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Measuring Digital Activities in the Australian Economy

Prepared by the Australian Bureau of Statistics

Summary

Rapid advancements in digital technologies in recent years have transformed the ways in which households, firms and governments interact with each other. Digital activities have grown rapidly and become an important contributor to economies around the world. This dynamic shift has increased the demand for statistical insights into digital activities in Australia for analytical and policy purposes.

While the Australian Bureau of Statistics (ABS) captures many aspects of the Australian digital economy in the National Accounts, it does not separately identify all digital activities, nor trace the estimated aggregate economic performance to its digital origins. In particular, measuring digital activities in official statistics has been challenging due to definitional, classification and measurement issues.

To guide estimation and comparability in official statistics, a framework for measuring a digital economy has been developed by the Organisation for Economic Co-operation and Development (OECD). The framework has been partially implemented by the Bureau of Economic Analysis (BEA) and Statistics New Zealand to gain insights into digital activities relative to the U.S. and New Zealand economy, respectively (Barefoot et al., 2018; Millar & Grant, 2017).

In this paper, ABS has applied the BEA approach to estimate digital activity in Australia using selected separately identifiable digital products from the ABS supply-use tables. The preliminary estimates provide insights into digital activities through a National Accounts lens. Applying the BEA approach enables Australia to engage in policy debate and international discussions of digital activities in a timely and responsive manner.

This paper outlines the ABS application of the BEA approach, and presents preliminary and experimental estimates of digital activity in Australia. The results indicate that information and telecommunication services, while representing a relatively small share of total Australian production, are an increasing driver of Australian economic growth. The paper also acknowledges the limitations of the approach and highlights areas for potential future developments.

The ABS welcomes feedback and comments on the preliminary work, which can be directed to: Lauren Ford, Director, Economic Research Section, email: prices.statistics@abs.gov.au. The ABS Privacy Policy outlines how the ABS will handle any personal information that you provide to us.

I. Introduction

1. In recent years, digital activities have grown rapidly and become an important economic contributor. Across major economies, including the U.S., U.K., France and Germany, expenditure on digital skills, digital equipment, software and intermediate digital goods and services are significant sources of economic activity (Watson, 2018). In New Zealand, digitally ordered products were estimated to account for around 20% of total gross output over the period 2007-2015. Further, the annual growth of digitally delivered products outpaced that of total gross output (Millar & Grant, 2017). In Canada, over half of the country's population purchased music and video downloads, and streaming services in 2017-2018 (Statistics Canada, 2018). Such results have increased the demand for insights into digital activities in Australia for analytical and policy purposes.

2. While the ABS captures many aspects of the Australian digital economy, the ABS National Accounts do not separately identify digital activities nor trace the estimated aggregate economic performance to its digital origins. Feedback from stakeholders and policy makers noted that this lack of visibility in official statistics hampers analysis and discussion.

3. Estimating digital activity in the economy presents many definitional, classification and measurement challenges. One main issue is the absence of a well-accepted definition of a digital economy. Variation in measurement and conceptual scope between countries can make comparisons difficult, and there are further difficulties in keeping conceptual and measurement pace with the rapid pace of digitalisation. Furthermore, the estimation and conceptual treatment of growing digital activities – such as "free" services and information, and the shared economy – remain in ongoing development and debate.

4. To enable estimation and comparison in official statistics, a framework for measuring a digital economy has been developed by OECD. The framework characterises digital economic activities around the System of National Accounts (SNA) production boundary by Producers, Product, Nature, Users and Enablers (Ahmad & Ribarsky, 2018). The framework has been partially implemented in case studies. For example, Statistics New Zealand measured digital activities as "digitally ordered" and "digitally delivered" goods and services produced in New Zealand (Millar & Grant, 2017). In contrast, the BEA measured digital activities in the U.S. as the production of information and communications technology and selected "primarily digital" products, based upon multiple dimensions of the digital economy framework (Barefoot et al., 2018). Both case studies have revealed that digital activities are an important contributor to their respective total economies.

5. To address the visibility gap, the ABS has developed preliminary experimental estimates of digital activity in the Australian economy. Using the BEA approach, digital products were selected from ABS supply-use tables. This means that for the first time, the Australian production of some digital products can be 'seen' through a National Accounts lens. Applying the BEA approach will enable Australia to engage in policy debate and international comparisons of digital activities.

6. This paper outlines the ABS application of the BEA approach, and presents the preliminary experimental estimates. Section Two summarises data compilation in current price and volume, and acknowledges the limitations in the current approach. Section Three provides insights into digital activities value added relative to the total Australian economy. Section Four concludes with areas for potential future developments.

II. ABS application of the BEA approach

A. Concept

7. Under the BEA approach, the ABS measured the digital activities in Australia as the production of:

- Digital enabling infrastructure: computer hardware, software, telecommunications equipment and support services that form and facilitate the use of computer networks;
- Digital media: digital audio, video and advertisement broadcasting services that can be created, accessed, stored or viewed on digital devices; and
- E-commerce: retail and wholesale services and margins from digitally ordered or platform enabled online transactions.

8. In the production approach, digital activity value added is the gross output of the selected digital products less the value of products consumed in production. For simplicity, the measurement focused on products that were "primarily digital" in nature, and separately identifiable in the supply-use tables.

9. The ABS acknowledges that this digital activity measurement is limited in scope. For example, peer-to-peer transactions and emerging digitalised products (such as UBER transport services, financial services and "smart" household electronic goods) are not included in the estimates. While the production of these digitalised products are embedded in the supply-use source data under existing product classifications, they are not separately identified and it would be resource intensive to unembed. Also, digital trade is not visible from the production approach. Exports and imports through digital networks can be estimated with components of final demand[1]. Hence, the measurement in this paper provides "lower-bound" insights into digital activities in Australia for analytical and policy purposes.

