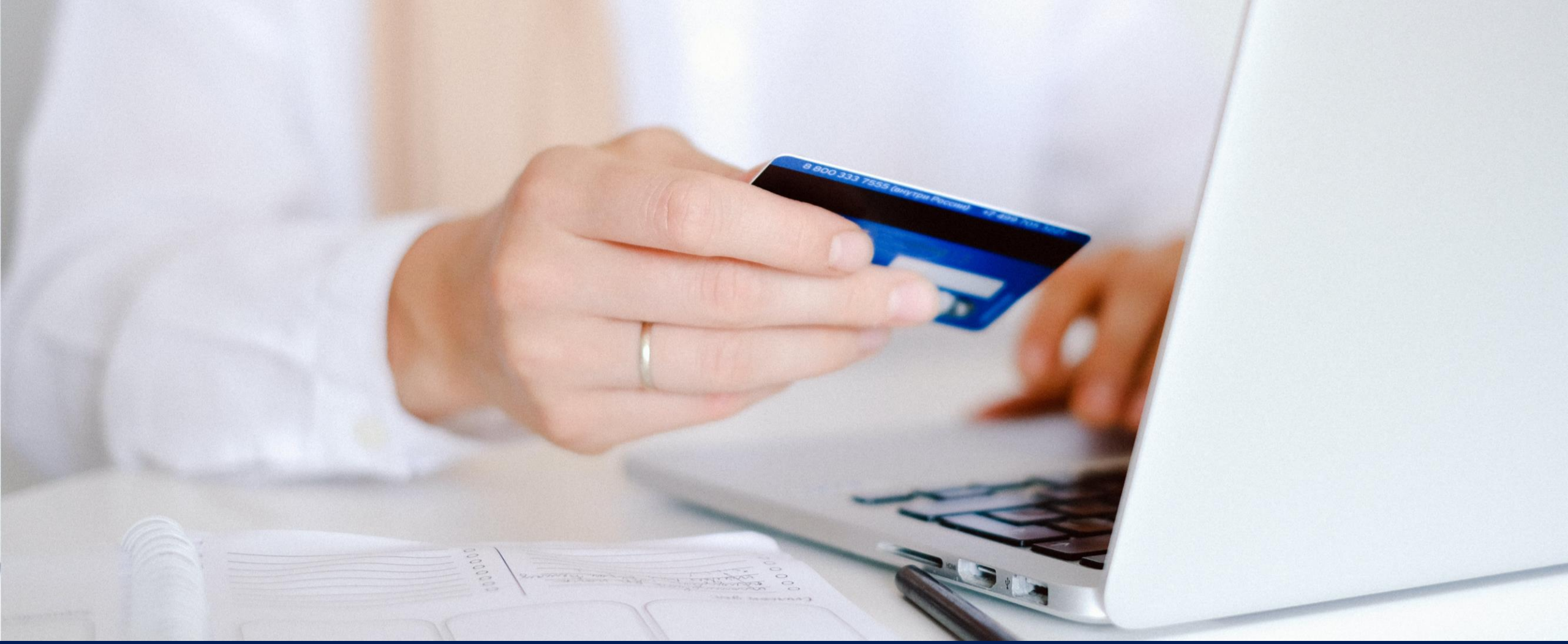

Surf, Shop, Save: *Online retail helps lower the cost-of-living*

Report – Prepared by Mandala

February 2024

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Contents

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This document is intended for general informational purposes only. The analysis in this report was commissioned by Amazon and prepared by Mandala.

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Note: All dollar figures are Australian dollars unless indicated otherwise.

Executive summary (I/II)

A perfect storm has created a cost-of-living crisis in Australia, hitting the hip pockets of all Australians

Households are hurting. The combination of higher prices and rising interest rates on debt has put household finances under significant strain, with the rate of inflation doubling from 2021 to 2022. To tame this, the Reserve Bank increased interest rates from 0.1% in April 2022 to 4.35% as of February 2024, the fastest rate hike in Australia's history.

Australia's cost-of-living crisis was created by a perfect storm of events. Supply chain challenges, the war in Ukraine and disruptions to global trade have constrained the supply of goods and services while the lagged effects of extraordinary monetary and fiscal supports during COVID-19 and the spending-down of household savings during the pandemic has boosted the demand for goods and services.

This combination of constrained supply and high demand has produced a double-whammy increase in prices.

Online channels help reduce cost-of-living pressures for Australians through cost-efficiency and competition effects

The retail sector consists of online and offline channels, with retailers using a mix of both to reach consumers, often within a single purchase journey.

Within this omnichannel retail sector, the cost-efficiency effect of online channels sees the cost savings from reduced handling and improved distribution being passed-on to consumers in the form of competitive prices. The competition effect of online channels sees reduced prices across the broader retail sector due to increased competition and increased consumer choice. This allows consumers to shop around for the best price.

To estimate the cost-efficiency effect, we analysed a sample of over 60,000 distinct products from online channels, creating a time series of prices from 2019 to 2023. Using this data, we constructed an 'Online Channels Index' (OCI) and compared each category of the OCI (e.g., clothing and footwear) to the corresponding sub-group of the ABS' Consumer Price Index (CPI). While the exact products in our baskets were not the same as the ABS', the categorisation, weighting and construction of the index was.

Since the start of 2019, OCI has fallen, while CPI has grown

Comparing the OCI to CPI, we find that the OCI has grown 10.5 percentage points less than CPI since 2019 for comparable categories of goods. This indicates that products that are available via online channels experience lower price growth than similar goods that are strictly sold through offline channels.

Furthermore, despite the high inflation environment, goods sold through online channels actually deflated between 2019 and 2023. These results are comparable to those from similar studies in other countries.

Executive summary (II/II)

Annual inflation in Australia was 0.7 percentage points lower than it would otherwise have been thanks to the competition effect of online channels

Using a Phillips curve model that includes the share of sales from online channels in total retail, we find that in the absence of competitive pressure from online channels, inflation would have peaked at 8.9% in December 2022, 0.7 percentage points higher than the actual peak of 8.2%.

Typically, lower inflation also means lower interest rates. Using a computable general equilibrium model, we also estimate that interest rates may have been up to 0.5 percentage points higher in the absence of the efficiency and competition effects of online retail channels. Since this constitutes a second-order economic effect, the additional benefits from lower interest rates are not included in our final estimate of household savings. However, this suggests that the household savings estimated in this report are conservative relative to the total effect.

Households have saved nearly $3,500 since 2019 thanks to the price effects of online channels

Since 2019, the price effects of growth in online channels has driven an estimated $3,463 in cumulative cost savings for the average household. This is the equivalent of receiving 3 weeks' worth of groceries for free each year, since 2019. These cost savings were largest for recreation and culture (items such as stationary, toys and pet food), where households have saved nearly $1,000 in the last 5 years.

These cost savings from online channels benefit all Australians, but particularly lower-income households

Online channels benefit Australians across all levels of income. But, relative to the distribution of income in Australia, the cost savings generated by online channels deliver more benefits to households with lower levels of income. Cost savings generated by online channels were distributed with a Gini coefficient of 0.20, significantly more equitable than the Gini on Australia's income distribution of 0.30. A lower Gini coefficient indicates a greater degree of equality. Global leaders like Norway have a Gini coefficient on household income of around 0.23.

Australian households would save more if they shopped online more

Online channels composed just 10.7% of Australian retail sales in 2023. However, the more that Australian consumers shop online, the more they save through both the cost-efficiency effect of lower prices of goods purchased online, and the competition effect of online channels on offline prices.

Modelling this hypothetical scenario, if sales in Australia through online retail channels had been 20% in 2023, cumulative household cost savings thanks to online channels would have been approximately 1.8 times higher, rising to $6,344 per household.

Government policies that support a competitive retail sector through both online and offline channels will continue to facilitate the growth of consumer choice and cost savings for Australian households.

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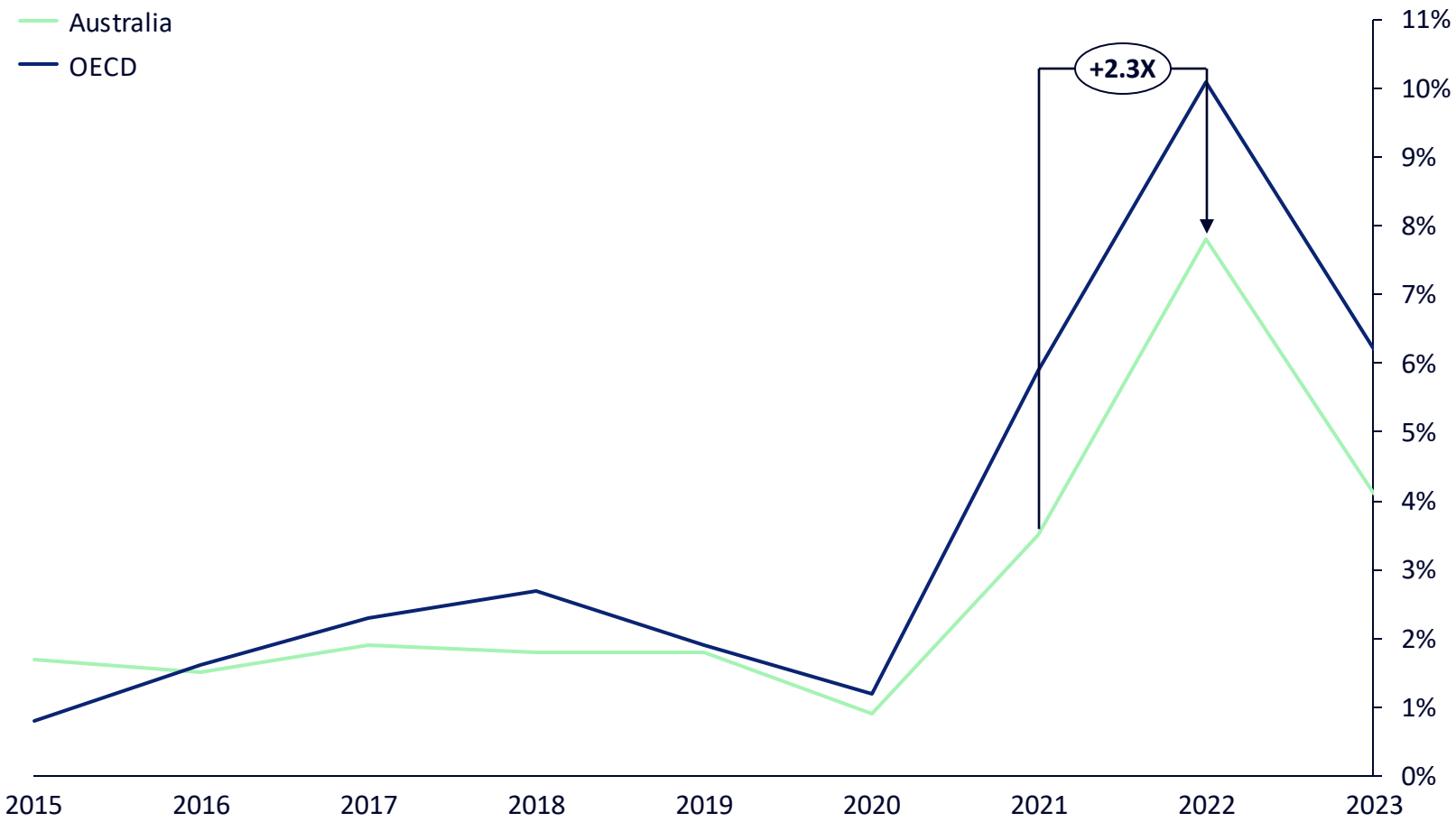
The combination of supply chain challenges and increased consumer demand after the pandemic saw the growth of consumer prices double from 2021 to 2022

Annual inflation rate in Australia and the OECD since 2015

CPI growth rate (%, p.a.), 2015-2023[1]



1 OECD Data is based on year-on-year inflation as at the December quarter, with the exception of 2023 which uses the latest available data from the September quarter.
Source: OECD (2024); ABS (2023B); Mandala analysis.

