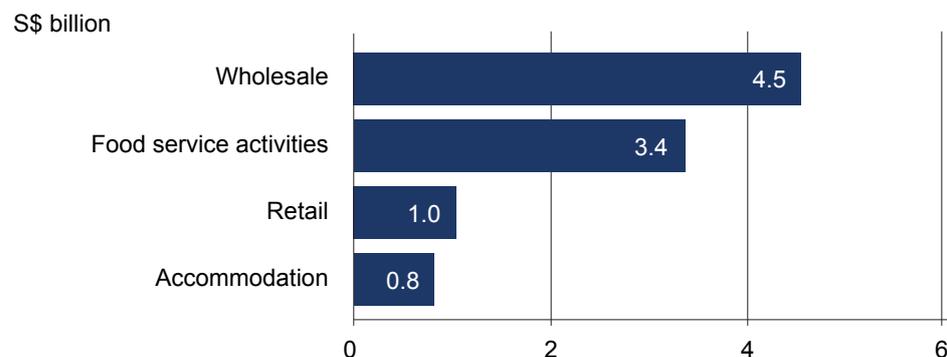
It is not just the manufacture of food that adds economic value. All across the city, from food hawkers on side streets to high-end restaurants, and from corner shops to major supermarkets, food permeates lifestyle in Singapore. The previous chapter presented estimates of the direct, indirect and consumer spending impacts of the food manufacturing industry itself. Beyond this, a considerable amount of additional economic activity is supported in sectors which distribute food and beverages to consumers and businesses throughout the city.

This chapter therefore considers the jobs and GDP supported by the food distribution sector, which we define to include wholesalers, retailers, accommodation providers (primarily hotels), and food service providers. The latter group includes restaurants, food courts, coffee shops and food hawkers. The analysis only reflects the sale of food and non-alcoholic beverages (and agricultural raw materials) in each of these sub-sectors. Sales of other items have been excluded.

Sales of food and beverages through wholesale routes and onwards to consumers in hotels, restaurants and shops made a S\$9.8 billion value added contribution to Singapore GDP in 2014. The chart below shows that the wholesale sector generated S\$4.5 billion of this value.

The chart also highlights the impact made by the food services sector, which includes restaurants, food courts, cafes and food hawkers. This sector contributed S\$3.4 billion to GDP in 2014.

Fig. 13. GDP directly supported by the food distribution industry, 2014

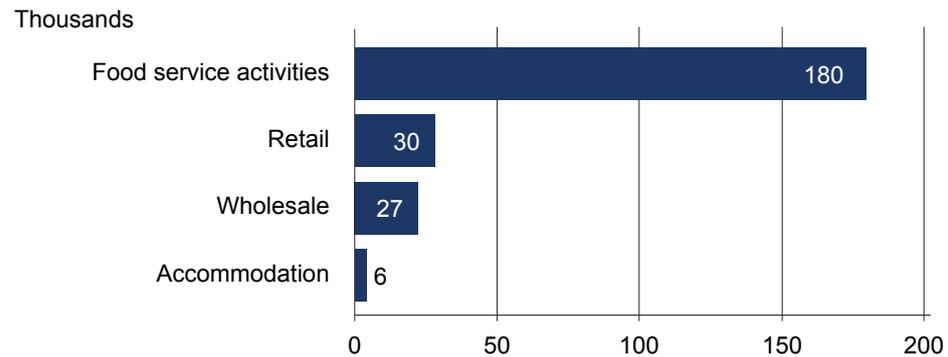


Source: Statistics Singapore, Oxford Economics

The selling of food and beverages is estimated to directly support 243,100 jobs across the four distribution sub-sectors. Three-quarters of that total (180,000) are employed in food services, reflecting the relatively labour-intensive nature of

the sub-sector’s customer service orientated activities. The wholesale and retail sub-sectors each account for more than 10 percent of jobs, while the sale of food in accommodation establishments, such as hotels, is estimated to support 6,000 jobs.

Fig. 14. Jobs directly supported by the food distribution industry, 2014



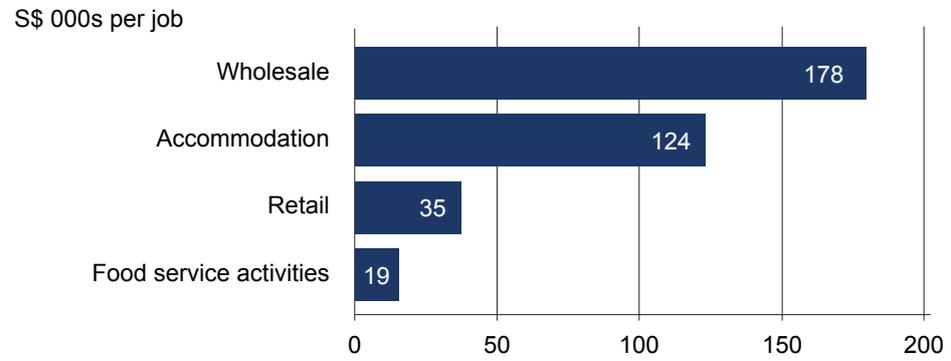
Source: Statistics Singapore, Oxford Economics

As with the food manufacturing sector, it is possible to estimate the productivity of food distribution sub-sectors. This suggests that productivity levels are extremely high in the food distribution and accommodation sub-sectors, where each job supports a contribution to GDP in excess of S\$100,000. While productivity levels are substantially lower in retail and food services, these activities represent an important source of jobs for those with lower skill levels, or those seeking casual work.

There are a number of potential reasons for extremely high productivity levels in wholesaling, especially when compared to the retail sector. In particular, the wholesale sector has low labour intensity (i.e. it employs fewer workers to create every S\$ of output), employs a more highly skilled workforce, and has been better able to apply ICT to transform operations than many other service industries.⁷ The sector is now highly automated and this has helped it achieve the high productivity level shown in Fig. 15.

⁷ See, for example, Christopher Kask, David Kiernan and Brian Friedman “Labor productivity growth in wholesale trade, 1990-2000”, *Monthly Labor Review* December 2002, available from www.bls.gov/opub/mlr/2002/12/art1full.pdf, accessed on 24.02.2016

Fig. 15. Productivity in food distribution sub-sectors, 2014



Source: Statistics Singapore, Oxford Economics

Based on both the GVA and jobs supported by the food-related sales of the distribution sector, we estimate that the food distribution sector generated S\$405 million in tax revenues and a S\$710 million contribution to the CPF in 2014.

4. THE TOTAL IMPACT OF THE FOOD INDUSTRY IN SINGAPORE

Together the food manufacturing and food distribution industries in Singapore make a substantial contribution to the Singapore economy. This chapter brings together the economic modelling results from the previous two chapters to present our estimates of the total economic contribution of the Singapore food industry.