B. Methodology

10. The Australian preliminary experimental estimates of digital activities were estimated using ABS supply-use data (ABS Cat. no. 5217.0). The following steps were undertaken:

1. Products (Supply-Use Product Classification, or SUPC) selected for the three broad digital activities outlined above.

2. Industry sources (Supply-Use Industry Classification, or SUIC) identified for the selected digital products.

3. Inputs and outputs of digital activities estimated.

Step 1: Selecting the Digital Products

11. To represent each of the three broad digital activities (digital enabling infrastructure, digital media and e-commerce), the SUPCs were selected in alignment with Barefoot et al (2018) and shown in Table 1. Infrastructure was divided into Hardware, Software, Support Services and Telecommunications. E-commerce consisted of Wholesale and Retail services. Within some of the selected SUPCs, only the listed Input-Output Product Classifications

12. (IOPC)[2] were relevant to the current measurement of digital activities.

[1] The ABS is separately investigating the estimation of imported digital products.

[2] The IOPC represents a detailed decomposition of the SUPC.

Table 1
Selected Supply-Use and Input-output Products by Digital Activity.

Digital Activity	SUPC	Product Description	Relevant IOPC	Product Description
Digital media	56005	Radio & TV broadcasting services		
	56010	Cable (pay TV) & other subscription broadcasting services		
	57005	Internet publishing & broadcasting		
	57010	Internet publishing advertising sales		
E-commerce - wholesale	33005	Wholesale margin		
	33010	Other wholesale trade		
E-commerce - retail	39005	Retail margin		
	39010	Other retail trade		
Infrastructure - hardware	16015	Recorded media reproduction		
	24005	Photographic goods (incl. optical fibres) & ophthalmic equipment (excl. spectacles)	24110050	Ophthalmic instruments & appliances
			24110090	Cameras, image projectors & parts, photographic goods nec. (excl. sensitised photographic film, paper, plates and chemicals)
			24190090	Optical fibres, fibre bundles & cables (excl. insulated)
	24025	Computer hardware & peripherals (incl. photocopiers & parts)		
	24035	Vending, video, monetary, office & other electronic hardware nec.		
Infrastructure - software	54010	Software publishing		
	54020	Copyright leasing	54200020	Copyright leasing – software (non-customised)
Infrastructure - support services	57020	Data processing & information storage services		
	70005	Computer consultancy, systems design & related services		
	94010	Machinery & equipment repair & maintenance services	94220010	Electronic & precision equipment repair & maintenance (excl. domestic appliance)
Infrastructure - telecommunications	24030	Telecommunication & audio visual equipment		
	24040	Electric lights (incl. torches), cables and	24310010	Uninsulated copper & aluminium stranded wire, ropes, cable, plaited bands and slings
			24310090	Cable, wire & strip
	57015	Internet services		
	58005	Telecommunication services (excl. equipment)		

Step 2: Identifying the Industry Sources

13. Both the primary and secondary industries producing the selected SUPCs were identified from the Australian production matrix within the supply-use table. The matrix shows the estimated value of goods and services produced by SUIC, which can be aggregated in concordance with the Australian and New Zealand Standard Industrial Classification (ANZSIC). In recent years, the Australian digital products were primarily produced in the following ANZSIC divisions:

- J Information, Media and Telecommunications;
- M Professional, Scientific and Technical Services;
- F Wholesale Trade; and
- G Retail Trade.

Step 3: Estimating the Inputs and Outputs of the Digital Activities

14. Gross output, intermediate consumption and value added of the digital activities were estimated with established assumptions and simple modelling. The estimation was firstly in current price, followed by volume and then contribution to total digital and economic growth.

Current Price Estimation

15. The current price estimation of the digital activities involved modelling the relevant digital products; compiling the gross output, intermediate consumption and value added of the digital activities within the source SUICs; and aggregating the estimated inputs and outputs across the industries.

16. Within some of the selected SUPCs, only certain components were relevant to the conceptual measurement of digital activities. To ensure consistency within the established scope, the supply-use gross output of such components were modelled using other data sources. The underlying model by digital product (and caveats in the estimated Wholesale E-commerce outputs) are highlighted in Appendix A.

17. Next, the digital activities were estimated in each of the identified primary and secondary industries. In a particular SUIC, digital gross output was estimated as the sum of the selected and modelled products. Due to the lack of information on the production processes, the industry production function for the digital products was assumed to be identical to the "non-digital" counterpart. Hence, the associated digital value added was estimated as the total value added weighted by the share of the estimated digital output in total output. Total intermediate consumption for the production of the digital products was calculated as the difference between the digital gross output and digital value added, which was then proportionately split amongst SUPCs.

18. Gross output, intermediate consumption and value added by digital activity were estimated as the sum of the relevant products across the source SUICs.

Volume Estimation

19. In volume terms, value added by digital activity was estimated with double deflation on a chain volume basis.

20. A chain volume measure shows change in quantity over time by holding the price constant at a reference year. The derivation of a chain volume measure separates the annual price effect from quantity, through dividing the current price measure by the corresponding price movement – the implicit price deflator. This deflation process yields a quantity estimate at constant prices[3].

[3] In this paper, a constant price measure is referred to as the current quantity valued at the corresponding price in the previous period (Pt-1Qt).

21. As prices for value added were unavailable, constant price value added by digital activity was estimated as the difference between the total digital output in constant prices and the total intermediate consumption in constant prices (double deflation). To derive the constant price digital output and intermediate consumption, each of the underlying products was deflated with the corresponding price movement.

22. Next, the volume movement of digital activity value added was estimated by accounting for the annual growth over time. The annual volume growth of the digital value added was calculated as the ratio of the constant price measure to the current price measure in the previous period. Then, the volume growth of the digital value added over time (the chain volume index) was derived as the cumulative multiplication (or 'chaining') of the annual volume movement across the time series.

23. The chain volume digital activity value added was estimated by converting the chain volume index into the dollar value of a selected reference year.

24. Further information on the chain volume calculations is provided in Appendix B.

25. Double deflation and the estimation of chain volume value added are demonstrated with a numerical example in Appendix C.

Estimating Aggregate Growth and Contribution to Growth

26. The aggregate digital activity value added growth was defined as the Laspeyres aggregation (ABS cat.no. 5206.0 feature article, 2012) of the underlying digital activities, where the activity contribution was the annual value added volume growth weighted by the corresponding lagged share in the total digital activity value added.

