Australia Post
Domestic Letter Volume Demand Update

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Prepared for:

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Note

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Diversified Specifics updated econometric demand analysis of each key domestic letter volume segment at Australia Post attempts to explain letter volume fluctuations using a statistically valid framework. Baseline projections are also generated over the 2018/19 to 2021/22 time frame utilising the preferred models and data up until June 2018.

1. Recent trends: post-GFC letter drivers are electronic substitution and, to a lesser extent, price.

The global financial crisis (GFC) marked a fundamental change in letter volume demand for Australia Post. As illustrated in Table 1, all letter volume segments have registered strong declines since 2007/08; these declines intensified during 2016/17 and 2017/18. The econometric models apportion this accelerated decline to increased rates of electronic substitution and the lagged impact of a 30 cent rise in the basic postage rate in January 2016.

Table 1: Historical percentage change in key domestic letter volume segments.

Letter volume segment	2016/17 % change	2017/18 % change	Average annual % change	
			2000/01 to 2007/08	2007/08 to 2016/17
Other (Ordinary) Small	-18.8	-10.2	-1.7	-9.9
PreSort Small	-7.5	-10.3	2.7	-4.8
Other (Ordinary) Large	-13.8	-15.2	1.0	-9.4
PreSort Large	-25.3	-25.1	2.2	-12.0
Print Post	-10.6	-9.9	N/A	-5.8

In 2017/18 the declines in the large letter segments were largely reflective of the previous year. In the small letter segments however, the Other (Ordinary) reductions decelerated over the past year as opposed to an acceleration in its PreSort counterpart.

Indeed, 2017/18 represents the first year where the annual percentage declines in PreSort small letter volumes exceed those of the Other small letter segment. This result may indicate

1) a levelling of bill payment type electronic substitution as traditional modes of bill payments via the letter such as cheque volumes have largely already been eroded; and

2) an acceleration in the presentation of bills and statements via non-letter based platforms as online bill presentment platforms appear and achieve increased rates of penetration.

Because one year of data represents a very small sample size such movements away from the long run trends are not yet considered conclusive.

Moreover, the econometric models employ a tendency for mean reversion so one year of data does not provide grounds for extrapolation to the projections generated. These very recent trends should however be monitored closely in future updates.

2. Pricing: the proposed price changes are considerably lower than those of January 2016.

The proposed letter volume price changes are part of the complete set of model inputs used in the projection process to reflect the changes in individual price points as provided by Australia Post. The proposed changes are presented in Table B.2.2 of Appendix B in the source documentation. To generate the projected price estimates to June 2022, each of the pricing input changes across the projection horizon were weighted according to 2017/18 volume proportions. These weighted letter price changes for the proposed (and most recent actual) changes to letter price are presented in Table 2.

Table 2: Projection horizon actual, proposed and hypothetical weighted letter price changes across the key domestic letter volume segments (%). *

		Small		*Large*		
		Other	**PreSort**	**Other**	**PreSort**	**Print Post**
Actual	**October 2018**	0.4	1.2	0.6	2.3	5.6
Proposed	**January 2020**	7.2	5.9	6.8	4.2	4.0

* Volume weightings as per 2017/18 proportions have been applied to all price change inputs across the entire projection horizon as provided by Australia Post.

There will always be a period of uncertainty as to how letter volumes will respond in the long-run when there is a major variation in one of the key letter volume drivers as has occurred with the letter price increases of January 2016.

This is especially true where there is no observed historical data throughout the time frame over which the econometric models have been developed relating to previous price changes of this magnitude. The full extent of the impact of the 2016 price increases on letter volumes will therefore be clearer in future years given a longer time frame.

3. Projecting: inelastic prices result in volume projections dominated by anticipated substitution.

The econometric models were used to generate a set of projections for each of the key letter volume segments. These letter volume projections are shown in Table 3. Given the minor changes in letter price across 2018/19, the projections contained within Table 3 reinforce the assertion that the key factor driving down letter volumes can be attributed to the forces of electronic substitution.

All price elasticities of demand are estimated as inelastic. A comparison with the price elasticities estimated by Diversified Specifics in 2014 is presented in Table 4.

Table 3: Projected changes in key domestic letter volumes (%).