4.1 THE TOTAL GDP AND EMPLOYMENT IMPACT OF THE SINGAPORE FOOD INDUSTRY

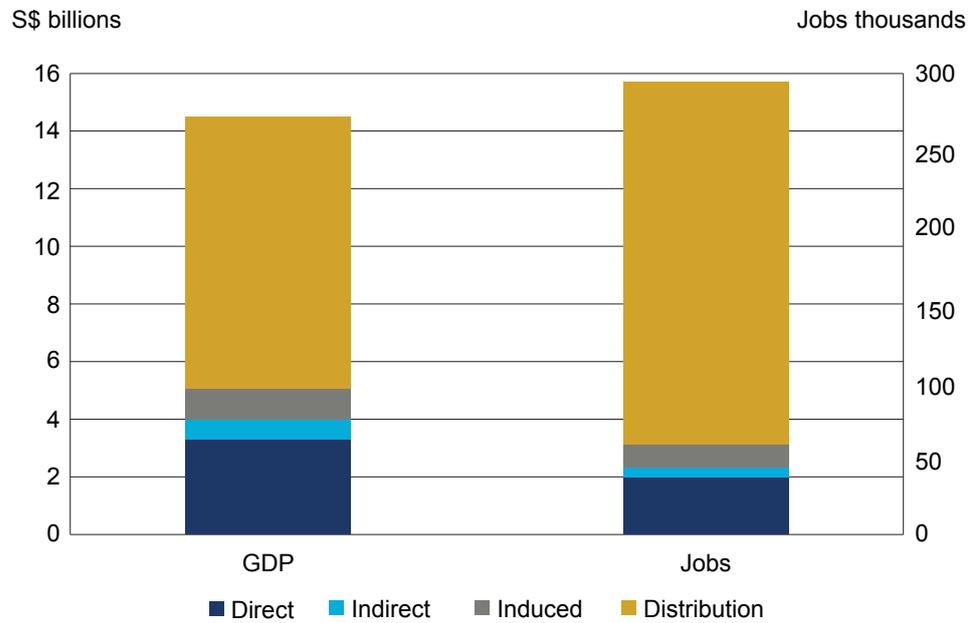
To estimate the total GDP impact of the food industry we add the value generated by the food distribution sector to the direct, indirect and consumer spending impacts generated by the food manufacturing sector.⁸

On this basis the Singapore food industry is estimated to have contributed S\$14.4 billion to the country's GDP in 2014. Of this total, 67 percent was generated by food distribution activities. The direct impact of food manufacturing contributed a further 22 percent of the total.

Applying the same approach we estimate that the food industry supported a total of 296,400 jobs in Singapore in 2014. The results for employment are dominated by the food distribution sector to an even greater extent than the GDP results. Around 80 percent of jobs supported by the food industry are in food distribution activities. A further 13 percent, or 38,800 jobs, result from the direct impact of food manufacturing.

⁸ The indirect and induced impacts of food manufacturing include a small amount of activity that is also captured within the food distribution industry estimates. The total impacts reported have been adjusted to avoid double counting of this activity, and so do not quite represent the simple sum of the values reported in the previous chapters.

Fig. 16. The total economic contribution of the Singapore food industry, 2014



Source: Oxford Economics

4.2 THE TOTAL TAX AND CPF CONTRIBUTION OF THE SINGAPORE FOOD INDUSTRY

Adding the tax revenues associated with the food distribution sector to those from the direct, indirect and induced impacts of food manufacturing suggests that the food industry as a whole generated S\$560 million in tax revenues for the Singapore government in 2014. In addition, the activities of the food industry as a whole supported a S\$930 million contribution to Singapore’s social security systems through employer and employee CPF contributions.

5. WIDER IMPACTS OF THE SINGAPORE FOOD INDUSTRY

This chapter examines the wider effects of the food industry's activities in supporting productivity and wellbeing in Singapore. These impacts represent the wider benefits that governments, consumers, society and other industries derive from the food industry's activities. For the food industry these are primarily captured in the contribution the industry makes to Singapore's development as a centre of advanced food manufacturing, and its broader economic and social development.

METHODOLOGY: THE WIDER IMPACTS OF THE SINGAPORE FOOD INDUSTRY

The discussion in this section has been informed by two main sources of evidence: a series of consultations with major companies in the Singapore food industry and an online survey of both members of Food Industry Asia (FIA) and Singapore Manufacturing Federation (SMF). Below we discuss each in turn.

Consultations with companies operating in the Singapore food industry

Consultations were undertaken with representatives of three global food manufacturing companies. Each consultation lasted 20 to 30 minutes and covered topics including:

- the size and nature of the company's business in Singapore;
- the benefits of being located in Singapore;
- how the company contributes to the country's broader economic and social development, including through initiatives to protect the environment and support healthier lifestyles; and
- research and development activity undertaken in Singapore.

Online survey

An online survey was circulated to FIA members in Singapore with the intention of gathering information on the same topics as the consultations from a wider sample of firms. A total of 23 responses were received during December 2015 and January 2016.

Around half of responses were from manufacturers, but other aspects of the industry were also represented.

While nine responses were received from companies employing more than 200 people, slightly more were received from SMEs.

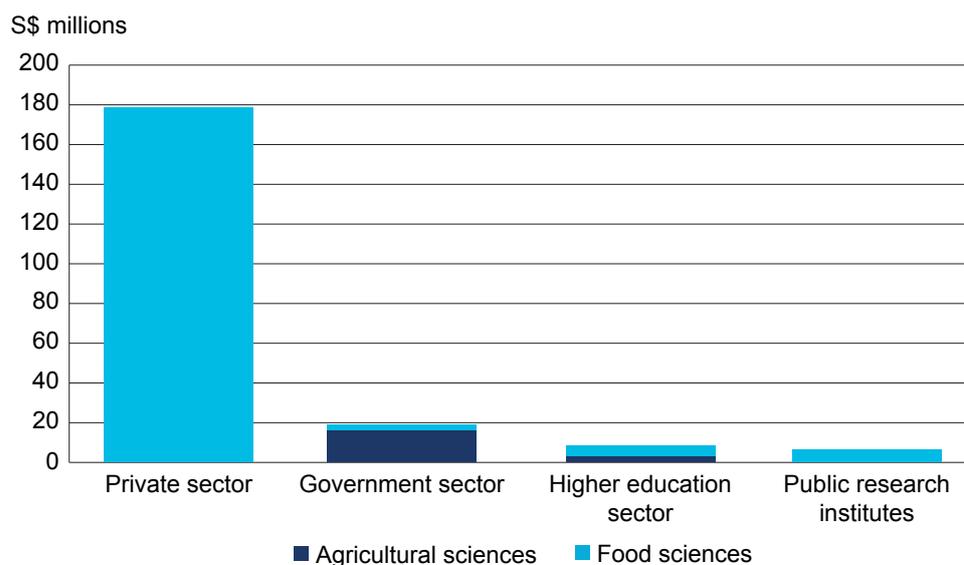
5.1 THE CONTRIBUTION OF THE FOOD INDUSTRY TO SINGAPORE'S STATUS AS A CENTRE OF ADVANCED MANUFACTURING

Research and development (R&D) activity supports economic productivity by improving the quality of goods, reducing the costs of producing existing goods, and increasing the range of goods or intermediate inputs available.⁹ Furthermore, R&D carried out in one company can have positive 'spillover' benefits to other firms or industries. For example, as researchers move between firms, or interact in formal or non-formal settings, they can share knowledge they have gained. Firms might disseminate new processes or products via supply chains, or to their clients. And as products are brought to market, their innovative nature can be observed, imitated and enhanced by others.