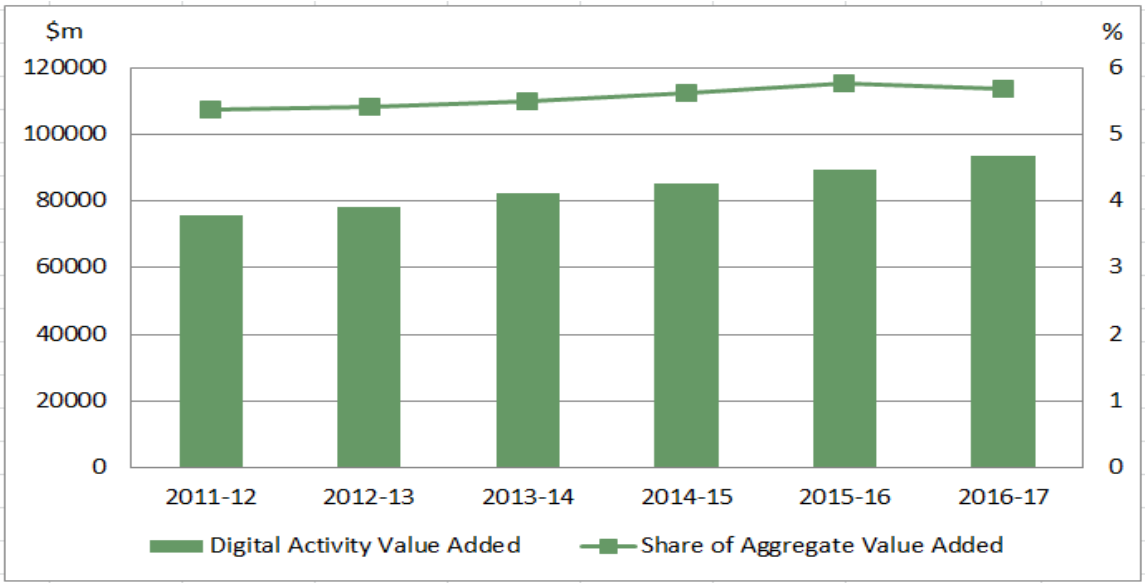
27. The total economy value added growth was estimated as the Laspeyres aggregation of all SUICs.

III. Results

28. The preliminary estimates of Australian digital activities, from 2011-12 to 2016-17, are summarised in this section.

Figure 1

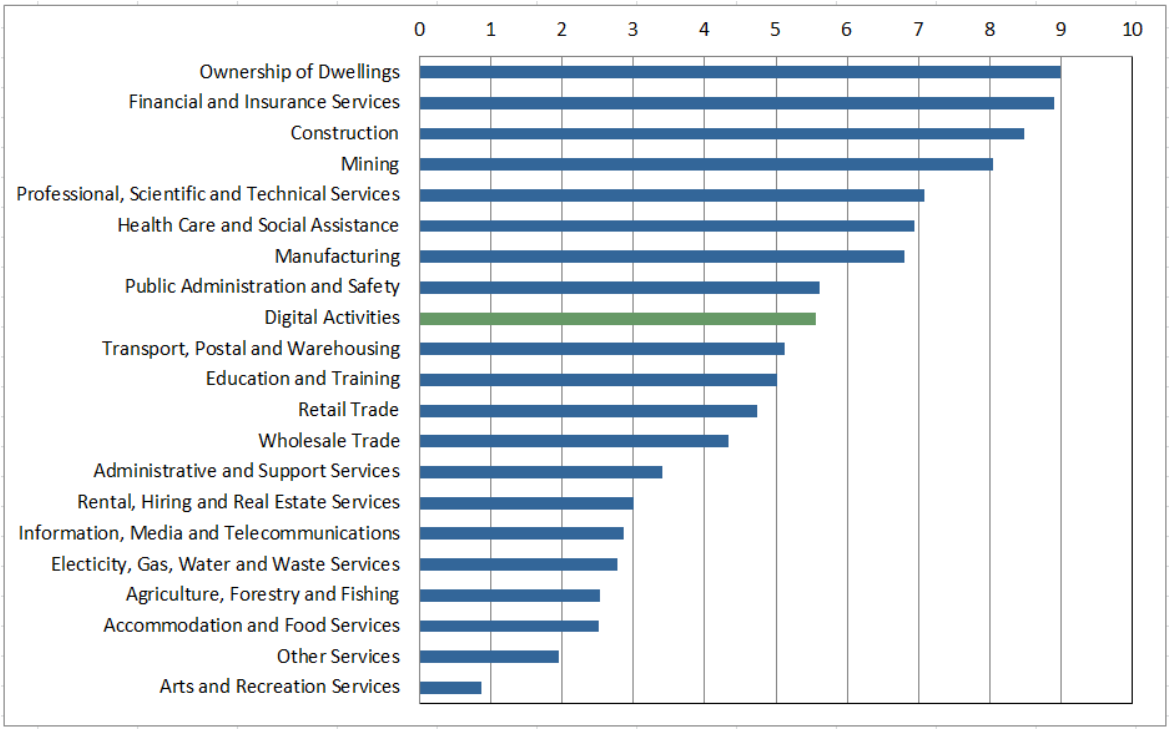
Digital Activity Value Added ($m) and Share in Aggregate Value Added (%), from 2011-12 to 2016-17, Current Prices



29. In recent years, domestic production of the selected digital products had grown relative to the total Australian economy, from 5.4% ($75.6 billion) of aggregate value added in 2011-12 to 5.7% ($93.5 billion) in 2016-17 (Figure 1). The relative size (and trend) of digital activities in Australia has been broadly similar to, albeit slightly less than, that seen in the U.S. (6.5% in 2016), as published in Barefoot et al (2018).

Figure 2

Average Division Share in Aggregate Value Added (%), Digital Activities Embedded, from 2011-12 to 2016-17, Current Prices



30. From a context perspective, noting the industries shown in figure 2 include digital activities, the selected digital activities represented higher aggregate value added than 12 industry divisions, but were behind traditional drivers such as Finance, Construction, Health and Mining (Figure 2)[4].