	Small Letters		*Large Letters*		
	Other	**PreSort**	**Other**	**PreSort**	**Print Post**
With Price Increases					
2018/19	-8.2	-10.0	-10.1	-7.0	-7.1
2019/20	-10.1	-8.5	-7.6	-10.5	-8.7
2020/21	-12.0	-8.7	-7.3	-13.1	-8.8
2021/22	-10.8	-7.4	-6.2	-14.3	-6.6

Table 4: Estimated price elasticities for key domestic letter volumes now versus previous (%).

	Small Letters		*Large Letters*		
	Other	**PreSort**	**Other**	**PreSort**	**Print Post**
Current models (data to June 2018)	-0.42	-0.24*	-0.60	N/A^ (-.40)	-0.34
Previous Models (data to September 2014)	-0.41	-0.35*	-0.78	N/A^	N/A+

* Denotes elasticities from dynamic ordinary least squares estimated models.
^ Denotes the absence of a statistically significant price elasticity estimate within the final preferred model (Statistically insignificant parameter in parentheses).
+ Denotes this letter volume product segment was not modeled in the previous research.

4. Conclusion: in the long-run, letter volume declines will largely reflect the trend of electronic substitution.

All econometric models developed in this research underline the importance of electronic substitution as the key driver of accelerated letter volume declines in recent years.

They also highlight the significant impact of the GFC in changing the business communications landscape, with organisations gradually moving to minimise their transaction costs which is inclusive of mail related spend in an environment where their own sales growth stagnated.

The development and penetration of an ever-expanding range of electronic communication platforms has resulted in a strong and sustained movement away from the traditional letter item. While recent price increases have had an impact, the price elasticities of demand remain robustly inelastic and the dominant negative force remains the influence of digital substitution.

In a time of rapid technological change, projections generated from econometric models derived using empirical data can quickly become obsolete as they only infer the impact of electronic substitution at a similar pace to that observed historically. They are also a function of the prevailing technological landscape which limits the extent to which future changes in digital capabilities can be accounted for.

The econometric letter volume projections must therefore be considered baseline estimates and only represent part of the entire forecasting task. They must be augmented by very recent and institutional intelligence to mitigate the projection errors that quickly become apparent when rapid technological change occurs.

For further detail please consult the source documentation.

1. INTRODUCTION

1.1 OVERVIEW

The task of projecting letter volume fluctuations at Australia Post is in its most challenging phase to date. After decades of prosperous growth, the traditional letter item is facing a combination of forces that continue to erode its remaining volume.[1]

Since the 2007/08 GFC electronic alternatives to paper-based mail items have driven down letter volumes at an accelerating rate. The forces eroding volumes have caused revenue from the letters business to decline; however, the number of delivery points across the postal network has continued to grow.

In response, Australia Post has made significant reforms that include changes to its letter delivery timetable in addition to a January 2016 increase in the basic postage rate by 30 cents. In combination, these reforms have assisted Australia Post in ensuring the cost of servicing its physical network could be met.[2]

In this report, Diversified Specifics draws upon its 18 plus year involvement in postal demand research in Australia and other countries to present an updated set of econometric models aimed at explaining recent volume movements across each of the key domestic letter segments.[3]

These models are then used to construct baseline projections of segmented letter volumes over a timeline from 2018/19 to 2021/22.

Differing scenarios underpin the projections generated, depending on the inclusion or exclusion of changes to letter service prices as supplied by Australia Post.

The findings suggest that even if the letter price increases are excluded, the dominant statistical driver of postal volumes in recent times – electronic substitution – ensures letter volume declines will continue unabated throughout the projection period.

This report documents Diversified Specifics' econometric process. It is a summary of how the demand for domestic letters within the Australian postal industry has responded to an intense period of technological change, recent postal price rises and the global financial crisis in 2007/08.

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[1] There has been a change in notation from previous documentation developed by Diversified Specifics. As a more accurate reflection of Diversified Specifics process, the term '*projection*' rather than '*forecast*' is used to emphasise a methodology that projects forward historical trends econometrically. Any forecast of future letter volumes must augment the baseline projections by incorporating off model market and industry-based intelligence on recently emerging trends or future events that the econometric process does not completely recognize.

[2] Related letter service rates also increased in January 2016. A complete discussion of the scope of the price rises can be found in ACCC 2015 (see bibliography).