A number of companies reported that Singapore is the leading location for consumer goods firms in South East Asia, in terms of geographical location, connectivity, political stability and the availability of skills. Building on these advantages, the Singapore Economic Development Board is supporting businesses as they seek to move from lower value manufacturing to higher-value manufacturing and research and development (R&D).

The Agency for Science, Technology and Research (A*STAR) estimates that organisations in Singapore spent a total of S\$210 million on R&D in the field of agricultural and food sciences in 2013. The vast majority of this spending was undertaken by the private sector, and three quarters of the funds spent were dedicated to the field of food science, with the remaining quarter going to agricultural science issues.

Fig. 17. R&D expenditure by sector, 2013

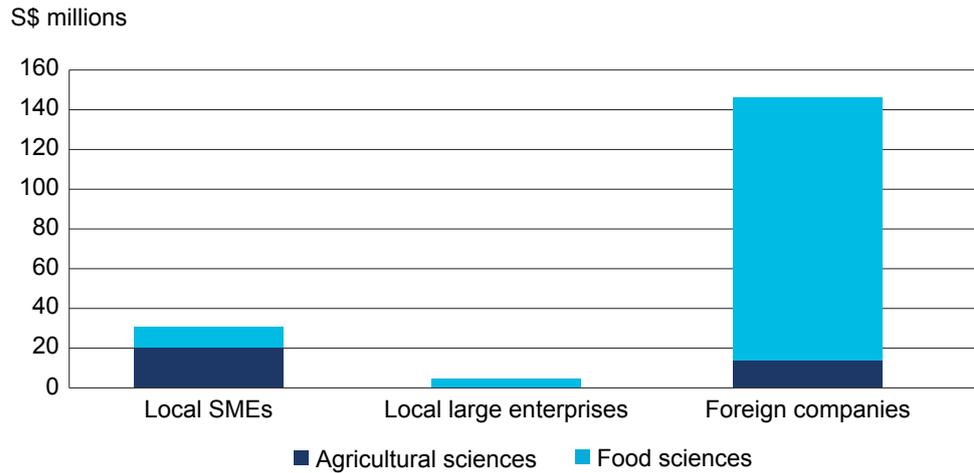


Source: Agency for Science, Technology and Research

⁹ Jacques Mairesse and Pierre Mohnen Bronwyn H Hall, "Measuring the returns to R&D", National Bureau of Economic Research Working Paper No. 15622, 2009.

The A*STAR data also suggest that the majority of R&D expenditure is undertaken by foreign companies, although local SMEs are estimated to have spent S\$31 million on R&D in 2013.

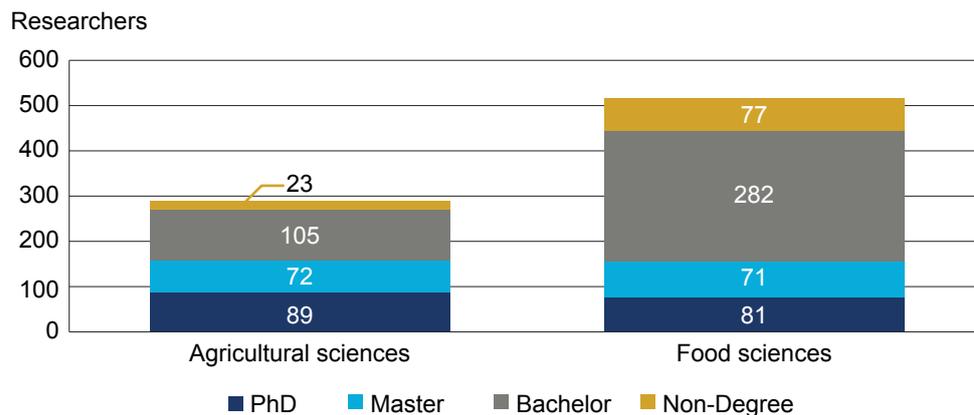
Fig. 18. Private sector R&D expenditure by type of business, 2013



Source: Agency for Science, Technology and Research

A*STAR's research suggests that 800 researchers were employed in R&D related to agricultural or food sciences in 2013, and just over 500 researchers were involved in the field of food science. Consistent with the expenditure data above, 615 out of the 800 researchers employed in these disciplines are in private sector roles.

Fig. 19. Researchers by level of qualification and field, 2013



Source: Agency for Science, Technology and Research

Half of the companies responding to the online survey undertaken for this study reported that they undertake R&D activity in Singapore. Firms explained that these activities often focus on the development and testing of new products, and market research into consumer preferences and emerging trends. Two respondents highlighted the international nature of their R&D activity: they typically test products that will be sold across Asia, or even the world.

The benefits generated by this work include healthier and safer products, less resource-intensive packaging, and reductions in energy and water use.

R&D BY MAJOR FOOD COMPANIES IN SINGAPORE¹⁰

Abbott

Abbott opened its Asia Pacific R&D Centre in Singapore in 2010, and it was Singapore's first nutrition R&D centre at that time. It is Abbott's largest nutrition R&D facility outside of the United States and houses about 65 scientists involved in developing new food ingredients and food flavours to address nutritional challenges and the ever-changing tastes of Asia-Pacific consumers.

Danone

Opened in 2011, the Nutricia Research Centre Singapore (then Danone Research Centre for Specialised Nutrition) is the first in Asia Pacific to focus on child and maternal health. It researchers issues including the impact of nutrition on gut bacteria, the immune system, and the growth and development of babies and children.

Kellogg's

In 2013, the world's largest manufacturer of ready-to-eat breakfast cereals and second largest producer of savoury snacks, cookies and crackers, decided to make Singapore its regional headquarters and savoury snacks R&D centre for Asia Pacific. The R&D centre focuses on food flavour and packaging developments, as well as nutrition and sensory science.

Mead Johnson

Mead Johnson has invested US\$325m to develop a manufacturing plant and a Paediatric Nutrition Institute (PNI) in Singapore.

Mondelēz International

Mondelēz International conducts R&D across three sites in Singapore, including at their "Center of Indulgent Confectionery" in Jurong. The latter was originally established in 2006 with support from EDB to set up a small team working on indulgent candy. The team now oversees the company's global R&D on indulgent candy. One example of its work is the development of all the recipes for Choclairs in the past 10 years, including new flavours, cost optimisation and patented technology to improve flavour enhancement when biting into the product.