[4] Note that the production of the digital products has not been removed from the existing industries for which it is partially embedded. Therefore, the shares add to more than 100% of aggregate value added.

Figure 3
Annual Current Price Value Added Growth (%), Digital Activities vs. Total Economy, from 2012-13 to 2016-17

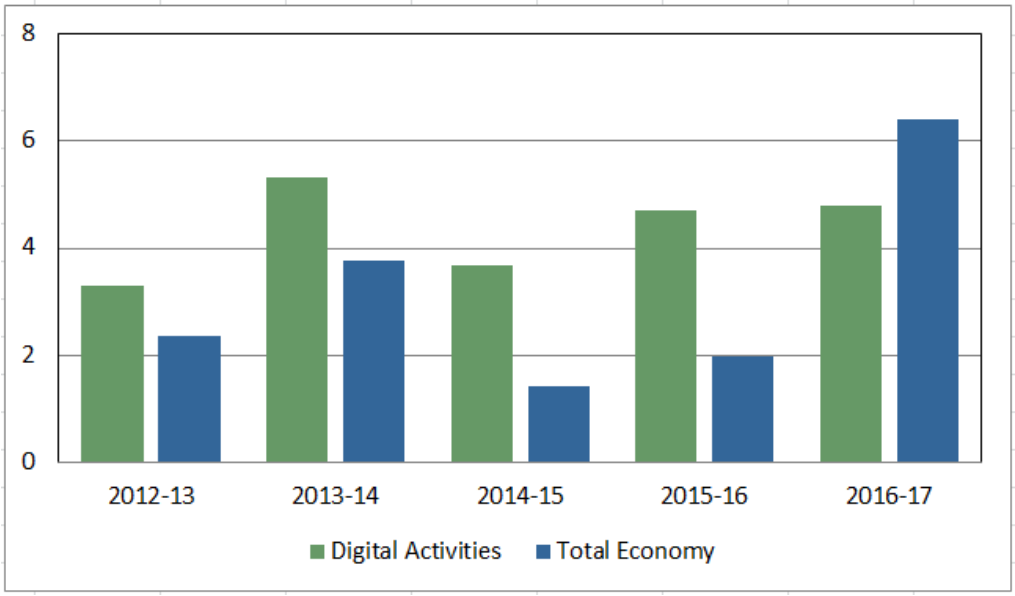
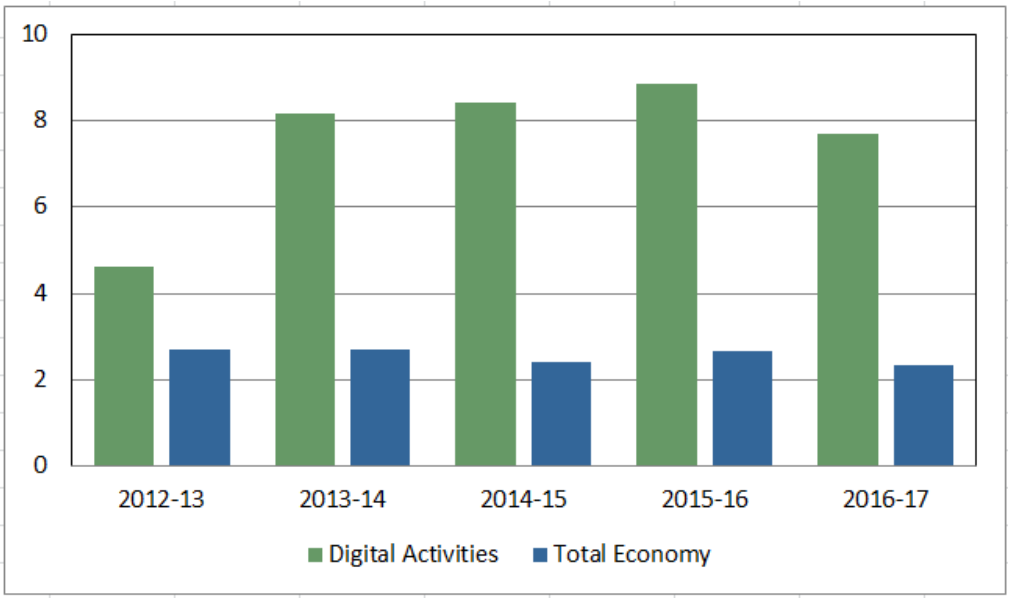


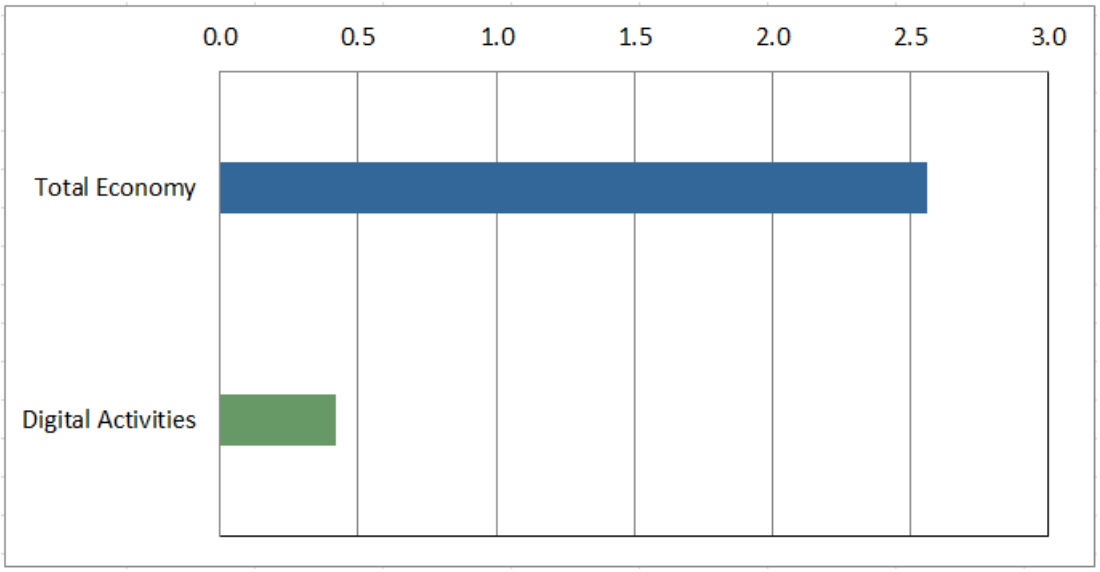
Figure 4
Annual Value Added Volume Growth (%), Digital Activities vs. Total Economy, from 2012-13 to 2016-17