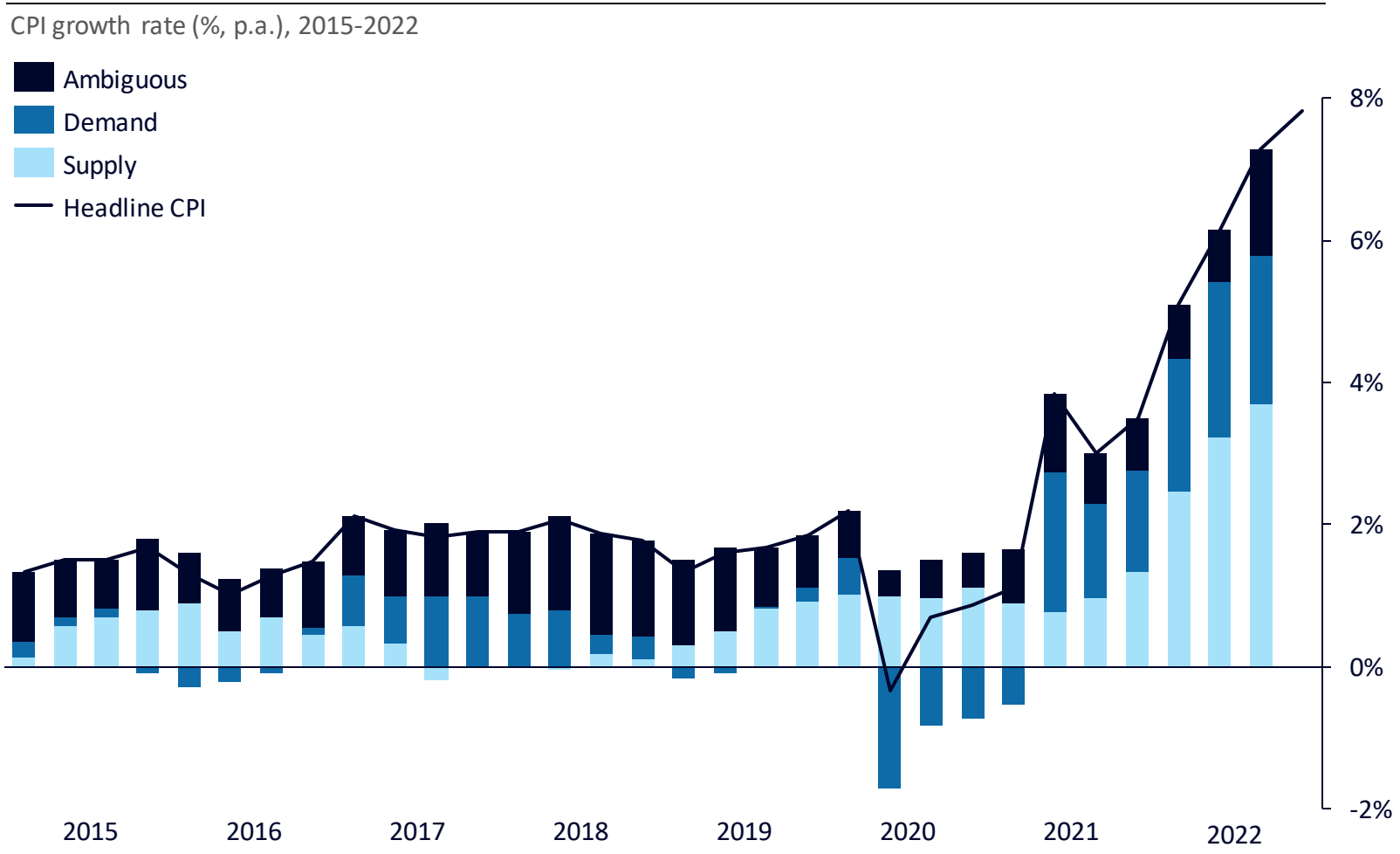
Inflation surged in advanced economies after the COVID-19 pandemic, with the OECD recording an annual inflation rate of 10.1% in December 2023.

This has been driven by a combination of factors, including unprecedented levels of monetary and fiscal stimulus in 2020, supply chain challenges due to disruptions in global trade, and cost pressures in food and energy arising from the Russia-Ukraine war.

Australia has not been an exception. Inflation hit 7.8% p.a. in the final quarter of 2022, reaching its highest level since 1990. In total, Australian prices rose 25.3% from the start of 2020 to the end of 2023, putting significant pressure on Australian households trying to make ends meet.

While Australia's inflation pressures have a range of drivers, supply side factors have been significant and highlight the importance of competition in combatting inflation

Headline CPI growth rate, decomposed by economic driver



Source: Beckers, Hambur & Williams (2023); Mandala analysis.

Much of the uptick in inflation since 2020 has been driven by supply side factors, including disruptions resulting from the COVID-19 pandemic, which strained the ability of firms to deliver goods; Russia's invasion of Ukraine, which led to sharp increases in commodity prices; and flooding on the east coast of Australia in the first half of 2022, which interrupted domestic supply chains. In the 12 months ending September 2022, supply side drivers were estimated to account for 50% of headline inflation.

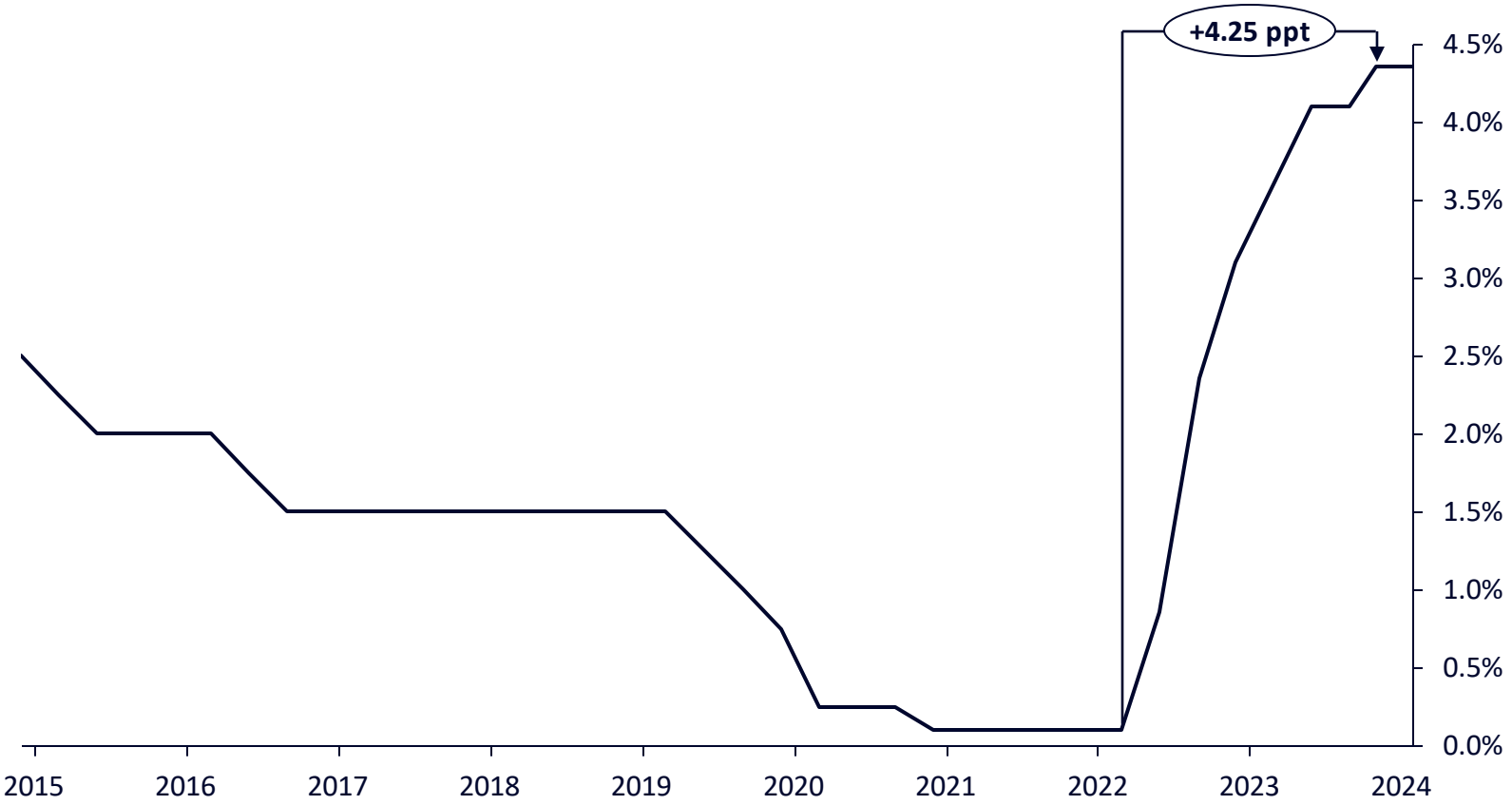
While the Reserve Bank has taken significant monetary policy action to curb rising inflation, these measures primarily address demand side drivers, including the rapid economic recovery following the faster-than-expected development of effective vaccines; and the significant fiscal and monetary policy support provided during the pandemic.

Supply driven inflation is generally less responsive to monetary policy. As such, policy conditions that promote competition and productivity across the economy are essential to help grow economic capacity and ease price pressures over time.