Nestlé

The company's Singapore R&D centre leads innovation work to support brands including Milo and Nescafe. The centre specialises in fields such as mechanical engineering, analytical chemistry, microbiology and sensory science. One of its main objectives is to ensure that nutrition and health are integral to new product development.

¹⁰ Most of the examples in this box are taken from: <http://www.a-star.edu.sg/Media/News/Press-Releases/ID/2504/AsiaS-First-Under-One-Roof-Nutritional-Research-Centre-Set-Up-in-Singapore.aspx>

Royal FrieslandCampina

FrieslandCampina launched their Development centre in 2013. The centre focuses on developing dairy-based beverages and infant and toddler nutrition products to suit Asian consumers' palates and nutritional requirements.

The Coca-Cola Company

The Coca-Cola Company (TCCC) is winding down its manufacturing and bottling operations in Singapore and in future will import from a modern facility in Kuala Lumpur. Activities in Singapore will increasingly focus on high value innovation and R&D centred around its new concentrate plant, which sells concentrate to bottlers who then export to other markets in South East Asia. This strategic change is consistent with the Singapore government's efforts to concentrate job creation in high value added activities, and develop Singapore as a regional hub for this kind of activity. TCCC has invested S\$150 million in Singapore during the last five years, and has earmarked S\$100 million to invest over the next five years, partly to fund the development of new technology and laboratories for use in its innovation activity.

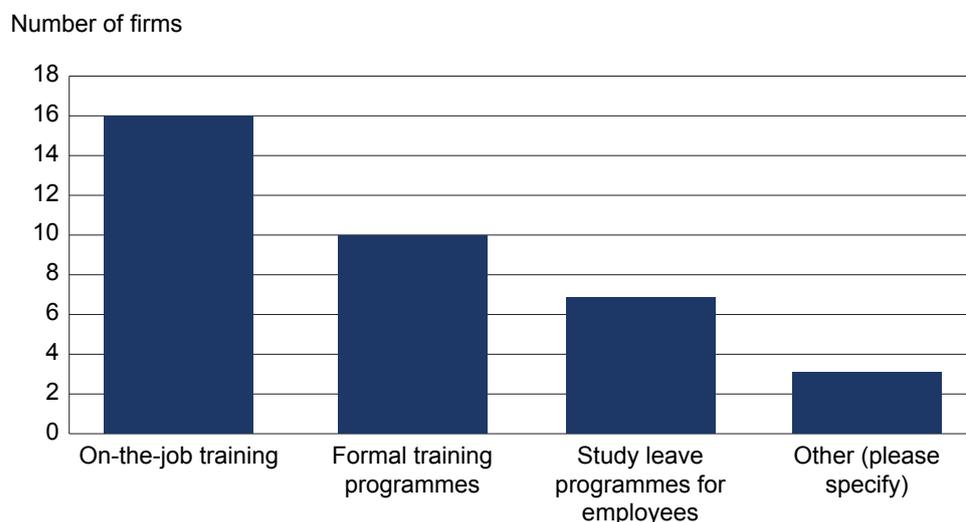
5.2 EDUCATION AND TRAINING

A skilled workforce is crucial to national productivity and economic growth. The food industry contributes to this through the education and training that it provides for its workforce. The benefits of this can extend well beyond the doors of a company itself. For example, some of those trained will go on to work in other organisations, or may start their own companies, spreading the benefits of the training received across the economy.

Just over two-thirds of online survey respondents reported that they provide skills development programmes for their workforce. Amongst those responding to this question, the most common type of training provided was on-the-job training, although 10 companies reported that they provide formal training programmes, and seven companies provide study leave programmes. Amongst those reporting they provided other types of training, one company stated that it provides accelerated development programmes across functions such as marketing, finance, sales and supply-chain. Another highlighted that it offers diplomas and university-accredited programmes, and a third offers overseas posting opportunities to enable staff to learn about specialised job functions.

A third of survey respondents also reported that they offer programmes to encourage students to study or train for a discipline related to the company's product offering. Three of the companies reported that they offer internships, including one major food manufacturer that runs an 'Emerging Leaders Program' in partnership with Singapore Management University. This program invests around S\$450,000 each year to train 30 to 40 upcoming leaders or high performers from across the region.

Fig. 20. What skills development programmes do you offer to your workforce?



Source: FIA online survey. Based on 16 responses (firms could select more than one option)

Another respondent reported that they offer an ‘Earn and Learn’ programme, which gives recent graduates from polytechnics and the Institute of Technical Education an opportunity to build on the skills they have learnt during education and support their transition into the workplace.¹¹

5.3 SUSTAINABLE DEVELOPMENT

As the global economy continues to develop, the pressure on the world’s natural resources is increasing. At the same time, there is a need to reduce carbon emissions to reduce the risk of harmful climate change. While Singapore has a long history of initiatives to ensure its economic development occurs in a sustainable manner, it continues to strive to improve the quality of life for its residents and ensure the city remains an attractive place to live and work.

The food industry has an important role to play in these efforts as a significant user of energy and natural resources. The online survey suggests that this is recognised by many firms within the industry and almost half of respondents reported that they have an environmental policy to reduce the impact of their activities. Firms reported three types of environmental policy:

¹¹ <http://www.skillsfuture.sg/earnandlearn>

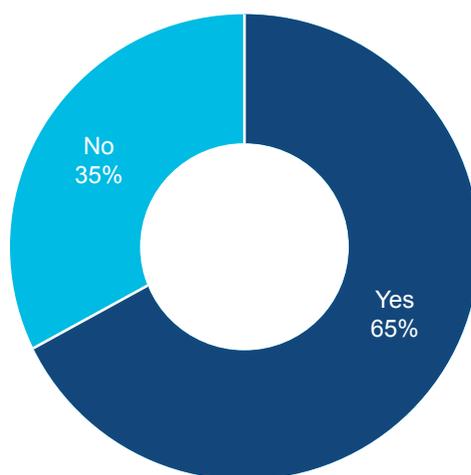
- **Reduction of waste.** One multinational company explained that it has an international commitment to reduce the amount of waste going to landfill to zero. Other examples included reductions in the use of paper napkins, individual sauce sachets, plastics, and an increase in collection, re-use and recycling.
- **Green energy.** Examples cited included switching to low energy LED lighting in restaurants, an aspiration to switch to solar energy, and straightforward objectives to reduce the amount of energy used.
- **Reductions in water usage.**

5.4 PROMOTING HEALTHIER LIFESTYLES

Another area where the food industry can support wider policy objectives is the promotion of healthy lifestyles. According to the WHO, global rates of obesity are rising due to lifestyle-related factors including physical inactivity and unhealthy diets.¹² In Singapore, obesity prevalence amongst adults is less than half the global average (6.2 percent and 13 percent, respectively)¹³, but the food industry is nonetheless taking steps to help individuals make better lifestyle choices and improve the general health of the Singapore population.