31. In both current price and volume terms, apart from current price growth in 2016-17, growth in the digital activities significantly outpaced growth in total production (Figures 3 and 4). The rapid expansion in digital activities was driven by strong demand for more advanced telecommunication and support services, and further digitalisation of wholesale trade in the Australian economy.

Figure 5

Digital Activity Contribution to Aggregate Value Added Growth (%), from 2012-13 to 2016-17, Volumes

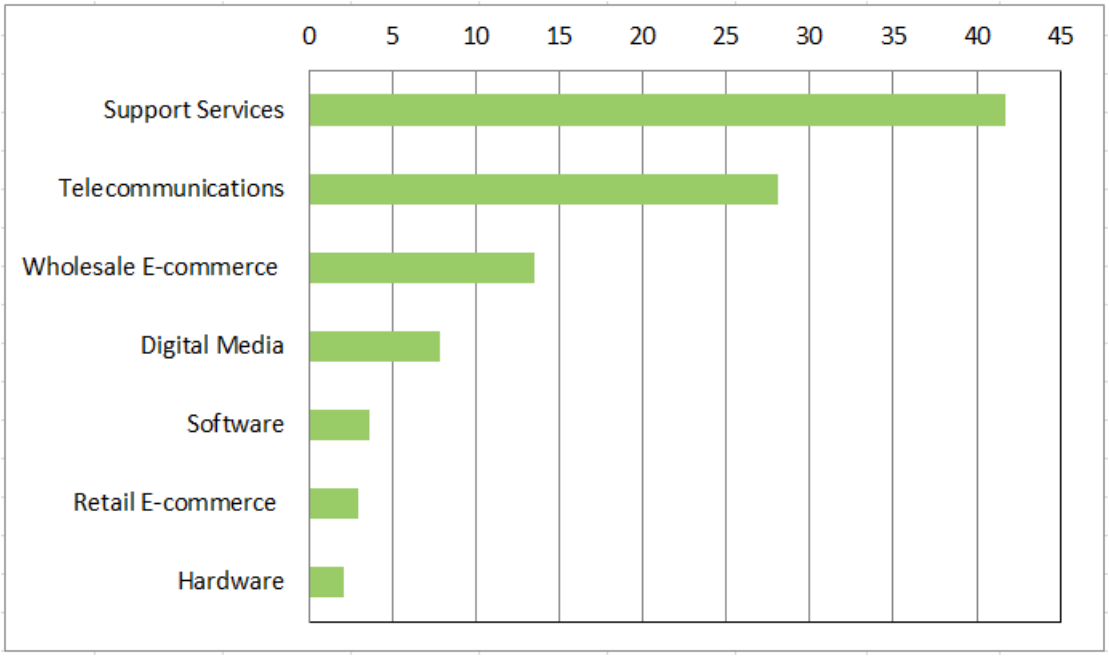


32. From 2012-13 to 2016-17, digital activities accounted for almost one sixth of the total economic growth in Australia (0.4% of the total 2.6%), due to the rapid growth proportional to the digital activities' moderate size (Figure 5). The level contribution of the digital activities in Australia was similar to the counterpart in the U.S. (0.4% in 2016), as published in Barefoot et al (2018).

33. The figures hereafter explore the drivers of the digital activity value added.

Figure 6

Average Share in Total Digital Activity Value Added (%), from 2011-12 to 2016-17, Current Prices