[3] The vector error correction technique nests the structural and cyclical components of letter volume trends into a methodology that allows an examination of short and long-run fluctuations of letter volumes and their relevant drivers. Dynamic ordinary least squares techniques are also employed to improve the precision of the long-run parameter estimates for some letter segments as a result of data availability or the presence of structural breaks.

As with any econometric study, all projections generated rely primarily on historical trends. In a constantly evolving environment, the extent to which the past is an appropriate indicator of future trends must always be evaluated. Sections 2.3.2 and 2.4.2 outline a range of techniques utilised to ensure the robustness of the projections regarding electronic substitution and letter volumes respectively within this research.

As a result, interpretations of the econometric projections in this report must be treated with all due care. Further amendments based on sound institutional knowledge must be continually considered.[4]

Structure of this report

Section 1 contains this introduction, which outlines the broad scope of the research effort. Section 2 focuses on trends in Australia Post's reserved letter segments, where the recent volume declines are illustrated. It also contains an examination of how the variables and projections on each of the statistically significant letter volume drivers were compiled throughout the statistical process.

Sections 3 to 7 contain individual summaries of the descriptive statistics, elasticities and projections for the five key reserved letter segments identified. Section 8 contains the concluding remarks. The Appendices section outlines the various techniques and statistical outputs generated throughout the research.

[4] Caveats on the econometric projections derived within this research can be found in Appendix D.

2. RECENT TRENDS

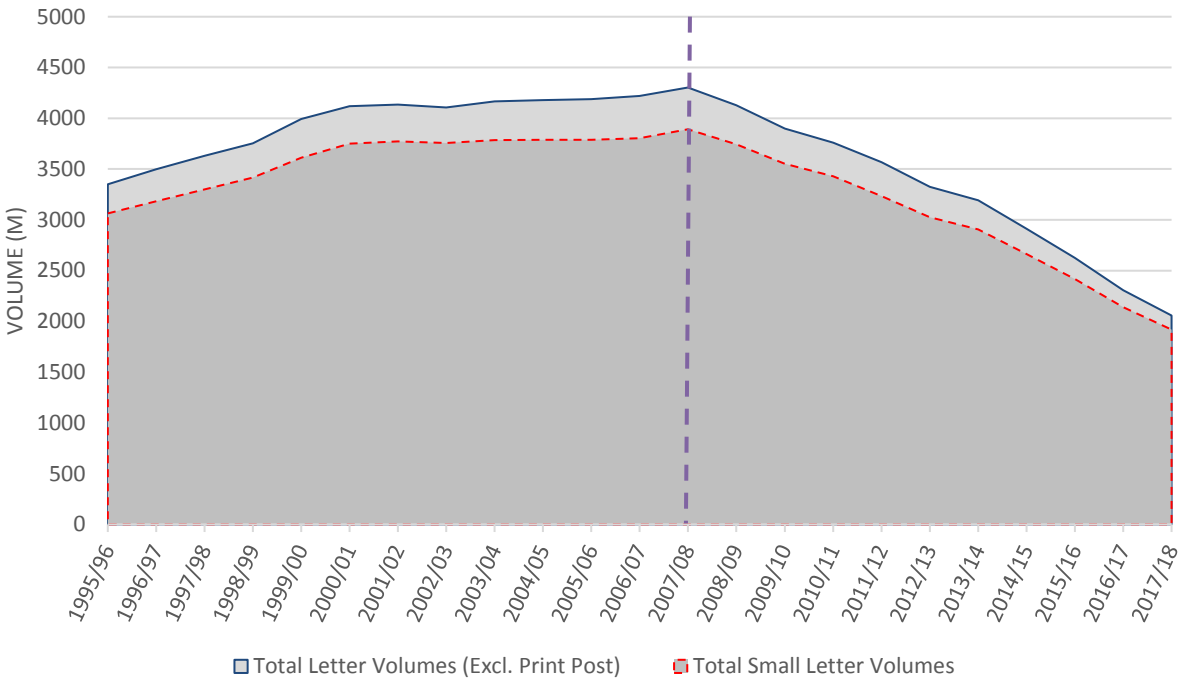
2.1 SEGMENTED LETTER VOLUME GROWTH

Total letter volume trends at Australia Post since the mid-1990s can be broadly divided into two distinct time periods.

1. In the period before 2007/08 (see Chart 2.1.1) Australia Post experienced letter volume growth, largely explained by the strong annual increases in traditional paper-based bills and statement-type letter volumes observed within the PreSort small letter segment.