Almost two-thirds of online survey respondents said that they promote healthier eating amongst their workforce. Examples of these kinds of initiatives include employee engagement activities to promote active lifestyles and provide information on nutrition, and organising company sports events.

Fig. 21. Does your company have initiatives to promote healthier lifestyles amongst your workforce?



Source: FIA online survey. Based on 23 responses. Non-responses counted as 'No'

¹² <http://www.who.int/mediacentre/factsheets/fs355/en/>

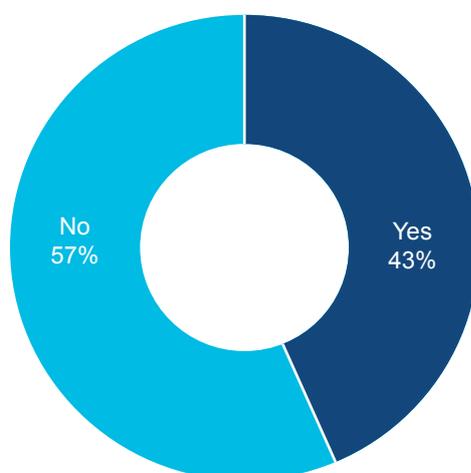
¹³ http://gamapserver.who.int/gho/interactive_charts/ncd/risk_factors/obesity/atlas.html

Companies were also asked if they run initiatives to promote healthier lifestyles across the wider Singapore population. 43 percent of respondents said that they do this. Initiatives include the offering of products with lower levels of sugar and fat. One major company also explained that it was careful to control its advertising to children to avoid placing adverts in schools and other public places.

Other examples of healthy eating initiatives include:

- organising ‘Olympic Run Day’, ‘National Breakfast Day’ and offering meals with fewer than 500 calories;
- collaborations with the Singapore Heart Foundation to promote heart health and healthy living;
- partnering with the Singapore Health Promotion Board, part of the Ministry of Health, to run campaigns to encourage healthy, active lifestyles and balanced diets. This includes participation in the Healthier Choice Symbol programme to help consumers make informed choices.

Fig. 22. Does your company have initiatives to promote healthier lifestyles across the wider Singapore population?



Source: FIA online survey. Based on 23 responses. Non-responses counted as ‘No’

APPENDIX A: ECONOMIC IMPACT METHODOLOGY

DATA SOURCES

The main data sources used in this study are set out below.

From the Department of Statistics Singapore:

- Report on Household Expenditure Survey 2012/13, published in September 2014 (latest available at the time of writing)
<http://www.singstat.gov.sg/publications/household-expenditure-survey>
- Yearbook of Statistics Singapore, 2015
<http://www.singstat.gov.sg/publications/publications-and-papers/reference/yearbook-of-statistics-singapore>
- Services Survey Series – separate reports published in 2015 for the Services Sector, Retail Trade and Wholesale Trade
http://www.singstat.gov.sg/publications/publications-and-papers/economy#services_sector_performance
- Singapore Supply and Use, and Input-Output tables, 2010, published in July 2014.¹⁴
http://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/national_accounts/io_tables_2010_publication.pdf

In addition, our work drew information from the following sources:

- Inland Revenue Authority of Singapore
<https://www.iras.gov.sg/IRASHome/Publications/Statistics-and-Papers/Tax-Statistics/#CIT>
- Singapore Yearbook of Manpower Statistics, 2015
<http://stats.mom.gov.sg/Pages/Singapore-Yearbook-Of-Manpower-Statistics-2015.aspx>
<http://stats.mom.gov.sg/Pages/Employment-Tables2014.aspx>
- United Nations Conference on Trade and Development (UNCTAD)
http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sRF_ActivePath=p,15912&sRF_Expanded=,p,15912
- Oxford Economics, 2016. Oxford Economics' in-house Global Economics Databank. Available from: <http://www.oxfordeconomics.com/subscription-services>, accessed on: 12.10.2015

¹⁴ Table is accessible in Excel format using the hyperlink on page 1 of the Singapore Supply and Use report

APPROACH TO ESTIMATING THE DIRECT CONTRIBUTION OF FOOD MANUFACTURING

The **direct GDP contribution** of food manufacturing is estimated in two sequential stages. First, the 2014 value-added contribution of manufacturing establishments by industry from the Yearbook of Singapore Statistics 2015 (Table 13.6) is scaled to total manufacturing GDP as published in Singapore National Accounts. This is to ensure consistency between the Survey of Manufacturers and headline national accounts data. Second, the industry estimate for food, beverages and tobacco is disaggregated to the FIA definition of food manufacturers (food and non-alcoholic beverage manufacture) by removing the value-added contribution to GDP of alcoholic beverages and tobacco using the relevant shares of value added from the 2010 Singapore Input-Output Table (Industry by Industry flow matrix, Table 4).

The estimate of **total sales** (or 'gross output') by food manufacturers is calculated by multiplying food manufacturers' value-added contribution to GDP estimated above by the relationship between sales to value added for food manufacturers in the 2010 Singapore Input-Output Tables.

Direct employment for food manufacturers in 2014 is estimated using table C1 in the Singapore Yearbook of Manpower Statistics, 2015. Data here relate to employment in the broader food, beverages and tobacco industry (which includes both alcoholic and soft beverages). We therefore use the employment data in conjunction with GDP data to estimate productivity (GDP per worker) for this broader industry. Our estimate of GDP in our preferred definition of the food manufacturing industry is then divided by this broader industry productivity figure to estimate employment amongst food and non-alcoholic beverage manufacturers. This approach assumes that productivity in the food manufacturing industry is the same as in the broader food, beverages and tobacco industry.

Direct tax revenues comprise four components: CPF employee contributions, CPF employer contributions, income tax and corporation tax. Tax payments related to employment (CPF and income tax) are based on remuneration per worker by industry. Data are drawn from two sources: the Survey of Manufacturers that provides total remuneration per worker by industry; and annual labour costs per worker by industry and cost published in Table B8 in the Singapore Yearbook of Manpower Statistics, 2015. For each worker in each industry we compute the proportion of total worker remuneration paid to the CPF and as income tax – the latter being based on taxable income by income tax band, and including 2014 data on tax rebates. Multiplying taxes paid per worker in each industry by employment in the industry determines the first estimate of total worker-related tax payments. These estimates are then scaled to figures

Reading across horizontally illustrates the distribution of each industry's output, split between intermediate demand from other industries (used as an input to production) and final demand (consumer spending, exports and other government consumption). Therefore, Industry 2 in Figure AA.1 purchases an amount, C2,1 from Industry 1 as an input to its production process. Thus, reading down vertically indicates what each industry purchases from other industries in the national economy by way of inputs which, when combined with imports from abroad (leakages), employment costs, operating surplus and any additional taxes or subsidies to production, give total inputs, which will equal total outputs. In the simple model illustrated in Figure AA.1, C8,1 will equal C1,8.