The RBA has aggressively raised interest rates to contain inflation by cooling-off consumer demand – while rate hikes work, they come at a cost

RBA cash rate target since 2015

RBA cash rate target (%), 2015-2023



In response to rising inflation, the RBA has embarked on the fastest rate hike cycle in its history.[1] This has seen the cash rate rise 4.25 percentage points from 0.1% as at April 2022 to 4.35% as at February 2024, with some economists anticipating that further rate hikes could remain on the cards this year.

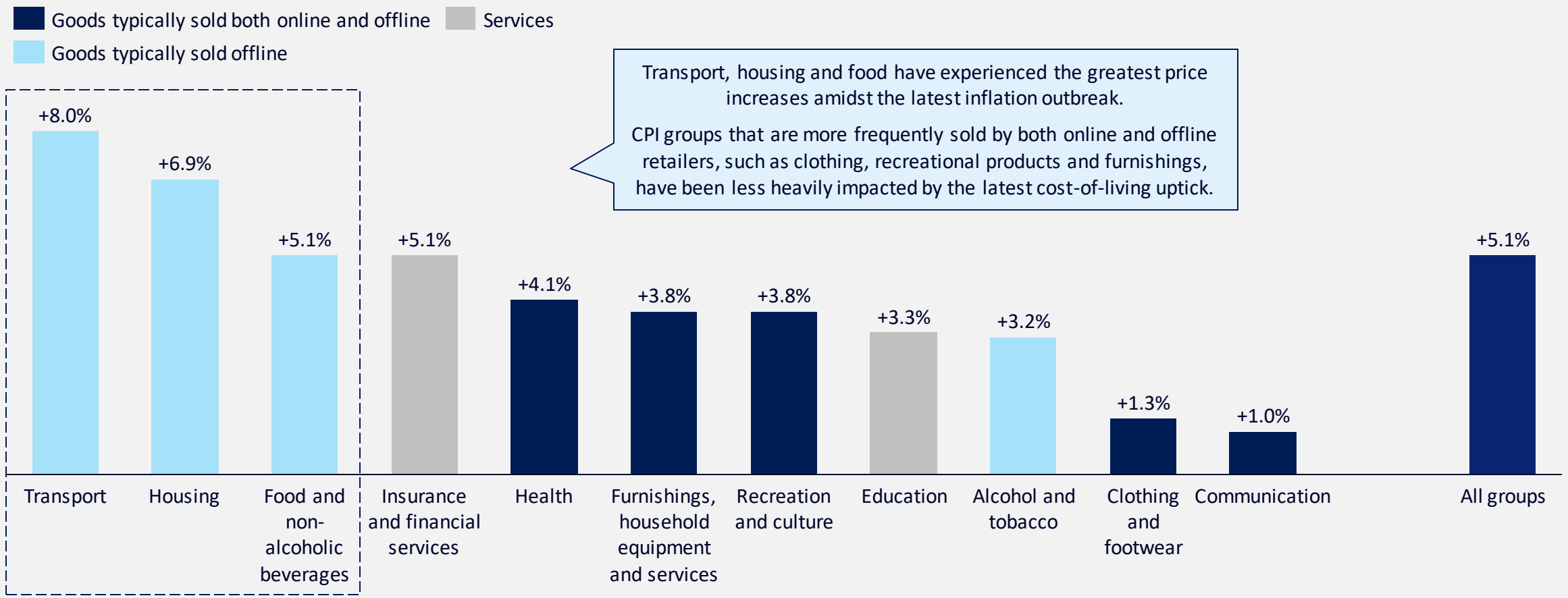
While raising interest rates are the strongest economic tool against inflation over the long-term, in the short-term, they can add further pressure on the cost-of-living for households through their impact on variable interest rate mortgages. Since the start of this rate hiking cycle in May 2022, the cumulative impact of interest rate rises has seen the cost of repayments on a $500,000 mortgage increase by $1,210 per month.[2]

1 CoreLogic (2023).
2 The Guardian (2023).
Source: RBA (2024); Mandala analysis.

Offline purchases have driven prices higher, with transport, housing, and food the source of the greatest cost-of-living increases

Annual inflation rate of CPI groups since the start of 2021

CPI growth rate (%, p.a.) since 2021



Source: ABS (2023B); Mandala analysis.

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Australian retail has matured into an omnichannel sector, with the emergence of online retailers facilitating an explosion in consumer choice

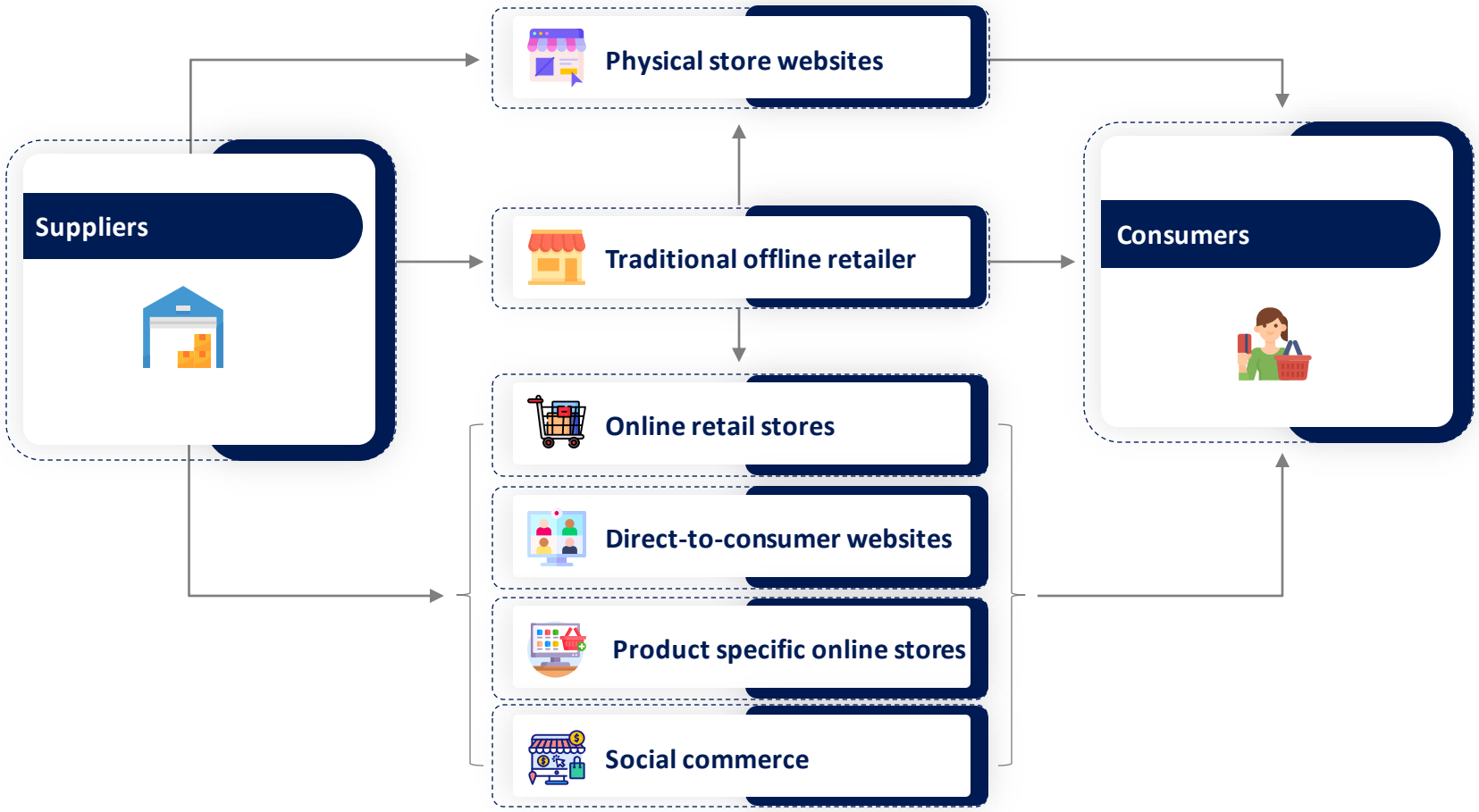
Online channels have unlocked a variety of mediums through which consumers shop

Types of online channels	Direct-to-consumer websites	Physical store websites	Product specific online stores	Online retail stores	Social commerce
Description	**Direct-to-consumer sites** are operated by the brand or manufacturer that creates the product, allowing them to sell directly to the consumer without intermediaries.	**Physical store websites** are online channels for traditional offline retailers, offering an online experience alongside the option of in-store shopping.	**Product specific online stores** focus on a specific type of product or category, providing a specialised selection for consumers.	**Online retail stores** give consumers a wide range of brands and products to choose from whether supplied by a third-party seller or a retailer.	**Social commerce** combines social media with direct purchasing through social media sites, connecting consumers directly to retail products via a content creator.
Example	Dyson / Apple / Temple & Webster	JB Hi-Fi / Office Works / Bunnings	Priceline / The Iconic / Appliances Online	eBay / Catch.com / Kogan / Amazon / Temu / SHEIN	Tik Tok Shop / Facebook Marketplace

Source: Mandala analysis.

Online channels expand the options for both consumers and suppliers and drive competition across the sector

Online channels help to create a more dynamic and diverse retail market



Source: Mandala analysis.