Chart 2.1.1: Total letter volumes since July 1995 (Annual).

------ Denotes the onset of the global financial crisis



This was also a period of strong economic growth, with a robust association between total letter volume movements and fluctuations in GDP. Reinforcing this correlation, there was an increasing take-up of mobile phones, credit cards, bank accounts, etc., that were each accompanied by an additional set of bills and/or statements – all delivered to account holders by Australia Post.

This trend offset any declines on the bill payments side of a typical transaction, where customers had already begun to accept an online relationship with the biller.[5]

[5] This research report focuses on more recent periods. An expanded discussion on the nature of bill presentment growth and bill payment type substitution in the late 1990s can be found in Paterson 2008 and Diversified Specifics 2013 (see bibliography).

2. After the global financial crisis of 2007/08, letter volumes at Australia Post recorded accelerated declines across all key segments as the use of electronic substitutes became ubiquitous.

Australian firms profit margins began to contract during the economic slowdown and businesses increased their focus on minimising transaction costs (the costs of doing business).

In many cases, posting a physical letter was deemed as one such transaction cost that could be reduced or eliminated, especially when compared with the perceived near-zero marginal cost of communicating a message electronically.

This post-2007/08 trend, highlighted in Table 2.1.1, emphasises how digital substitution has become increasingly challenging across all key letter segments.[6]

Table 2.1.1: Historical percentage change in key domestic letter volume segments.

Australia Post letter volume segment	2017/18 % change	Average annual % change	
		2000/01 to 2007/08	2007/08 to 2016/17
Other (Ordinary) small	-10.2	-1.7	-9.9
PreSort small	-10.3	2.7	-4.8
Other (Ordinary) large	-15.2	1.0	-9.4
PreSort large	-25.1	2.2	-12.0
Print Post	-9.9	N/A	-5.8

It is the post-GFC period of sustained letter volume decline that the econometric techniques used in this research primarily attempt to capture and project forward.

Each of the key letter volume segments identified in Table 2.1.1 represents an aggregation of individual letter services provided by Australia Post. Table 2.1.2 lists the product-level letter services contained within the broad aggregations.

[6] The declines cannot be entirely attributed to electronic substitution. Another element contributing to decreasing letter volumes occurred because of consolidation and rationalisation practices that led senders to decrease their exposure to mail. Such strategies do not necessarily imply a substitution away from mail *per se*, but rather an attempt by organisations to influence their cost base to maintain profit margins.

Table 2.1.2: Components of the key domestic letter volumes segments as used in the econometric modelling.