A primary application of domestic use input-output tables is to create multipliers that are used to illustrate how an increase in demand in one sector affects the whole economy:¹⁵

- **Type I multiplier** – estimates the impact on the whole economy of S\$ 1 spent in a given industry, through its supply chain.
- **Type II multiplier** – includes the Type I multiplier, but also includes the effect of spending by households as a result of the additional employment generated by the additional S\$ 1 spend. The multipliers are known as Type II multipliers and are used to calculate the wage consumption, or 'induced', impacts of S\$ 1 spent in a given industry.

To calculate the indirect and induced impacts for food manufacturers, we built a bespoke input-output model using domestic-use input-output tables from Statistics Singapore. This allowed us to estimate the multiplier impacts which occur across the sectors of the Singapore economy as a result of the food industry's supply chain purchases and consumer spending by those employed in the food industry and its direct supply chain. This model was also used to develop an understanding of the linkages between the food manufacturing industry and the distribution industry, and subsequently to adjust the estimated total impact of the Singapore food industry to remove double counting of the indirect and induced impacts generated by the food manufacturing and distribution sectors.

DISTRIBUTION

An important aspect of our study is to estimate the economic impact of the distribution of food and non-alcoholic beverages in Singapore. Our analysis focused on four distribution channels: wholesale, retail, food service providers and accommodation providers (primarily hotels).

Information on the sales, profits and value added generated by food and non-alcoholic beverage distribution from these four sectors was sourced from the Singapore Department of Statistics Services Survey Series (Wholesale Trade, Retail Trade and The Services Sector). Details of the methodology used to

¹⁵ In a domestic IO table intermediate demand has been adjusted to remove the effects of imports. Imports are itemised in a different part of the IO table.

estimate each sub-sector's economic contribution using these survey data are set out below.

Wholesale – food and non-alcoholic beverage sales are based on the operating receipts of food, beverage and tobacco wholesalers (SSIC 4630). This includes sales of both domestically produced and imported goods. The value-added contribution of these sales to GDP is calculated using the ratio of value added to sales – this is particularly important in calculating the GDP impact of wholesale (and retail) companies as in most, if not all, instances, sales by such firms involve simply re-selling products in bulk or repacked form without any transformation to the product itself. Shares of value added and sales for alcohol and tobacco from the 2010 input-output table were used to remove alcohol and tobacco sales and value added from the broader category SSIC 4630.

Retail – the retail distribution impacts follow a similar estimation process to the wholesale sector, with one refinement. While the 2010 input-output table is used to disaggregate sales and value added by food, beverage and tobacco retailers (SSIC 472), detailed product by product household spending data are used to allocate the sales of food and non-alcoholic beverages made as a share of total sales by supermarkets, mini-marts, convenience stores, department stores and hypermarkets (SSIC 471).

Food and beverage services (SSIC 55) – sales and value added data are available for the following categories: restaurants, fast food outlets, cafes, food courts, pubs, canteens, food caterers, and other food and beverage service providers. We assume that 75 percent of sales and value added from restaurants is associated with food and non-alcoholic beverages (the remainder being alcohol), and 25 percent of sales and value added from pubs are associated with non-alcoholic beverages and food. For all other categories of SSIC 55, the full value of sales and value added are included in our analysis.

Accommodation providers (mainly hotels, SSIC 56) – within this category we measure food and beverage sales and value added supported by accommodation providers. To estimate the value of these we used the 2010 input-output tables and import use matrix to analyse the proportion of input costs spent on food and beverages. For example, if five percent of input costs were food and beverages, then we assume that five percent of sales are related to food and beverages. The results are then adjusted to remove spend on alcoholic beverages using the input-output table. The sales to value added ratio for the accommodation industry is applied to the estimate of food and non-alcoholic beverage sales to obtain our estimate of value added.

RECONCILIATION

To maximise the information available to the study, we have analysed the food industry's economic contribution from two sides:

- **the supply side** of the industry, which includes producers within Singapore, their supply chains, and food imports; and
- **the demand side**, which includes spending by households and exports.

In this way we can trace the full value chain of the food industry in our analysis, from the supply side, through the food distribution sector, to the demand side. We would not expect the supply side and demand side approaches to fully align given that each relies on different data sources, and that these data are collected from different groups using different approaches. The picture is further complicated by the role of the distribution sector, which acts as an intermediary between producers and importers, and households, and applies a mark-up as goods pass through it. Moreover, a degree of estimation is necessary at each stage to obtain estimates for 2014, and to ensure alignment with the FIA's preferred definition of the food industry.

Nonetheless, tracing through the food industry's value chain in this way provides a helpful sense check to help validate our approach and findings.

Figure AA.2 presents the value chain for the food industry in Singapore in 2014. Despite the complications outlined above, the results presented appear plausible. In particular, the estimates of household expenditure are of a similar order of magnitude to the sales of retailers, and accommodation and food service providers which sell to households. Moreover, the value of sales to households is greater than the value of domestic sales by food manufacturers and the value of imports which go to other industries in Singapore. This is in line with our expectation, given the intermediary role of the distribution sector in adding value to these products and applying a margin before they are sold on to households.

On the supply side, Singapore imported S\$12 billion of food and beverage products, with S\$2.9 billion (or 24 percent) used by food manufacturers as inputs into their production process, while S\$3.3 billion was re-exported (exported from Singapore to another country without any value added accruing to Singapore). The remaining S\$5.8 billion of food imports were purchased by other industries, which in turn distributed these goods to consumers through retail, accommodation, and food and beverage service providers.