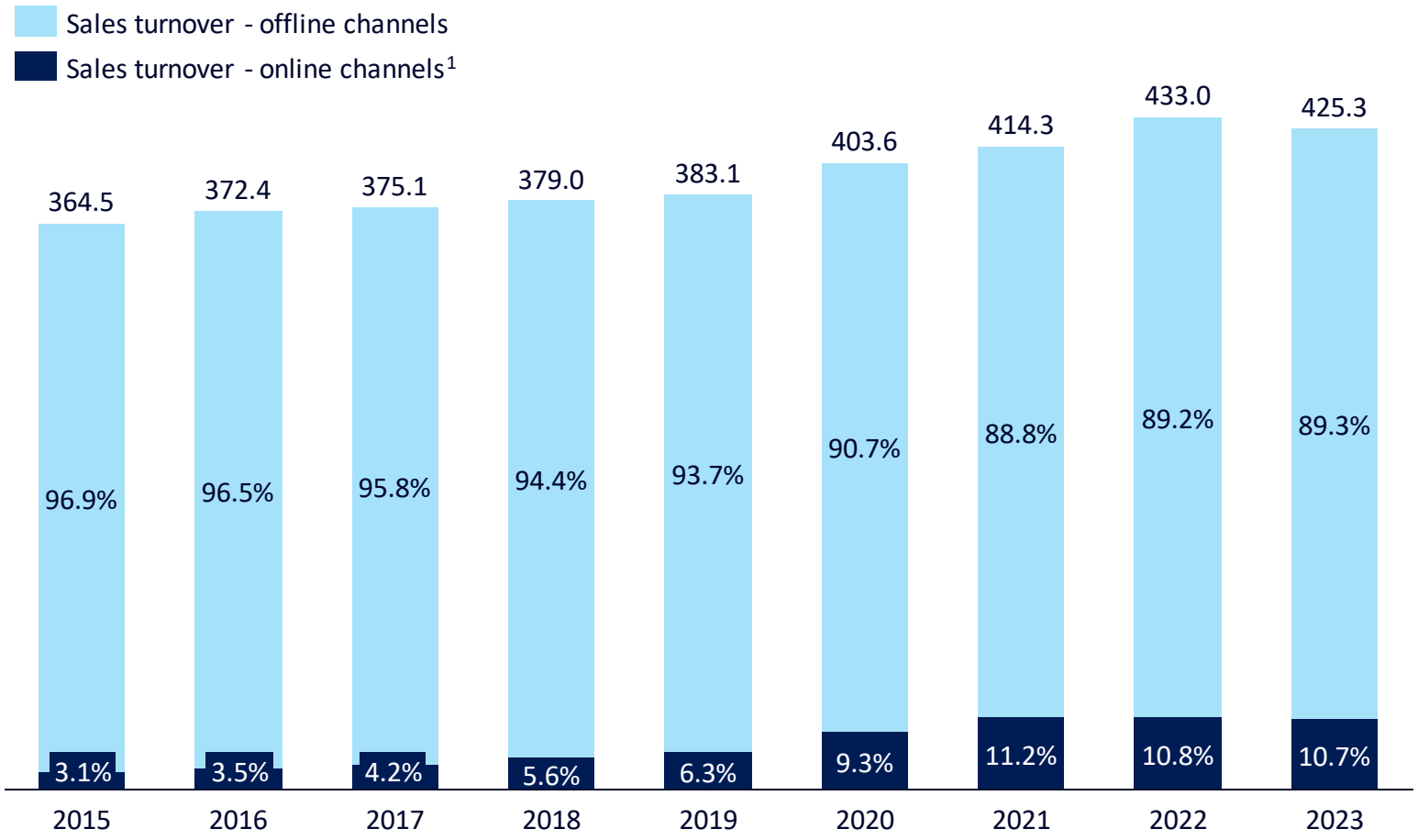
The emergence of online channels has seen the retail market evolve, expanding the options that are available to consumers, suppliers, traditional offline retailers, and new entrants. The ability to service customers through online channels has materialised in several ways, with physical store websites, direct-to-consumer websites, product specific online stores, online retail stores and social commerce, each operating unique business models within a broader retail ecosystem.

Consumers now have more information available to them than ever before, as well as more options. This enables a reduction in information asymmetries between buyers and sellers, allowing consumers to more easily compare prices across retailers and spurring competition. This effect is amplified by both the emergence of more sophisticated online comparison sites such as Google Shopping, as well as the ability for consumers to shop globally via greater access to international sellers. This combination of demand side and supply side effects drives a more efficient and competitive retail sector.

On the demand side, growth in online channels enhances the information available to consumers making it easier to compare prices across offline and online channels

Australian retail sales over time, online versus offline channels

$, billions, online vs offline, 2015-2023



Notes: Sales turnovers have been converted to December 2023 dollars.
1 Includes purchases made via the internet from employing retail businesses who predominately sell to households; ABS (2023) *Retail Trade.*
Source: ABS (2023B, 2023C, 2023D); Mandala analysis.

The sales share of online channels has dipped below its peak, following an artificial lockdown boost. However, online delivery channels in the Australian retail sector have created a range of demand side benefits for consumers, including:

Reduced search costs

- Online channels make it easier for consumers to find products suited to their preferences
- This reduces barriers to consumption, supporting greater consumer choice and increasing demand

Increased accessibility

- Online channels allows consumers to access retailers and products that were previously unavailable in their local area

Increased price transparency

- Online channels allow consumers to more easily compare prices across products and make more informed choices
- Aided by price comparison websites, this helps to drive competition across retailers and puts downwards pressure on price growth

On the supply side, online channels lower prices by passing cost savings directly to consumers and by increasing the competitive pressure faced by incumbents

While online channels are commonly associated with their demand side benefits for consumers, they are also critical in drivin g innovation and competition on the supply side, putting downward-pressure on consumer prices

Supply side effects

Online channels can facilitate lower prices through **two effects**

1 Cost-efficiency effect

First, online channels lower prices by selling more efficiently, passing on cost savings from:

- **Reduced in-store handling** (unpacking and stocking of shelves is limited to distribution centres)
- **Centralised inventory management** (inventory is stocked and managed across central warehouses rather than multiple stores)
- **Reduced cost of sales** (increased automation, improving productivity)
- **Reduced rent** (low-cost distribution centres replace expensive urban or suburban real estate)

2 Competition effect

The cost-efficiency effect then exerts competitive pressure across the retail sector, further lowering all prices through a competition effect, which sees:

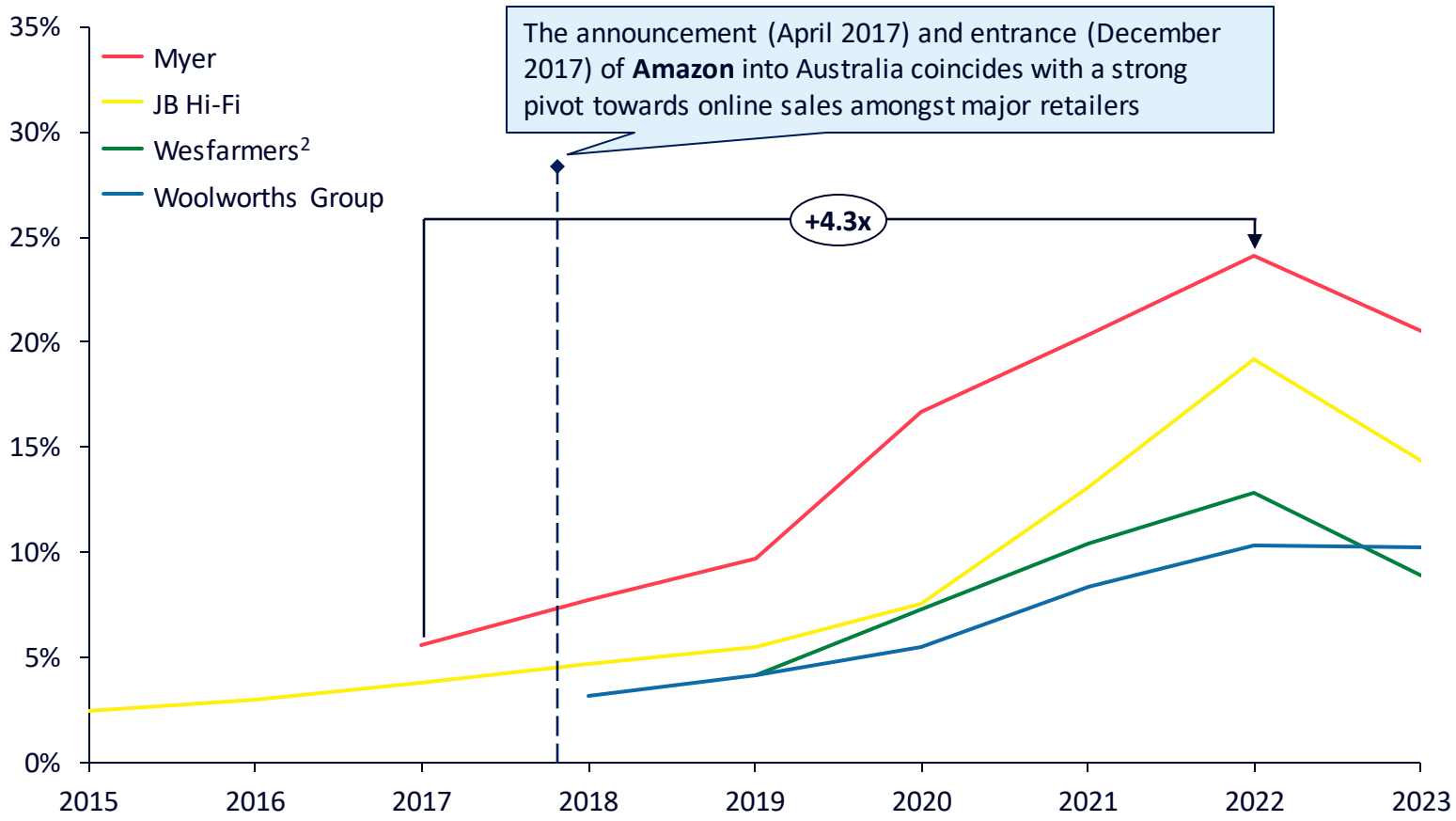
- **Margins reduced to competitive levels** (due to an increase in competition now that consumers can access goods and services through both online and offline channels)
- **Increased productivity** (firms seek to reduce marginal costs by increasing productivity in response to competitive pressure)
- **Innovation of new products** (firms create new products, increasing consumer choice and putting downwards pressure on prices)

Source: Basker (2005); Borenstein and Saloner (2001); Mandala analysis.

These supply side effects have driven competition across Australian retail as the entrance of online retailers has seen incumbents pivot to online channels

Online share of total sales amongst select Australian retailers over time

% of total sales, 2015-2023[1]



1 Based on financial year reporting data. Data availability is limited for some companies.
2 Based on retail sales only (excluding wholesale, chemicals, industrial products and other non-retail segments).
Source: Woolworths; Coles Group; Wesfarmers; Myer; JB Hi-Fi; Mandala analysis.

The entrance of online retailers such as Amazon has seen large established retail incumbents pivot to grow their own online channels. This acceleration has been evident since at least 2019, pre-dating the effects of the pandemic. For example, from 2017 to 2022, Myer grew its online share of total sales by over 4 times.

Similarly, Wesfarmers' has also pivoted heavily online, with subsidiaries Bunnings, Kmart, Target and Officeworks launching expansive online presences, while Bunnings Marketplace and Catch.com serve as online retail stores for third party sellers. This strategy is supported by the OnePass program, which provides benefits such as free shipping across online and offline stores, as well as access to streaming service Disney+.

JB Hi-Fi is another example of this pivot, with heavy investment in their online store. This has seen the integration of features such as real time stock availability to provide a holistic omnichannel offering to consumers. As online channels drive retail incumbents to be more competitive, Australian consumers benefit.

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Informed by the economic literature, we estimated both the cost-efficiency and competition effects to quantify the overall impact of online channels on prices

1 Measuring the cost-efficiency effect

Description

Economic literature suggests that online retailers pass-on marginal cost savings made by avoiding expenses such as in-store handling into lower prices.[1] In this report, we refer to this as the cost-efficiency effect.

Method

To examine this effect, we analysed a sample of over 60,000 distinct products available through online channels, creating a time series of online prices over the period from 2019 to 2023.