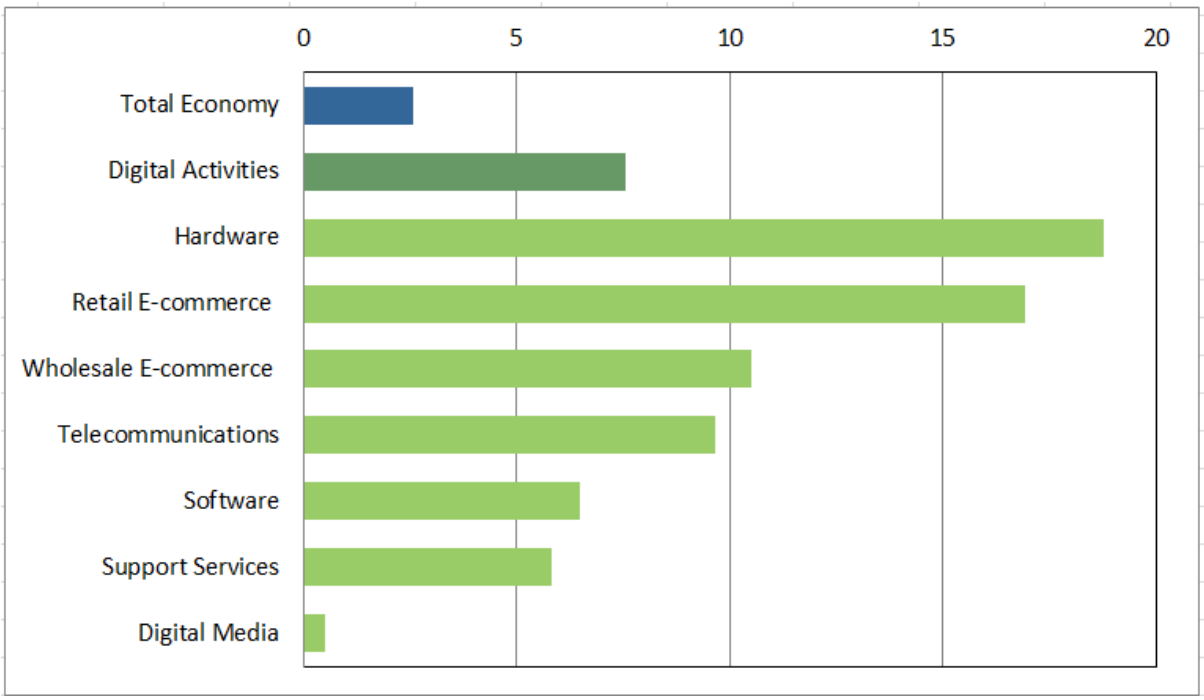


34. Within the digital activities, production was dominated by Support Services, Telecommunications and Wholesale E-commerce (Figure 6). Support Services and Telecommunications were driven by strong demand for high speed and volume internet services, and increased commercial adoption of new technologies (such as Cloud computing

and storage, remote data access and multi-platform networking) under the ongoing rollout of the National Broadband Network (NBN). Wholesale E-commerce was relatively significant due to intensified digitalisation, and a high commercial reliance on imported necessities in response to the limited domestic supply of manufactured goods (Table 8, Appendix D). In contrast, Hardware and Retail E-commerce were overshadowed by low-cost imported computer products (Lo, 2017) and traditional retail sales (NAB Online Retail Sales Index (NORSI) January 2010 – January 2012 and June 2017), respectively.

Figure 7

Average Annual Value Added Growth by Digital Activity (%), from 2012-13 to 2016-17, Volume

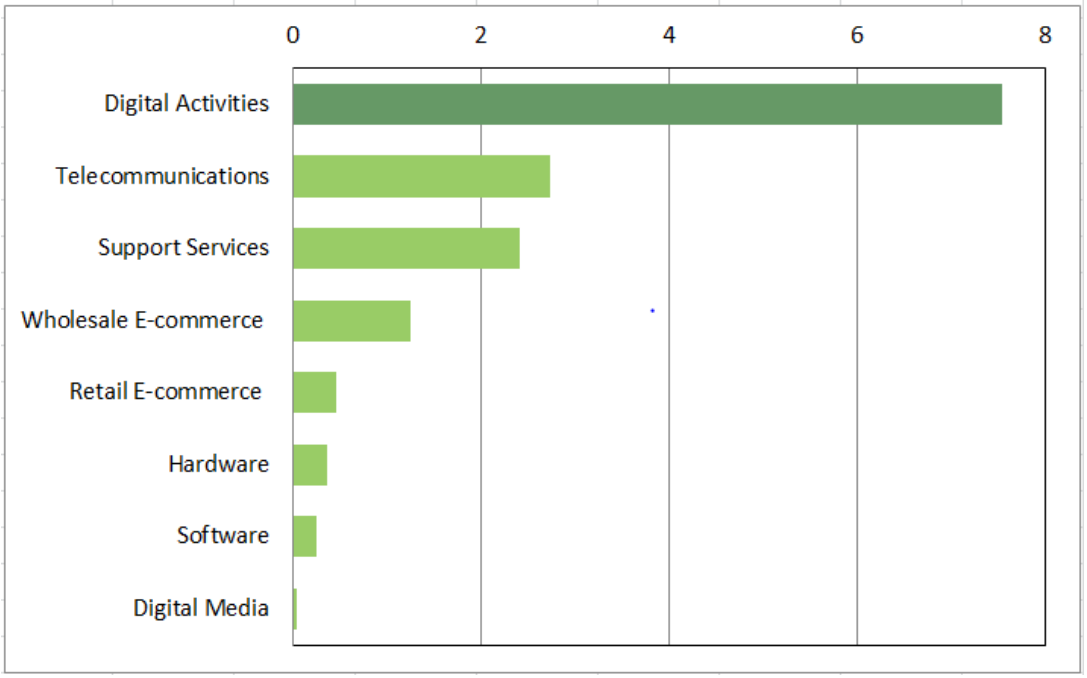


35. Looking at volume, the estimated value added growth in most of the digital activities significantly outpaced that in the total Australian economy (Figure 7). Hardware experienced the highest growth, followed by Retail E-commerce, Wholesale E-commerce and Telecommunications. Hardware was driven by depreciation in the Australian dollar, efficiency improvements and increased focus on local customisation and support for businesses and governments (Lo, 2017). Retail E-commerce thrived on the affordability and convenience of online shopping, and the integration of "Click and Collect" and physical retail presence. The growth in Wholesale E-commerce primarily reflects significant digitalisation within the Wholesale Trade division. In response to strong downward pressure on profits[5], wholesalers could cut costs by replacing labour with advanced automated systems for order, inventory and customer service management[6]. Digital Media experienced the lowest growth due an ongoing shift in consumer viewing trend, from free-to-air digital TV and radio to on-demand internet streaming services.

[5] Profitability in wholesale trade activities sharply diminished in recent years due to the depreciation of the Australian dollar, decrease in oil prices and intensified competition from overseas.

[6] One example of such systems is the radio-frequency identification (RFID).

Figure 8
Contribution to Digital Activity Value Added Growth (%), from 2012-13 to 2016-17, Volumes



36. Overall, the digital activity value added grew by 7.5% per annum primarily due to the production in Telecommunications (2.7%) and Support Services (2.4%); and the intensified digitalisation of Wholesale Trade (1.3%) (Figure 8). The contribution from Hardware and Retail E-commerce was minor, as the high value added growth rate was offset by the relatively small production.

37. In summary, information and communication technologies were a growing engine of the Australian economy. Characterised by rapid growth and relatively significant production, telecommunication and support services were significant direct contributors to the aggregate digital activities and economic growth. Further, technological innovation and increased commercial adoption of new ICT amongst producers enables vital productivity gains. For example, the intensified automation within Wholesale Trade significantly reduced labour costs and, in turn, allowed wholesalers to confront declining profitability. Maintaining competitive supply channels through Wholesale E-commerce will be important as Australia continues to transition towards a services economy.