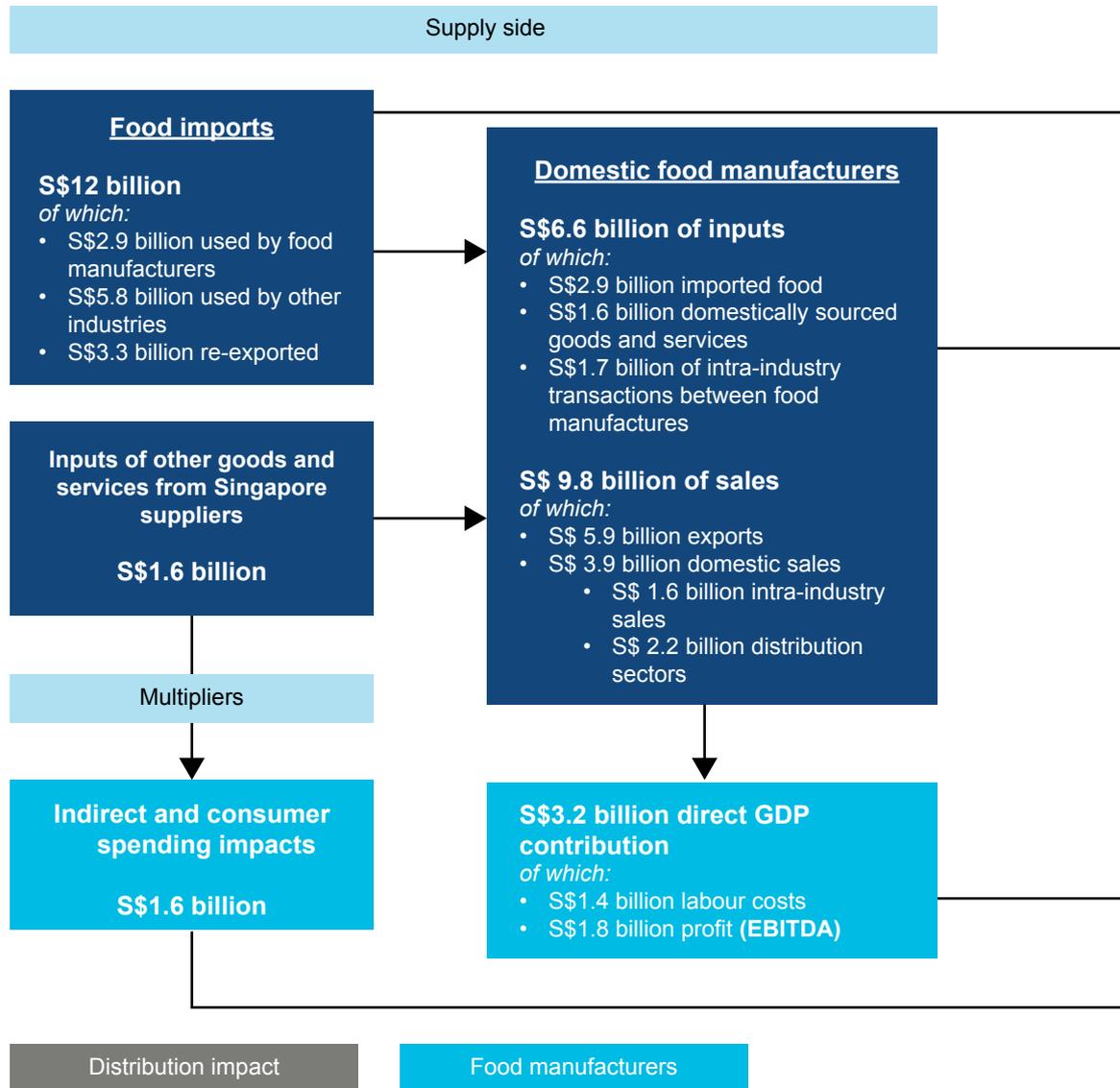
On the demand side (in the fourth column of the diagram), our estimates, which are based on the Household Expenditure Survey, suggest households spent around S\$17 billion on food and non-alcoholic beverages in 2014, with around S\$6 billion of goods purchased from retailers and S\$11 billion from food service and accommodation providers.

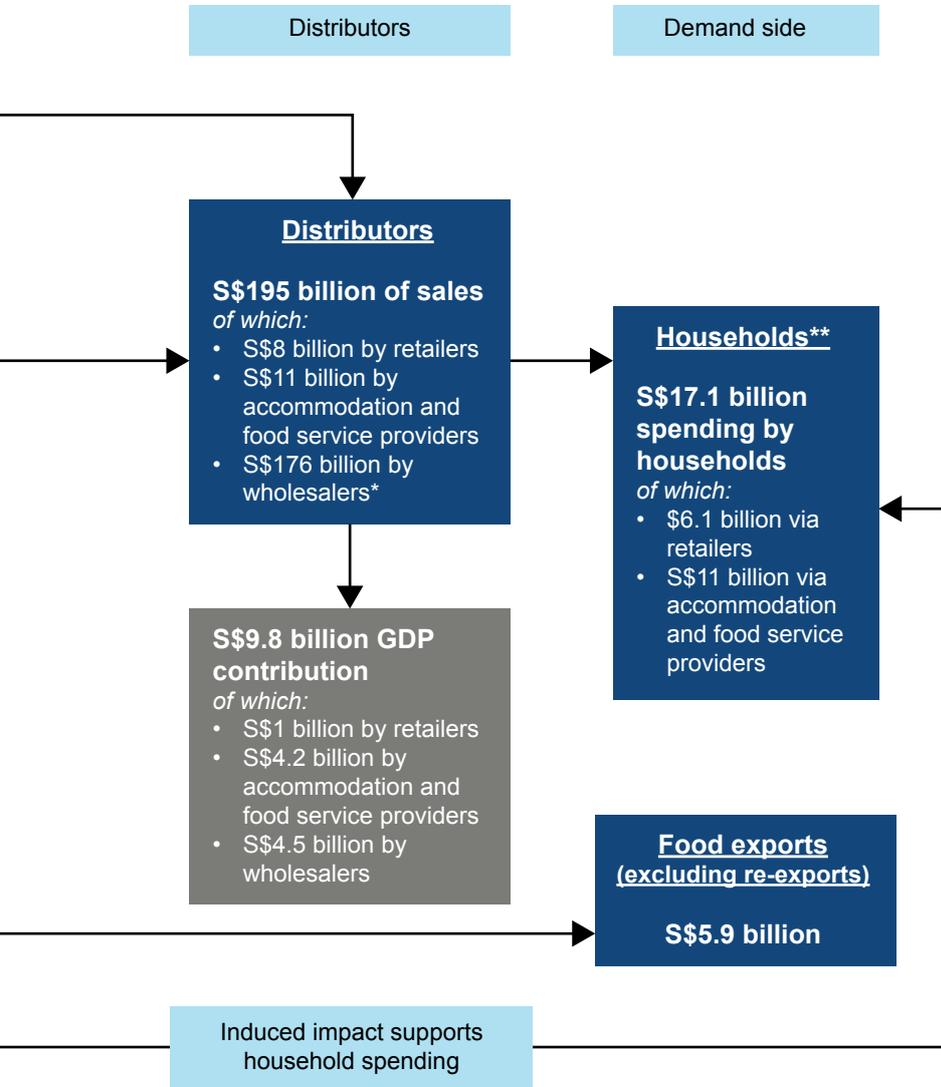
Looking more closely at how individual food distribution channels (the third column in the diagram) align with household expenditure (the fourth column), we estimate that retailers sold S\$8 billion of food and non-alcoholic beverages in Singapore, while Singapore households spent about S\$6 billion on food and non-alcoholic beverages in these outlets (as noted above). We would expect the value of sales by retailers to be different to spending by households for two main reasons. Firstly, sales by retailers include sales of food and non-alcoholic beverages to overseas visitors and businesses, while the estimates of spending by households include sales tax.