Using this data, we constructed an *'Online Channels Index' (OCI)* and compared each category of the OCI (e.g., clothing and footwear) to the corresponding sub-group of the ABS' Consumer Price Index (CPI). While the exact products in our baskets were not the same as the ABS', the categorisation, weighting and construction of the index was.[2]

Relevant literature

This approach extends on Goolsbee and Klenow (2018) *Internet Rising, Prices Falling: Measuring Inflation in a World of E-Commerce,* and Cavallo (2013) *Online and Official Price Indexes: Measuring Argentina's Inflation.*

2 Measuring the competition effect

Description

The competition effect represents the extent to which the expansion of online channels places downward pressure on prices quoted by offline channels. This effect is consistent with a Nash-Bertrand model of differentiated sellers with competition arising from entry or expansion.

Method

To investigate the competition effect, we estimated a Phillips curve model that includes online retail sales' share of total retail turnover in Australia as reported by the ABS.

Since web scraping only accounts for around 5% of the ABS's CPI, we regarded this index as a price measure for goods and services sold exclusively through offline channels.

Relevant literature

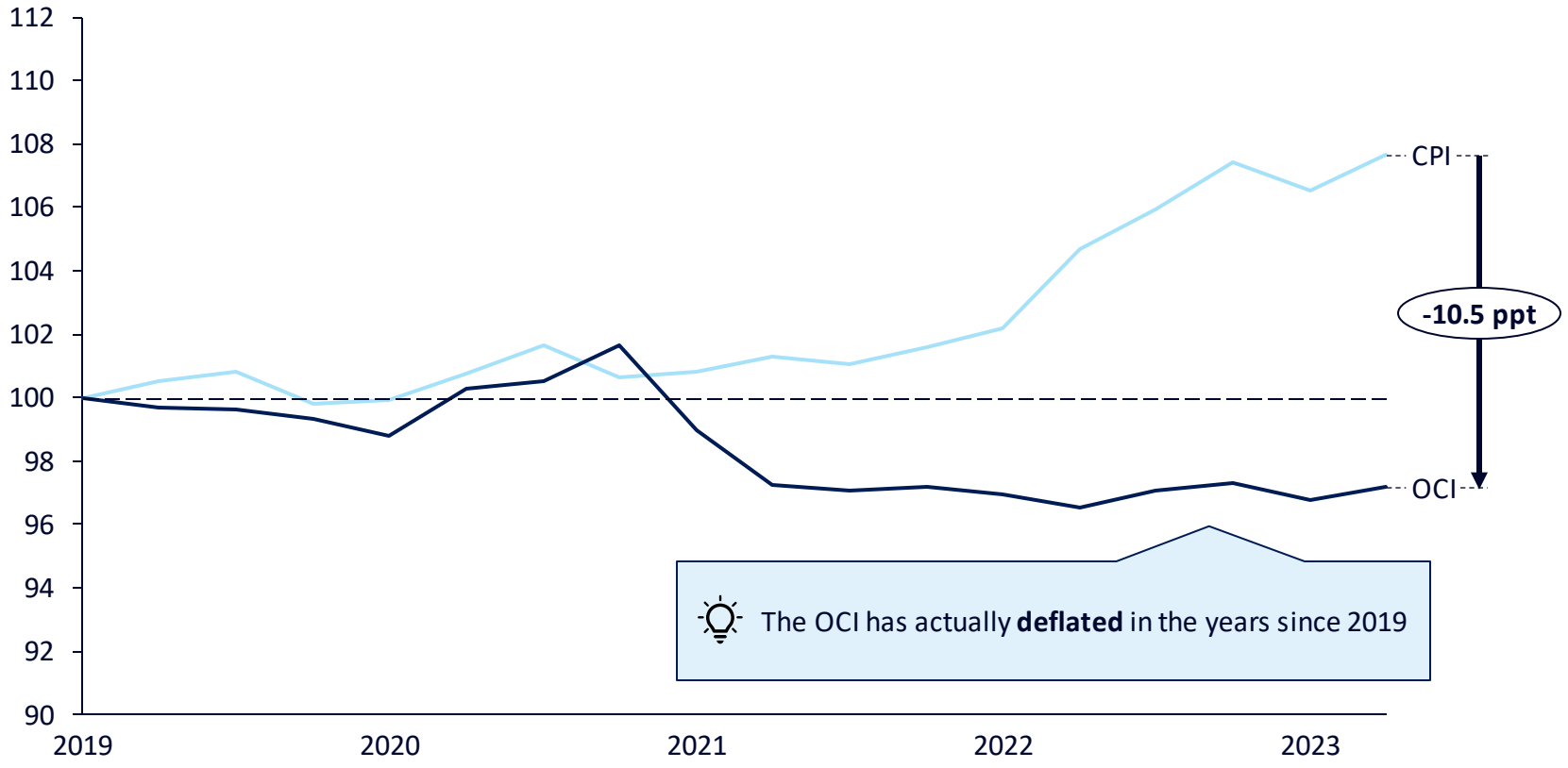
This approach is based on Csonto et al. (2019). *Is Digitalization Driving Domestic Inflation?* and Cavallo et al. (2022) *E-commerce During Covid: Stylized Facts from 47 Economies.*

1 See, e.g., Borenstein and Saloner (2001).
2 The categories of goods included in the OCI and CPI baskets were Recreation and culture, Furnishings and household equipment, Health, Clothing and footwear, and Communication. See ABS (2019) for more details.
Source: ABS (2020); Mandala analysis.

Estimating the cost-efficiency effect, we find that the OCI has fallen, while CPI has grown since the start of 2019

Cumulative price growth in the OCI versus CPI[1]

Index points, 100 = aggregate price level at start of 2019, 2019 – 2023



1 We used the same set of ABS expenditure classes to construct both our comparison CPI and the OCI. See appendix for details. Due to data availability, the price series for the OCI ends in Q2 2023. For the purposes of extrapolating the cost-efficiency effect in later sections, the difference between OCI and CPI is conservatively assumed to remain at this level for the remainder of 2023.
2 The categories of goods included in the OCI and CPI baskets were Recreation and culture, Furnishings and household equipment, Health, Clothing and footwear, and Communication. See ABS (2019) for more details.
Source: ABS (2023B); Data obtained for Mandala by Purpose Bureau; Mandala analysis.

Comparing the OCI to CPI, we find that the OCI has grown 10.5 percentage points less than CPI since 2019 for comparable categories of goods.[2] This suggests that products that are available via online channels experience lower price growth than similar goods that are strictly sold through offline channels.

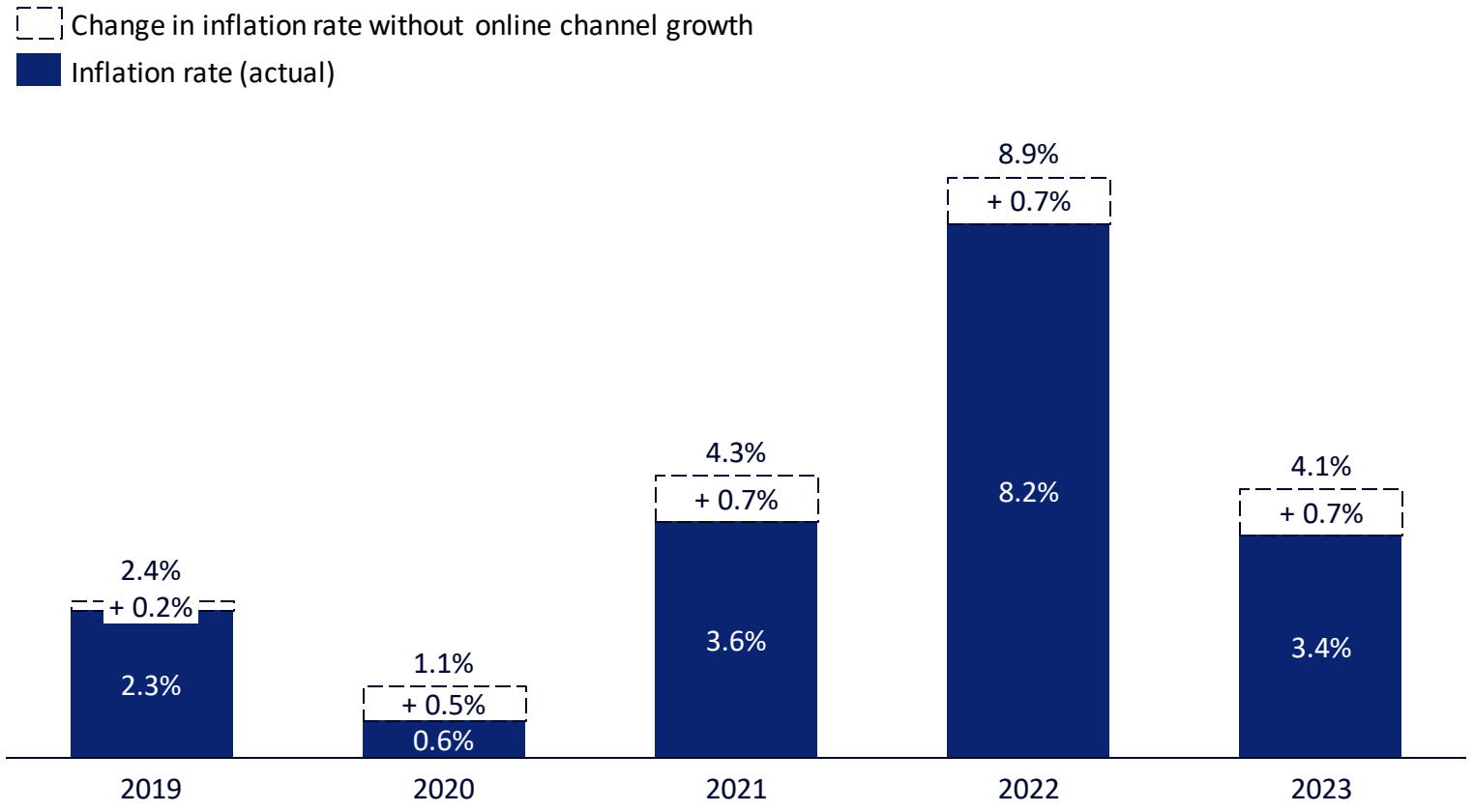
This does not mean that an identical product (e.g., t-shirt A) sold online and offline will be cheaper through an online channel. Cavallo (2017) finds that for specific products, prices on offline channels generally match those that are quoted online. Rather, it means that t-shirt A, which is sold both online and offline, will likely be cheaper than an otherwise similar t-shirt B, that is only sold offline.

The comparison of the OCI and CPI aligns closely with the findings of Ambrosetti (2023), which conducts a similar analysis in Italy, comparing price indices from 2020 to 2023. At the end of the sample period, Ambrosetti (2023) finds that goods sold through online channels were 8.8% cheaper than those sold through offline channels.