38. The results also indicate that Retail E-commerce is currently a relatively minor contributor to the Australian digital activities and aggregate economy. However, the activity has demonstrated much potential for future growth.

IV. Conclusions

39. Rapid progress in digitalisation has increased the demand for statistical insights into digital activities in the Australian economy. In response, the ABS has measured selected domestic digital activities under the BEA approach. Adopting the BEA approach enables Australia to engage in policy debate and international comparisons of digital activities in a timely and responsive manner.

40. While representing a relatively small share of total Australian production (behind traditional economic drivers such as Mining, Finance, Health and Construction), the selected digital activities contributed significantly to the aggregate economic growth in recent years. In current price and volume terms, the selected digital activities grew rapidly, primarily due

to strong demand for more advanced telecommunications and support services. The results also highlight the economic importance of Wholesale E-commerce in Australia's ongoing economic structural change.

41. The ABS acknowledges the scope limitations in the current approach to measuring digital activities in the Australian economy. Potential areas for future research and development include:

42. Measurement of emerging digitalised services, such as finance (particularly Financial Intermediation Services Indirectly Measured, or FISIM) and UBER transport;

43. Digitalisation in products across time, including improvements in modelling Wholesale E-commerce;

44. Outsourcing of digital activities across time; and

45. Digitalisation of international trade.

46. The ABS will consider any future research in this area in conjunction with broader organisational forward work program priorities.

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Appendix A

Appendix A highlights the underlying model by digital product, and provides caveats in the current modelled Wholesale E-commerce activities.

To ensure consistency within the established scope, the supply-use industry output of certain digital elements is modelled with existing data sources (Table 2). Infrastructure, ophthalmic instruments, cameras, optical fibres, software copyright leasing, metal wires and electronic equipment repair were estimated using the individual product's share in the corresponding SUPC from the ABS Input-output table. In wholesale and retail trade activities, however, E-commerce is not well represented by the underlying IOPCs. Hence, retail E-commerce margin and trade services were estimated using the share of Australian online retail sales (NORSI) in the total Australian retail turnover (ABS Cat. no. 8501.0). Wholesale E-commerce margin and trade services were based on the share of internet income (unpublished experimental data from the ABS Business Characteristics Survey (BCS)) in the total sales of goods not produced (Economic Activity Survey) for the Wholesale Trade division. For simplicity, the estimated shares of E-commerce activity were assumed to be identical across all SUICs.

The significance of E-commerce relative to total wholesale trade may be overestimated due to the scope and limitations of the estimated internet income. Internet income was derived from the reported proportion of online sales in business income from the BCS. The BCS definition of online sales accounts for all internet business-to-business (from a producer to a wholesaler, and from a wholesaler to a retailer etc.) and business-to-consumer transactions on any particular good. Moreover, the current estimated internet income cannot be traced to non-wholesale business activities and the underlying goods traded between businesses.

Table 2
Data Sources for Modelling the Relevant Digital Products

Data Source	**Frequency**	**Availability**
ABS input-output table	Annual (financial year)	1994-95 to 2015-16
NAB online retail sales index (NORSI)	Monthly	January 2010 to December 2018
Retail turnover by industry group ABS Cat. no. 8501.0 Table 1	Monthly	April 1982 to December 2018
ABS Business Characteristics Survey (BCS)[7]	Annual (financial year)	2009-10 to 2016-17

[7] Unpublished experimental internet income for the Wholesale Trade division.

Appendix B

Appendix B formulaically shows the final stages in the estimation of the chain volume digital activity value added.

The chain volume index of digital activity value added ($\frac{Q_{i,t}}{Q_{i,0}}$) was calculated as the cumulative multiplication of the annual volume movement across time:

$$\frac{Q_{i,t}}{Q_{i,0}} = \frac{P_{i,t-1}Q_{i,t}}{P_{i,t-1}Q_{i,t-1}} \times \frac{P_{i,t-2}Q_{i,t-1}}{P_{i,t-2}Q_{i,t-2}} \times \frac{P_{i,t-3}Q_{i,t-2}}{P_{i,t-3}Q_{i,t-3}} \times \ldots\ldots \frac{P_{i,0}Q_{i,1}}{P_{i,0}Q_{i,0}} \quad (1)$$

Where:

$Q_{i,t}$ is the quantity of value added in digital activity *i* at time t,

$P_{i,t-1}$ is the price of value added in digital activity *i* at time t-1,

$P_{i,t-1}Q_{i,t}$ is the constant price value added in digital activity *i* at time t, and

$P_{i,t-1}Q_{i,t-1}$ is the current price value added in digital activity *i* at time t-1.

The chain volume digital activity value added ($P_{i,ref}Q_{i,t}$) was estimated by converting the chain volume index into the dollar value of a selected reference year:

$$P_{i,ref}Q_{i,t} = \frac{Q_{i,t}}{Q_{i,0}} \times P_{i,ref}Q_{i,ref} \div \frac{Q_{i,ref}}{Q_{i,0}} \quad (2)$$

Where:

$P_{i,ref}Q_{i,ref}$ is the current price value added in digital activity *i* at a selected reference year, and

$\frac{Q_{i,ref}}{Q_{i,0}}$ is the chain volume index in digital activity *i* at a selected reference year.

Appendix C

Appendix C numerically demonstrates double deflation and the estimation of chain volume value added.

In this example, an industry produces products one and two through the intermediate consumption of three other products. The industry's current price gross output and intermediate consumption by product, as well as the corresponding annual change in price (the implicit price deflator, or IPD), are shown in Tables 3. The current price value added is the difference between the gross output and intermediate consumption.