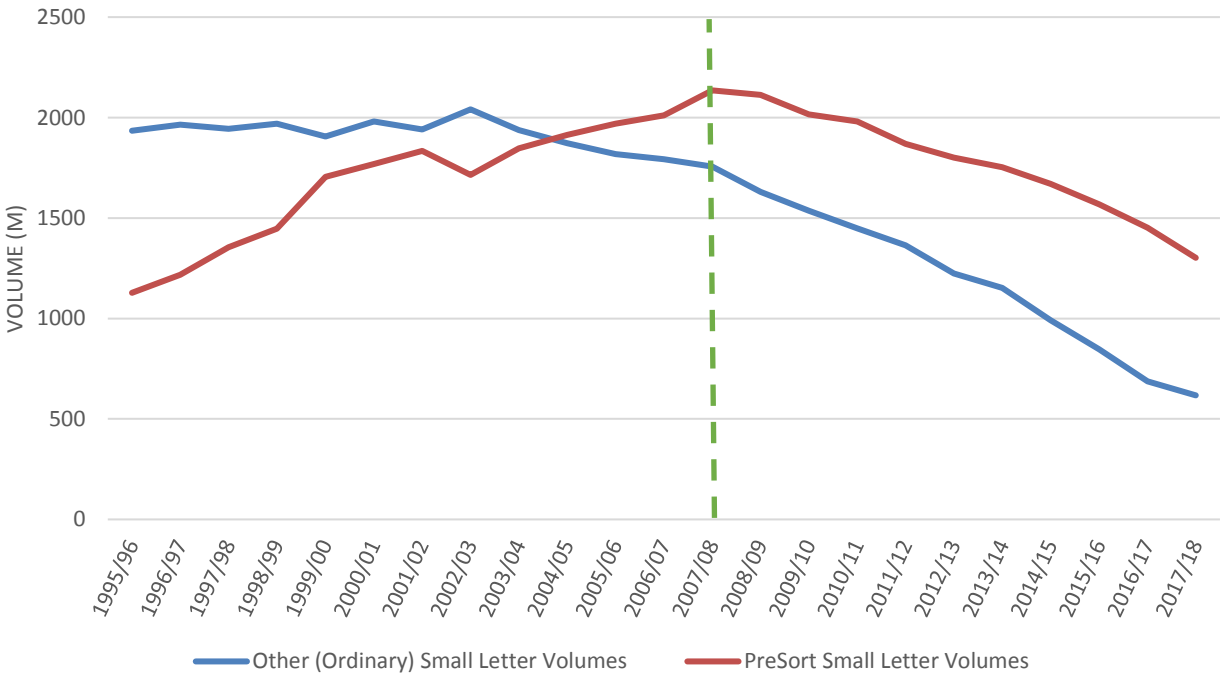
Small letter product categories		Large letter product categories	
Other (Ordinary)	**PreSort**	**Other (Ordinary)**	**PreSort**
Ordinary Stamped Regular	PreSort Regular	Metered Imprint Charge 0-250g Regular	PreSort Medium Regular
Ordinary Stamped Priority	PreSort Priority	Metered Imprint Charge 0-250g Priority	PreSort Large 0-250g Regular
Local Rate Regular	Charity Mail Priority	Metered Imprint Charge 250-500g Regular	PreSort Small Plus Regular
Local Rate Priority	Charity Mail Regular	Metered Imprint Charge 250-500g Priority	PreSort Large 250-500g Regular
Metered Imprint Charge Regular	Promo Post Regular	Imprint Cash 0-250g Regular	PreSort Small Plus Priority
Metered Imprint Charge Priority	Promo Post Priority	Imprint Cash 0-250g Priority	PreSort Large 0-250g Priority
Clean Regular		Imprint Cash 250-500g Regular	PreSort Medium Priority
Clean Priority		Imprint Cash 250-500g Priority	PreSort Large 250-500g Priority
Reply Paid Regular		Ordinary Stamped 0-250g	**Print Post**
Reply Paid Priority		Ordinary Stamped 0-250g Priority	Print Post Standard Size
Imprint Cash Regular		Ordinary Stamped 250-500g	Print Post < 500g
Imprint Cash Priority		Ordinary Stamped 250-500g Priority	Print Post > 500g
Ordinary Prepaid Envelope Regular		Local Rate Regular and Priority	
		Clean Small Plus Regular and Priority	
		Reply Paid Regular and Priority	
		Ordinary Prepaid Envelope Regular 0-250g	
		Ordinary Prepaid Envelope Regular 250-500g	

Most of Australia Post's small letter volumes are classified as transactional mail, which comprises bill presentments, notices of terms and conditions, announcements of price changes and bill payments.

The letter segments contained within the small letter service are Other (Ordinary) and PreSort. Total volume movements since 1995/96 for each of these segments are illustrated in Chart 2.1.2.

Chart 2.1.2: Small letter volumes – Other (Ordinary) and PreSort

------ Denotes the onset of the global financial crisis



From a statistical perspective, the initial objective of this study was to identify the precise date when the impact of the GFC became problematic for each letter volume segment.

This impact manifested in different ways across the various segments, requiring alternative approaches to dealing with the changing environment after 2007/08 when attempting to econometrically model the situation.

For segments such as the Other (Ordinary) small letter service, substitution away from the traditional letter item was deemed to have already started before the GFC arrived. Therefore, the impact could be embedded within the modelling framework using a dichotomous variable.

In contrast, other segments such as the PreSort small letter service were affected by the GFC in a cantilever manner: a period of volume growth was suddenly transformed into continual declines.

In those cases where the GFC had a more pervasive effect on both the long-run and short-run parameter estimates, the time frame over which the model was developed was truncated to start at the point in time of the structural break.

The rationale behind the differing approaches was to determine a period for statistical evaluation where electronic substitution was impeding letter volume growth, as this represents a more realistic overview of the landscape for the letters business.