For the competition effect, we find that annual inflation was 0.7 percentage points lower due to competitive pressures from growth in online channels

Actual inflation versus counterfactual inflation[1]

Percentage change in CPI in twelve months to December, 2019 – 2023



1 Inflation figures are based on the December figure from the ABS' monthly inflation series, differing minorly from the traditional quarterly figures. Use of the higher frequency monthly series was essential for modelling purposes.
2 The assumptions of this model ties competition benefits to growth in online channels. It is likely that the static presence of competition from online channels (without relative growth) is likely sufficient in generating such benefits in and of itself. As such, this model may underestimate the size of the competition effect.
Source: ABS (2023C, 2023E); loans.com.au (2023); Mandala analysis.

By estimating the impact of online channels on inflation, we constructed a counterfactual measure of CPI, based on a world in which online channels did not expand beyond their level at the start of 2019.

In doing so, we estimate that in the absence of competitive pressure from online channels, inflation would have peaked at 8.9% in December 2022, 0.7 percentage points higher than the actual peak of 8.2%.[2]

Typically, lower inflation also means lower interest rates. Using a computable general equilibrium model calibrated to the Australian economy, we estimate that interest rates may have been up to 0.5 percentage points higher in the absence of the efficiency and competition effects of online retail channels. On an average owner-occupier mortgage of $585,000, this interest rate effect translates to up to $2,925 in saved annual interest repayments. Since this constitutes a second-order economic effect, we exclude this from the household savings calculation in Section 4 to be conservative.

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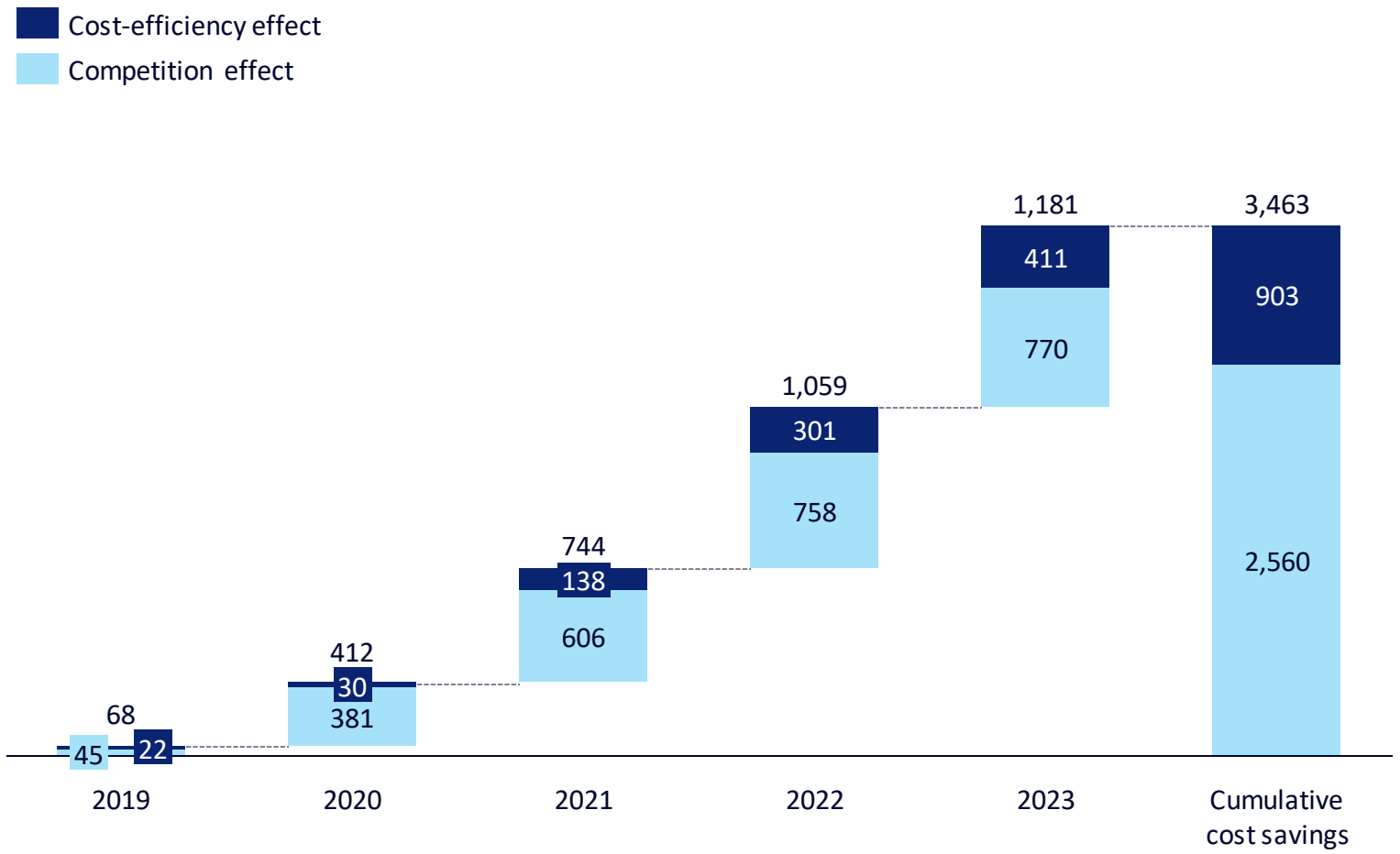
Households have saved nearly $3,500 since 2019 thanks to the price effects of online channels

Average household cost saving due to online channels

$, 2019-2023[1]



1 All dollar figures in this section have been converted to constant 2023 prices.
Source: ABS (2022B); Data obtained for Mandala by Purpose Bureau; Mandala analysis.

By analysing the annual expenditure of average Australian households by category, the cost-efficiency and competition effects of online channels can be translated into annual cost savings.

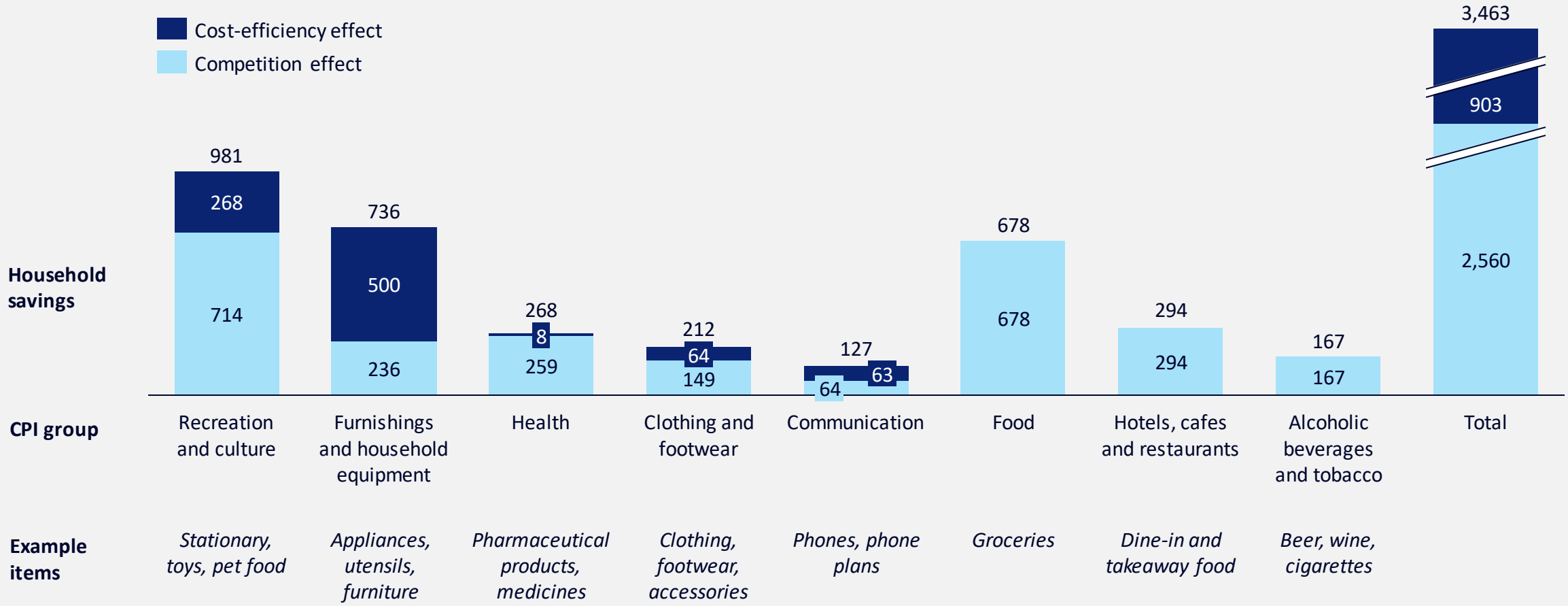
Since 2019, the price effects of growth in online channels have driven an estimated $3,463 in cumulative cost savings for the average household. These savings do not incorporate second-order benefits from reduced prices such as lower interest rates and subsequent savings on interest repayments. Even without counting this additional benefit, these cost savings are equivalent to receiving 3 weeks' worth of groceries for free each year, since 2019.

Such savings represent a significant and timely benefit when cost-of-living pressures have impacted households across Australia.

These cost savings were largest for recreation and culture, where households have saved nearly $1,000 in the last 5 years

Cumulative average household cost saving due to online channels

$, 2019-2023 (cumulative)