Table 3
The Industry's Gross Output, Intermediate Consumption and Value Added in Current Prices

Current price ($m)	Year 1	Year 2	Year 3	Year 4	**Implicit Price Deflator**	Year 1	Year 2	Year 3	Year 4
Gross Output					**Gross Output**				
Product 1	1000	1100	1200	1300	Product 1	1.01	1.01	1.03	1.02
Product 2	100	110	120	130	Product 2	1.02	1.01	1.02	1.01
Total	1100	1210	1320	1430					
Intermediate Consumption					**Intermediate Consumption**				
Product 3	500	510	530	550	Product 3	1.02	1.01	1.01	1.03
Product 4	100	110	120	130	Product 4	1.03	1.01	1.02	1.01
Product 5	10	20	30	40	Product 5	1.01	1.02	1.02	1.01
Total	610	640	680	720					
Value Added									
Total	490	570	640	710					

To remove the price effect from quantity of value added, the current price gross output and intermediate consumption were separately deflated at each individual product (Table 4). The double deflation involved dividing the current price measure by the corresponding IPD. The industry's value added at constant prices was estimated as the difference between the total deflated gross output and the total deflated intermediate consumption.

Table 4
Estimating the Constant Price Value Added with Double Deflation

Constant price ($m)	Year 1	Year 2	Year 3	Year 4
Gross Output				
Product 1	990.1	1089.1	1165.0	1274.5
Product 2	98.0	108.9	117.6	128.7
Total	1088.1	1198.0	1282.7	1403.2
Intermediate Consumption				
Product 3	490.2	505.0	524.8	534.0
Product 4	97.1	108.9	117.6	128.7
Product 5	9.9	19.6	29.4	39.6
Total	597.2	633.5	671.8	702.3
Value added				
Total	491.0	564.6	610.9	700.9

The chain volume value added shows change in quantity by accounting for the annual growth rate over time. For a particular year, the annual value added volume growth was calculated as the ratio of the industry's constant price value added to the industry's current price value

added in the previous year (Table 5). The quantity of value added has not grown at the beginning of the time series (Year 1).

Table 5
The Industry's Annual Value Added Growth Rate

	Year 1	Year 2	Year 3	Year 4
Value Added (constant price, $m)	491.0	564.6	610.9	700.9
Value Added (current price, $m)	490.0	570.0	640.0	710.0
Annual Value Added Growth	**1.00**	**1.15**	**1.07**	**1.10**

The change in quantity of the industry value added over time was estimated as the cumulative product (or "chaining") of the annual volume growth rate (equation 1). The estimated chain volume index is shown in Table 6.

Table 6
The Chain Volume Index of Value Added

	Year 1	Year 2	Year 3	Year 4
Annual Value Added Growth	1.00	1.15	1.07	1.10
Cumulative (Chain) Volume Index	**1.00**	**1.15**	**1.23**	**1.35**

For example, setting Year 1 as the reference year, the chain volume index of value added from Year 1 to Year 4 ($\frac{Q_{VA,Year4}}{Q_{VA,Year1}}$) is calculated as:

$$\frac{Q_{VA,Year4}}{Q_{VA,Year1}} = \frac{P_{VA,Year1}Q_{VA,Year2}}{P_{VA,Year1}Q_{VA,Year1}} \times \frac{P_{VA,Year2}Q_{VA,Year3}}{P_{VA,Year2}Q_{VA,Year2}} \times \frac{P_{VA,Year3}Q_{VA,Year4}}{P_{VA,Year3}Q_{VA,Year3}}$$

$$= 1.15 \times 1.07 \times 1.10$$

$$= 1.35$$

The chain volume measure of value added was estimated by converting the chain volume index into the dollar value of the selected reference year (Year 1) (equation 2). The estimated chain volume measure is shown in Table 7.

Table 7
Estimating the Chain Volume Value Added

Reference year = Year 1	Year 1	Year 2	Year 3	Year 4
Current Price Value Added ($m)	490			
Cumulative (Chain) Volume Growth	1.00	1.15	1.23	1.35
Chain Volume Value Added ($m)	**490**	**565**	**605**	**663**

As an example, the chain volume value added in Year 4 ($P_{VA,Year1}Q_{VA,Year4}$) is calculated as:

$$P_{VA,Year1}Q_{VA,Year4} = \frac{Q_{VA,Year4}}{Q_{VA,Year1}} \times P_{VA,Year1}Q_{VA,Year1} \div \frac{Q_{VA,Year1}}{Q_{VA,Year1}}$$

$$= 1.35 \times 490 \div 1$$

$$= 663_{8}$$

[8] Includes minor rounding error.

Appendix D

Appendix D summarises the common elements in the top 15 imported and wholesale margin products, from 2011-12 to 2016-17 (Table 8). The imports, wholesale margin and Australian production by product were estimated as the current price summation across the established timeframe.

As indicated by the high ratios of imports to Australian production, the main products sold for commercial purposes were significantly sourced from abroad. The high levels of import were consistent with the slowing domestic sources of manufactured goods under Australia's ongoing structural change.

Table 8
The Common Elements in the Top 15 Imported and Wholesale Margin Products, 2011-12 to 2016-17, current price

SUPC	SUPC description	Import ($m)	Wholesale margin[9] ($m)	Australian production ($m, basic price)	Ratio of imports to Australian production
23005	Motor cars	119340	25763	23584	5.1
17015	Automotive petroleum and coal products	91343	26447	129072	0.7
24030	Telecommunication and audio visual equipment	79077	19199	7597	10.4
24065	Specialised machinery and equipment	69334	33351	36499	1.9
13070	Clothing (excluding knitted or crocheted)	67248	28224	5566	12.1
24025	Computer hardware and peripherals (incl photocopiers and parts)	63972	18474	14564	4.4
24075	Other machinery and equipment	57300	27123	31033	1.8
18025	Medicinal and pharmaceutical products	51335	32210	52519	1.0
23060	Motor vehicle parts (excluding engines and panels) and accessories	34153	19393	21553	1.6
	Total	633102	230184	321987	2.0
	Grand total of goods[10]	1846104	670686	3453466	0.5
	Percentage of the top products in the grand total	34.3	34.3	9.3	

[9] The wholesale margin by SUPC was derived with an experimental product allocation from the ABS Retail Industry and Wholesale Industry surveys (RIS/WIS). Hence, ranking the estimate by size would reasonably indicate the main underlying products in wholesale trade.

[10] The grand total estimate only includes goods that attract wholesale margin in the source supply-use table.