Diversified Specifics carried out a series of structural break tests to isolate these effects for each letter segment. The results of these tests illustrate the importance of the GFC as a catalyst that triggered intense downward pressure on letter volumes in the years that would follow.[7]

The large letter volume segments, the movements for which are illustrated in Chart 2.1.3, comprise letters that satisfy the relevant large letter category size and weight requirements at Australia Post.

Volumes in these segments comprise non-standard-sized letter items that may include contracts, magazines, prospectuses, annual reports, promotional material, etc.

Smartphones and tablets have altered the communications landscape to provide an enhanced ability for reading and research-based applications to acquire higher levels of penetration across the community at the expense of large letter volume growth.

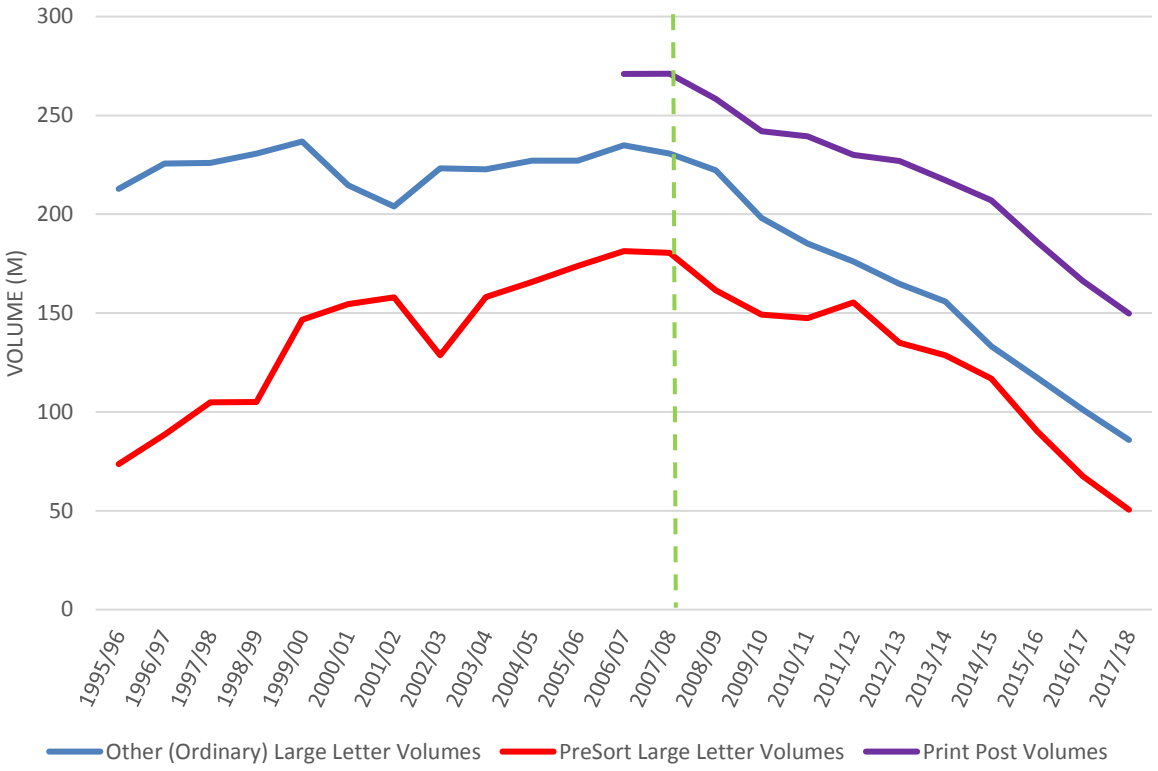
Combining this trend with the reach and interaction capabilities of various social media portals gives Australian organisations and the general population a plethora of communication avenues that are easy and immediate.

A new postal landscape has evolved from this confluence, where organisations have become increasingly likely to shift their focus to the new communication platforms, strategies and behaviours and away from traditional postal services.

[7] A summary of the statistical decision criteria associated with these structural break tests can be found in Appendix A.

Chart 2.1.3: Large letter volumes – Other (Ordinary), PreSort and Print Post.

------ Denotes the onset of the global financial crisis



However, successful electronic substitution of small or large letter items does not occur instantaneously. A process of investigation and development must precede the deployment of any platform before its arrival on the mass market.