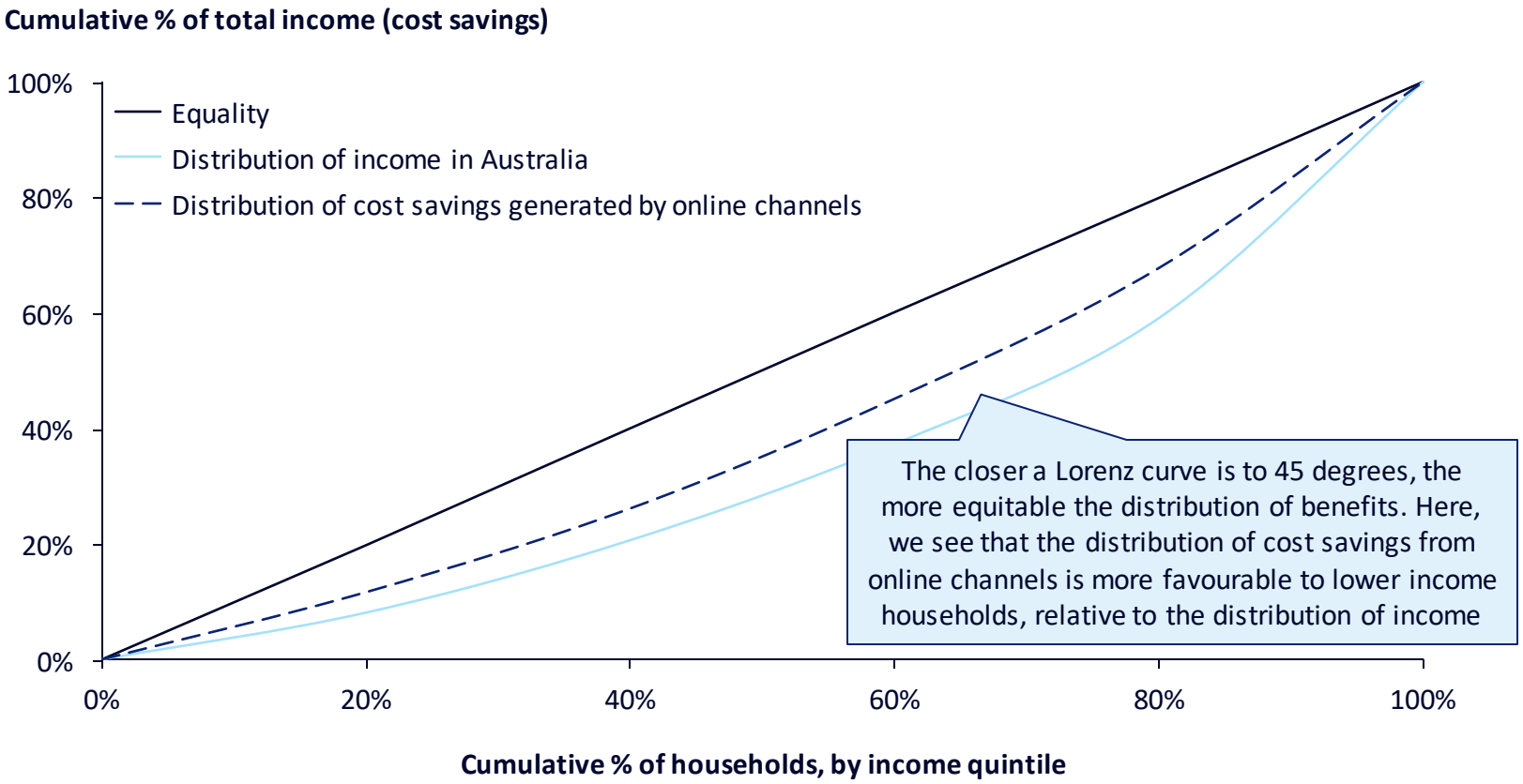


Notes: We assumed parity between online and offline prices for Food; Alcoholic beverages and tobacco; and Hotels, cafes and restaurants throughout the sample period as we did not observe online prices for these groups.
Source: ABS (2022B); Data obtained for Mandala by Purpose Bureau; Mandala analysis.

All Australians benefited from online channels, but the cost savings generated by online channels delivered more benefits to households on lower incomes

Lorenz curve of the distribution of cost savings relative to the distribution of income

%, based on cumulative cost savings from online channels and disposable household income[2]



1 Wood, Chan and Coates (2023).
2 For each income quintile, a point on the Lorenz curve is calculated as the cost savings (or household income) that is attributable to that quintile, as a share of the total cost savings (or total household income). For example, the bottom 20% of households received around 12% of the cost savings, but earn around 8% of total income. This forms the Y-axis point for each Lorenz curve at the 20% mark. The Gini coefficient can then be calculated as the area between a Lorenz curve and the equality line, divided by the total area under the equality line. A lower coefficient indicates a more equitable distribution.
Source: ABS (2022A, 2022B); Data obtained for Mandala by Purpose Bureau; Mandala analysis.

Periods of high inflation disproportionately impact lower income households. Not only do these households have less ability to reduce discretionary spending, eat into savings, or draw down on assets to insure against rising cost-of-living, they also spend more on consumption as a share of their disposable income.[1]

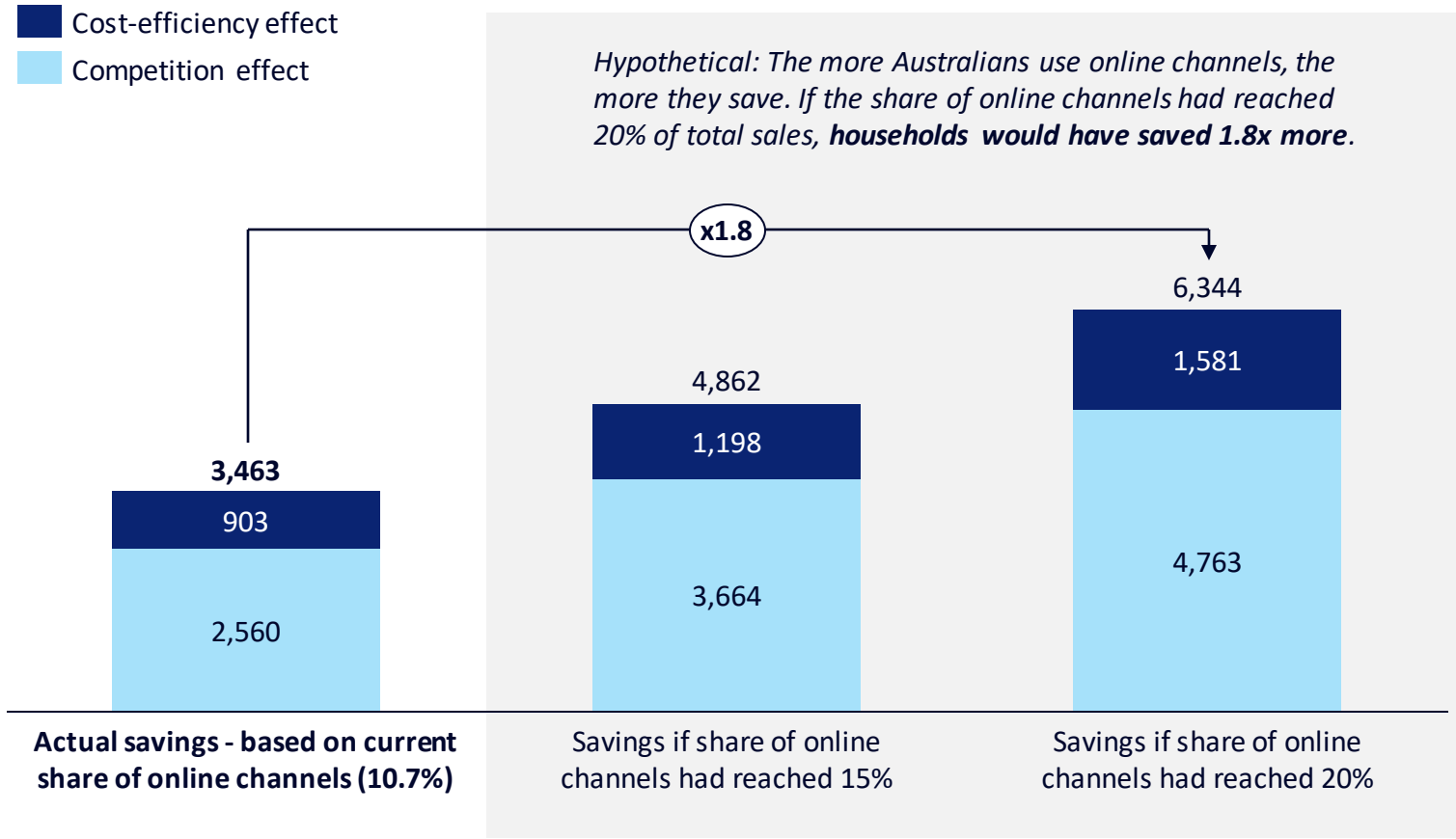
This is evident when comparing estimated cost savings of Australian households, where the lowest income quintile of households saved nearly double that of the highest income quintile, relative to their annual disposable income.

This effect is captured by the lower Gini coefficient of 0.20 that can be calculated on the distribution of cost savings, relative to the 0.30 that relates to Australia's distribution of income. A lower Gini coefficient indicates a greater degree of equality. Global leaders like Norway have a Gini coefficient on household income of around 0.23.

The more Australians use online channels, the more they save

Total household savings from 2019-2023, by online channel scenario

$, household savings from 2019-2023 (cumulative), by online channel scenario



Source: ABS (2022B); Data obtained for Mandala by Purpose Bureau; Mandala analysis.

Only 10.7% of Australian retail sales were through online channels in 2023. The more that Australian consumers use online channels, the more they save through both cost-efficiency and competition effects.

Modelling this hypothetical scenario, if 20% of retail sales were through online channels instead of 10.7%, cumulative household cost savings thanks to online channels would have been 1.8x higher, rising to $6,344 per household.

Government policies that support a competitive retail sector through both online and offline channels will continue to facilitate the growth of consumer choice and cost savings for Australian households.

In recent years, these benefits have already had major impacts on households during a period of high inflation and can continue to support a stronger, more resilient Australian economy.

A

Cost-efficiency effect: Constructing the Online Channels Index for Australia

B

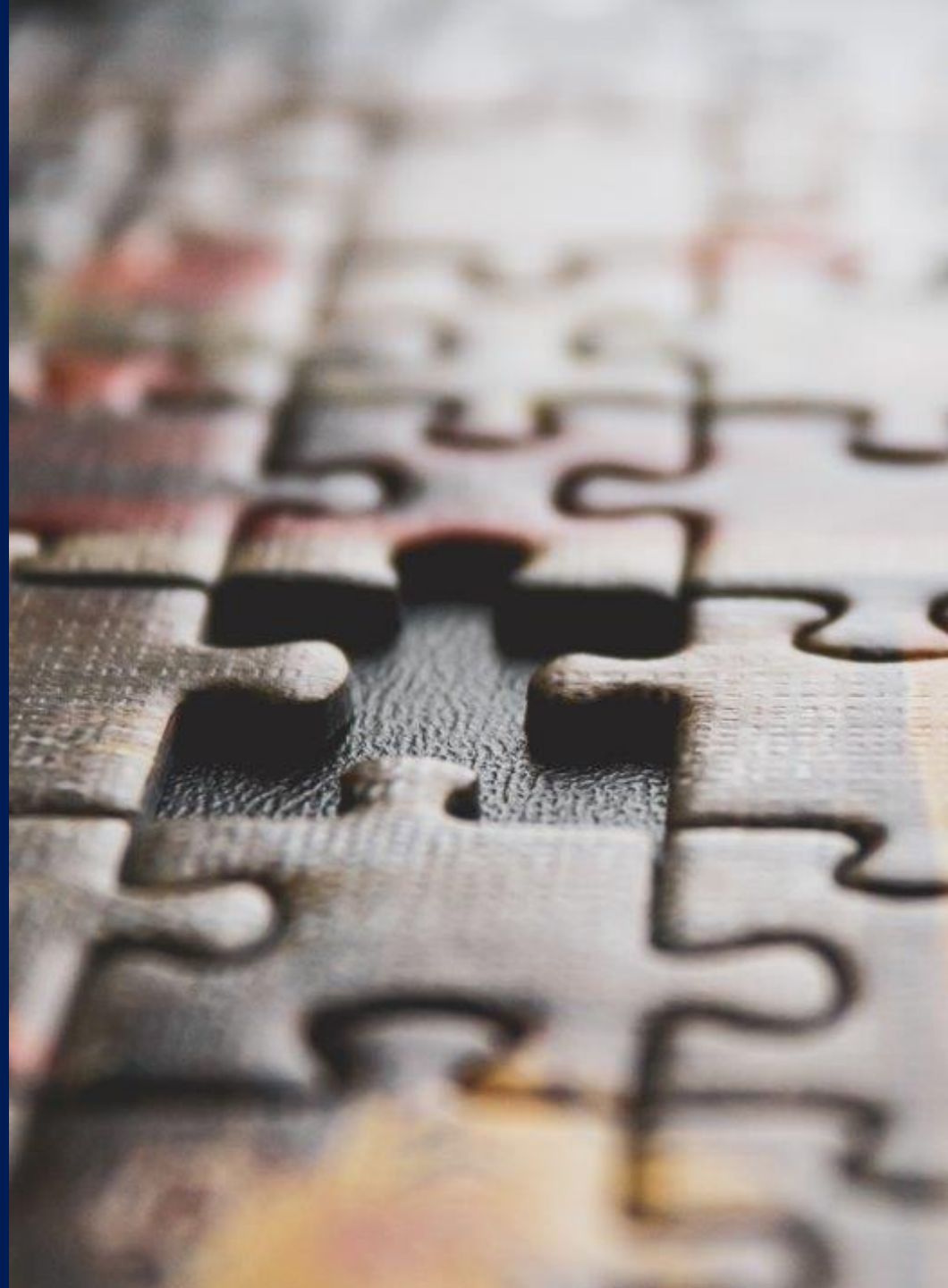
Competition effect: Estimating the effect of online channels on inflation