Our estimate of sales of food and non-alcoholic beverages by accommodation and food service providers matches the estimates based on the Household Expenditure Survey of S\$11 billion. This result is slightly surprising—as with sales by retailers we would expect the sales figure to be different to the household survey-based estimate due to the inclusion of spending by foreigners and businesses in the former and sales tax in the latter. The fact that the two numbers are the same appears to be coincidental in this case, though we would expect them to be of a similar order of magnitude.

The S\$4.5 billion GDP contribution which results from wholesalers' sales appears reasonable in light of data published in the Services Survey Series Wholesale Trade publication, and in national accounts data. However, the value of sales associated with this GDP contribution is extremely high at S\$176 billion. This reflects the inclusion of sales transactions that take place between wholesalers as goods are moved around Singapore, with little or no value-added contribution made to Singapore GDP. Nonetheless, the sales value is sensitive to the underlying assumptions used in our modelling process and further research could be helpful in building up a richer picture of transactions between wholesalers within Singapore.

Figure AA.2: The Singapore food industry value chain, 2014





* Includes sales transactions between wholesalers where no value added is generated

** Includes GST

POTENTIAL DATA ENHANCEMENTS

Our study has shown that economic data for Singapore are detailed in coverage, released in a timely manner, and are relatively straightforward to access. Based on our experience of undertaking similar studies in other countries, in our opinion the quality of the data for Singapore is comparable to that of many of the leading statistical agencies around the world. Nonetheless, it is possible to suggest a small number of potential enhancements to the published data which would enable an even more robust assessment of the economic impact of the food industry to be undertaken in future.

One key area where estimation was required in our study was to remove the impact of alcoholic beverages and tobacco from published data for the manufacturing industry since official statistics often relate to the wider food, beverages (soft and alcoholic) and tobacco sector. To make this adjustment we used the latest supply-use and input-output tables for Singapore, though these relate to 2010 and so it was necessary to assume that the relative shares of food, non-alcoholic beverages, alcoholic beverages and tobacco manufacturing have remained unchanged over the past four years. Accordingly, more recent information about the sales, value added and employment of food and non-alcoholic beverage manufacturers in isolation would improve the food industry estimates in this report.

Similarly, by only focusing on food and non-alcoholic beverages several assumptions had to be made to estimate the distribution impacts of the food industry. For example, we estimated that 62 per cent of sales made by the retail category 'supermarkets, mini-marts and department stores' related to the sales of food and non-alcoholic beverages. The estimate is calculated from the share of weekly household spending on food and non-alcoholic beverages out of a basket of goods that households typically purchase from this group of retailers. The robustness of the estimates could be strengthened if data were available on the actual sales made by supermarkets (and other types of retailer) by product line.

The most detailed published data for wholesalers provide sales figures for 'liquor and non-alcoholic beverages' and 'tobacco products, food, beverages, and tobacco not elsewhere classified (nec)'. We therefore had to use the input-output table to estimate the proportion of sales which relate to food and non-alcoholic beverages. A more granular breakdown of wholesalers' sales by product type would enable more accurate estimates to be made here.

We were also forced to make assumptions regarding the proportion of sales by pubs, restaurants and hotels which relate to food and non-alcoholic beverages. A more detailed breakdown of the value of sales by type of good or service for these establishments would, once again, enable more robust estimates.

APPENDIX B: THE FEASIBILITY OF APPLYING OUR METHODOLOGY TO OTHER MARKETS

This section assesses whether the methodology set out in Appendix A could be applied or adapted to estimate the economic contribution of the food industry across other Asian markets, namely: China, India, South Korea, Singapore, Taiwan, Indonesia, Malaysia, Thailand, Vietnam and the Philippines.

DATA REQUIREMENTS

Whether the methodology can be applied to other countries will be determined by the availability of the necessary data inputs for each country. The data requirements can be split into three broad components:

- **industry level data** for value added, employment, labour costs and investment;
- **input-output tables** for each country to assess the multiplier impacts of food manufacturing, quantify the associated economic activity in the food distribution channel and, where necessary, disaggregate industry level data to include only food and non-alcoholic beverage manufacturers in line with the FIA definition of the sector; and
- **imports, exports, household expenditure and tax revenue data** to support the data reconciliation exercise.

Other information to be collected includes broader macroeconomic data on total GDP and jobs, along with tax rates (e.g. income tax, corporation tax).

INITIAL FINDINGS

We have completed an initial investigation of the key sources of information required to extend the Singapore study to other markets. This investigation suggests that a good proportion of the necessary information is available from sources including:

- National statistical agencies
- OECD and World Input-Output database (WIOD)
- UNCTAD – for imports and exports.

The industry detail available does differ between countries – as we found in Singapore, some data are separately available for food, beverages and tobacco, but for other metrics these categories are combined. But our initial findings suggest that the input-output and supply-use tables can help split the industry data to the required FIA footprint.

One area that may be more challenging regards household expenditure data. In a few countries, notably Vietnam and the Philippines, data relate to 2012 and are not as detailed in their product category coverage as elsewhere. These data may hinder how the impacts of the distribution sectors are calculated. In such instances, we would use information from a similar country to proxy the likely household expenditure patterns and to facilitate the role played by the household expenditure data in the overall data reconciliation process.

In summary, further investigative work will be necessary to finalise the detailed methodology that can be adopted for each country. But in principle, assessing the complete value chain for other countries in Asia will be possible for most, if not all, countries listed above.

FEASIBILITY OF MAPPING FOOD INDUSTRY TRADING RELATIONSHIPS BETWEEN THE SIX LARGEST ASIAN MARKETS

It is possible to interrogate data in the United Nations Commodity Trade Statistics Database (UN Comtrade)¹⁶ to establish the value of trade flows (both imports and exports) of food products between Asian markets. This means it is feasible to map the food industry trading relationships between all countries in Asia, or the six largest Asian markets (the largest markets could be determined by the value of exports, value of imports, total country GDP, or some other set of criteria). The information is available on the basis of the Harmonised Systems Code Commodity Classification (HS). The level of detail is such that both alcoholic beverages and tobacco products can be excluded from the trade statistics to precisely map the FIA definition of the food industry.

There are some issues with trade data that are specific to particular countries, notably in China and Taiwan, which mean the mapping exercise is not entirely straightforward, but in our view it is feasible. For example, trade data between China and Taiwan do not exist in UN Comtrade, but can be estimated as a residual between each country's trade with all other countries in Asia, while the treatment of the costs of carriage, insurance and freight will mean the bilateral import and export figures between two nations will not sum to zero.

It may also be feasible to map the trading relationships between several Asian markets within the context of a Global Input-Output framework, so as to identify the role played by food imports from different source countries within the domestic food manufacturing industry of each country. Our approach would build on existing analysis conducted by the European Commission as part of its World Input-Output Database study. The world model includes China, India, Japan, South Korea, Taiwan and Indonesia within its existing framework, though we could use input-output and supply-use tables for other countries in Asia to broaden the country coverage to meet FIA's needs.

¹⁶ <http://comtrade.un.org/db/default.aspx>

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