Even then, cultivating widespread acceptance and penetration of electronic channels as an alternative to the traditional mail item can present its own challenges. Therefore, the diffusion of electronic substitutes to the detriment of traditional letter volumes is often a gradual rather than immediate process.

This explains the protracted set of average annual volume declines across each of the key letter segments from 2007/08 to 2016/17, as identified in Table 2.1.1.

Other non-substitutive effects that also focused on limiting communication costs began to intensify in the post-GFC period, contributing to total letter volume declines. The first was 'rationalisation', which involved assessing the frequency of mailing and billing cycles to achieve a reduction in the number of invoices and statements sent according to a given timetable.

The second was mail 'consolidation practices', which included efforts to alter the composition of letter-based communications and to consolidate differing messages into a single communication. Examples include the recent rise in popularity of the 'trans-promo' mail item.

In 2017/18 the declines in each of Australia Post's key letter volume product segments continue to be in excess of the average annual declines across the 2007/08 to 2016/17 period, as illustrated in Table 2.1.1. Reductions in volumes within the large letter segments in 2017/18 were similar to those of 2016/17. In the small letter segments however, the Other (Ordinary)

volume reductions fell from -18.8% in 2016/17 to -10.2% in 2017/18. This movement contrasts with an increase in PreSort small letter volume decline from -7.5% in 2016/17 to -10.3% in 2017/18. Indeed, 2017/18 represents the first year where the annual percentage declines in PreSort small letter volumes exceed those of the Other small letter segment.

Such distortions from the underlying trend were not entirely unexpected, given the relatively large increases in postal rates that took effect in January 2016. This contributed to a unique set of letter volume declines pertinent to each segment in 2016/17. As the impact of those price increases eventually dissipates the underlying electronic substitution trends will become more evident.

Although the full extent of the 2016 price increase impact on letter volumes should continue to be monitored, so too should the continuation of segment specific small letter volume trends across the 2016/17 to 2017/18 period continue to be observed.

Importantly the 2017/18 result may indicate:

- **A deceleration of bill payment type electronic substitution as Other (Ordinary) small letter volume declines soften.** Traditional modes of bill payments via the letter include cheques and money orders. The popularity of these channels have dwindled over the course of many years. Therefore, the eventual softening of Other (Ordinary) small letter volume declines makes intuitive sense; and

- **An acceleration in the presentation of bills and statements via non-letter based platforms resulting in diminishing PreSort small letter volumes at an increasingly rapid rate.** Should online bill presentment platforms appear and successfully achieve increased rates of penetration then the PreSort small letter segment would be prone to declines that run deeper than those witnessed historically.

Because one year of data represents a very small sample size such movements away from the long run trends are not considered conclusive. Moreover, the econometric models employ a tendency for mean reversion so one year of data does not provide grounds for extrapolation to the projections generated.

Despite a disruptive period for letter volume movements characterised by the January 2016 price changes, the introduction of a dual speed (Regular-Priority) letter, in addition to these recent changes at a small letter segment level discussed above, the price elasticity estimates across each of the letter volume segments have remained convincingly inelastic and remarkably stable.

This lends further support to the theory held by most postal econometricians worldwide that electronic substitution has and will continue to dominate as the primary driver of letter volume decline for some time to come, irrespective of changes in the postage rate.

Table 2.1.3 illustrates the proposed weighted real letter price increase from October 2019 which was supplied in conjunction with other inputs by Australia Post.

Based on the statistical findings contained in this research, the comparatively smaller price increases proposed by Australia Post combined with their inelastic demand properties suggest electronic substitution will continue to be the dominant explainer of letter volume projections across this horizon.

Table 2.1.3: Actual and proposed weighted letter price changes in key domestic letter volume segments (%). *

		Small		*Large*		
		Other	**PreSort**	**Other**	**PreSort**	**Print Post**
Actual	**October 2018**	0.4	1.2	0.6	2.3	5.6
Proposed	**January 2020**	7.2	5.9	6.8	4.2	4.0

* See Table B.2.2 in Appendix B for individual proposed price point changes.
Volume weightings as per 2017/18 proportions have been applied to all price inputs across the entire projection horizon as provided by Australia Post.

2.2 SEASONALITY

The quarterly seasonal factors for each letter volume segment from July 1995 to June 2018 are summarised in Table 2.2.1. To give each of these figures practical interpretation, the quarterly seasonal factors can be contrasted to a quarterly average of 100%.