C

Estimating household cost savings due to online channels

D

Literature review



Cost-efficiency effect: Constructing an Online Channels Index for Australia

Our approach to constructing an 'Online Channels Index' (OCI) is based on Cavallo (2013), with adjustments made to achieve consistency with the Australian Bureau of Statistics (ABS)'s group, sub-group, expenditure class and elementary aggregate taxonomy, and general weighting methods. A detailed methodology to the ABS' approach to constructing CPI can be found at ABS (2019). The cost-efficiency effect was then derived by comparing price growth in the OCI to the comparable measure of CPI from 2019-2023.

Prices for individual items from 2019-2023 were scraped from the Australian websites of selected online retailers, market shares for elementary aggregates were derived from Statista (2023), and CPI expenditure class weights were sourced from ABS (2022). Item prices, market shares and CPI weights were all recorded on a quarterly basis. Our online channels basket includes such expenditure classes as *Garments for men*, *Books*, *Personal care products*, and *Major household appliances.* Our procedure consisted of the following steps:

Step 1: Calculate average price changes at each point in time for each elementary aggregate

Obtain the unweighted geometric average of price changes in each elementary aggregate a, expenditure class c and quarter t:

$$R_{t,t-1}^{c,a} = \prod_{i \in N_{c,a,t}} \left(\frac{p_t^i}{p_{t-1}^i} \right)^{\frac{1}{|N_{c,a,t}|}}$$

where p_t^i is the price of item i at time t, and $N_{c,a,t}$ is the set of items in elementary aggregate a of expenditure class c that are present in the sample at t.

Step 2: Convert price changes into cumulative price indexes for each elementary aggregate

Compute elementary aggregate-level indexes at t

$$I_t^{c,a} = R_{1,0}^{c,a} R_{2,1}^{c,a} \dots R_{t,t-1}^{c,a}$$

Step 3: Merge elementary aggregate level indexes into broader, expenditure class indexes

Compute the weighted arithmetic average of elementary aggregate-level indexes within a given expenditure class c at t to compute expenditure class-level indexes

$$J_t^c = \sum_{a \in A_c} m_t^{c,a} I_t^{c,a}$$

where $m_t^{c,a}$ is the market share for elementary aggregate a at t in the market for expenditure class c, and A_c is the set of elementary aggregates in expenditure class c.

Step 4: Merge expenditure class indexes into a holistic OCI

The OCI is the weighted arithmetic average of all expenditure class indexes

$$D_t = \sum_{c \in C_{OCI}} \frac{w_t^c}{W_t} J_t^c$$

where w_t^c is the official CPI weight for expenditure class c at t and W_t is the sum of all the weights at t included in C_{OCI}, the set of 'online' expenditure classes.

Source: Mandala analysis.

Competition effect: Estimating the effect of competition from online channels on aggregate inflation

Estimating the competition effect of online channels on offline channels was conducted over two stages. First, we used a Phillips curve model to estimate the marginal effect of an increase in online channel market share on the ABS' CPI. We then applied the results of this regression to chart a counterfactual measure of CPI under a scenario where online channel market share did not grow beyond 2019 levels.

Estimating the competition effect

Our Philips curve model was specified as follows:

$$\pi_t = \delta_1^b \pi_{t-1} + \delta_2^f E_t \pi_{t+1} + \delta_3^g Y_t^{gap} + \beta_1^{Online} \log(ORS_t) + \theta_1^{food} FOOD_{t-1} + \varepsilon_t,$$ where:

- π_t is year-over-year inflation (ABS),
- π_{t+1} is inflation expectations (Melbourne Institute),
- ORS_t is online channel share of retail turnover (ABS) (our proxy for online channel competition),
- Y_t^{gap} is the unemployment gap, calculated as the ratio of the difference between unemployment (ABS) and a HP filter series with λ=129,600 and the filtered series,
- $FOOD_t$ is a global food price index (World Bank).

We found that the estimate $\hat{\beta}_1^{Online} = -1.17$ is statistically significant at the 1% level. Given the linear-log specification, we concluded that a 1% increase in online channel share leads to a $\frac{\hat{\beta}_1^{Online}}{100} = -0.017$ percentage point increase in CPI inflation.

Charting a counterfactual inflation series

Modelling CPI inflation in a counterfactual world that lacks online channels, our counterfactual series was computed as

$$CPI_t^C = CPI_{t-12}^C \, e^{\pi_t^C/100},$$

where counterfactual inflation was computed as

$$\pi_t^C = \pi_{t-1}^C + \left(\Delta\pi_t - \hat{\beta}_1^{Online} \ln(\Delta ORS_t)\right), \text{ and}$$

$CPI_{t-12}^C = CPI_{t-12}$ for the months of 2018.

It was assumed that $\hat{\beta}_1^{Online}$ operates in each month from January 2019.

Notes: For the hypothetical scenarios where the market share of online channels reaches 15% and 20% of the total retail market by 2023, a hypothetical series of online channel market share was constructed for each case. These series were indexed to the relative changes of the actual online channel sales share but were extrapolated such that this share reached 15% (or 20%) by the end of 2023.
Source: Mandala analysis.

Estimating household cost savings due to online channels

The calculation of household cost savings derived from the availability of online channels was apportioned into a two-by-two matrix of mutually exclusive, collectively exhaustive components. From 2019 to 2023, households consumed via both online and offline channels. In the absence of online channels over this period, households would have lost access to the price benefits generated by both the cost-efficiency and competition effects. As such, for each category of household expenditure, i, total household cost savings derived from online channels can be computed as the sum of the following components:

	Savings from online household consumption	Savings from offline household consumption
Cost-efficiency effect	$(1)\ \ HH\ Spending_i^{Online} * \left(e^{-A_i(1+\varepsilon)} - 1\right)$	(2) 0, since we attribute all cost-efficiency effects to online household consumption
Competition effect	$(3)\ \ HH\ Spending_i^{Online} * \left(e^{-(A_i+B_i)*(1+\varepsilon)} - 1\right) - (1)$	$(4)\ \ HH\ Spending_i^{Offline} * \left(e^{-B_i*(1+\varepsilon)-1}\right)$

Where:

- $HH\ Spending_i^{Online}$ = the share of online in total household spending
- $A_i = \ln\left(\frac{ORI_i}{CPI_i^{Actual}}\right)$, the difference between online and offline prices; and
- ε = the price elasticity of consumers, assumed to be -0.2[1]
- $B_i = \ln\left(\frac{CPI_i^{Actual}}{CPI_i^{Counterfactual}}\right)$, the difference between actual and counterfactual CPI
- $HH\ Spending_i^{Offline} = 1 - HH\ Spending_i^{Online}$

The cost-efficiency effect can then be computed as ***(1) + (2),*** the competition effect as ***(3) + (4),*** and the total effect as ***(1) + (2) + (3) + (4)***.

1 This assumption is based on recent price elasticity estimates for food (Hasan and Sinning, 2017), petrol (Breunig and Gisz, 2008), and electricity (Conway and Prentice, 2019) in Australia.
Source: Mandala analysis.

Literature review: There are two branches of academic literature on the impact of online channels on prices, with empirical evidence supporting a downwards effect

There are two bodies of literature that look at the effect of online channels on prices:

This study seeks to estimate the **price level effect** of online channels in Australia

Branch of literature	Description	Key papers
Price level effects	Economic literature suggests that there are **two ways** in which online channels can put downwards pressure on prices (European Central Bank, 2015) *Cost-efficiency effect:* Lower online prices derived from **cost savings** online channels make by streamlining distribution and avoiding the burden of brick-and-mortar stores. *Competition effect:* Lower offline prices derived from **increased competition among retailers**, facilitated by lower search costs and price transparency enabled by the internet.	The empirical literature does not differentiate between these two channels. **Goolsbee and Knelow (2018)** construct a digital price index (DPI) to estimate online inflation. They find that DPI ends up 4% lower than CPI for the same categories from 2014-2017. **The European House - Ambrosetti (2023)** constructs an online basket of goods in Italy and finds that it finishes 8% lower than CPI for the same categories from 2020-2023. **The European House - Ambrosetti (2023)** suggests that an increase of one percentage point in the diffusion of online retail generates a reduction in inflation by 0.02 percentage points, and that in the last six years, inflation has been about 5% lower than it would have been without such an effect.
Price dynamics	Many empirical researchers have also analysed the broader **price dynamics** of online channels in the broader retail market, rather than specific price level effects.	**Cavallo (2018)** and **Gorodnichenko and Talavera (2018)** look at price flexibility among online and offline retailers. **Cavallo et al. (2014), Cavallo (2017), Ater and Rigbi (2018), Cavallo (2018)** and **Jo et al. (2019)** analyse uniform pricing among online, multi-channel and offline retailers. **Cavallo (2018)** shows that when combined, these pricing behaviours make prices quoted by retailers more sensitive to aggregate nationwide shocks, such as changes in gas prices or fluctuations in nominal exchange rates.

Source: Mandala analysis.

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