Table 2.2.1: Quarterly seasonal factors by letter segment.

	Other (Ordinary)		PreSort		Print Post^	Regular^	Priority^
	Small	Large	Small	Large			
March	91.6%	91.5%	96.1%	85.1%	92.8%	94.7%	93.0%
June	95.9%	97.0%	98.6%	89.7%	98.0%	100.4%	94.8%
September	101.2%	104.8%	104.1%	106.7%	103.1%	100.5%	109.4%
December	111.4%	106.7%	101.2%	118.1%	106.2%	99.9%	102.7%

^ The time frame applicable spans the March 2014 to June 2018 period due to data availabilities. Seasonal factors for the remaining segments are estimated over the July 1995 to June 2018 time frame.

The seasonal factors highlight regular demand tendencies throughout any given year:

- PreSort large letter volumes in the December quarter are typically 18.1 percentage points higher than the quarterly average due to the proliferation of annual report-type mail.

- The Christmas-related peak is evident in Other (Ordinary) small letter volumes in the December quarter.

- Volume traffic across all segments tends to be higher in the September and December quarters of any given year when contrasted to the initial six months of the calendar year.

The evolutionary path of specific seasonal factors in key letter segments since 1995/96 is provided in Tables A.6.1 through A.6.7 in Appendix A. These tables highlight the shift in seasonality over time.

The econometric approach used in this research therefore conducts seasonal adjustments based on the dynamic set of seasonal factors as reported in Tables A.6.1 through A.6.7 rather than the summary statistics contained in Table 2.2.1 to avoid redundancy issues.

2.3 VARIABLE PROJECTIONS

The *ex-ante* projections generated in this report are based on reasonable estimates of the statistically significant drivers. Broadly, the econometric modelling narrows down the statistical drivers of letter volumes in the recent past to four dominant effects:

- the substitution, consolidation and rationalisation practices that have reduced the demand for paper-based modes of communication such as the letter. These combined effects have been generalised under the term 'substitution' within this discussion.
- movements in the real price of the letter item.
- extreme fluctuations in a long-run driver of letter volumes, specifically economic growth.
- the outlier in real price changes as given by the January 2016 date of effect.

In the prevailing econometric framework, which focuses on letter volume movements since the turn of the century, the statistically significant volume drivers across all segments tend to be dominated by substitution and price effects (to a lesser extent).

However, monitoring projected movements on long-run drivers is a crucial component of the analytical methodology. Radical swings in these long-run drivers will always have some effect on letter volume movements.

The GFC is a good example. Although substitution and price were the prevailing drivers, the definition of 'transactional volumes' implies a response to the changing economic environment was likely.

This response was based on the premise that given fewer transactions occur in an economy, then all else being equal this would result in less transactional mail. These income-centric effects tend to be disguised by the rapid movement of letter volumes to electronic alternatives when economic growth changes only marginally. However, wild swings in GDP growth highlight the effect on letter volumes more readily.

More importantly, shocks to long-run drivers such as GDP can accelerate substitutive pressures as organisations are increasingly likely to shift their focus to cost containment when sales targets cannot be realised. Such tendencies are discussed by Paterson et al in relation to postal volumes in Finland following the GFC.[8]

The impact of a changing set of forward estimates on the statistically significant letter volume drivers of substitution and price over the projection period is more directly related to the set of *ex-ante* projections generated because they represent genuine inputs to the model. Therefore, it becomes important to assess the degrees of variability in the projections on the primary variables used within the preferred models.

[8] See Paterson et al 2012 in the bibliography.

Diversified Specifics has attempted to source projections on the key drivers from a selection of recognised institutions. In cases where reliable projections were unavailable, historical percentage change trends have been extrapolated to provide a reasonable projection.

The scenarios constructed do not provide any explicit treatment of possible cross-segment volume migration resulting from the asymmetrical pricing policies across service speeds.

Although a very small sample size of volumes across the differing speeds is presently observable, preliminary evidence suggests no statistically significant difference in the price elasticities between the Regular and Priority services.[9]

Sections 2.3.1 and 2.3.2 outline the determination of a reasonable set of projections in the case of the two statistically significant letter volume drivers – real price and substitution.[10]

2.3.1 Real price

The real price of the various letter volume segments is determined by a combination of:

(i) inflationary pressures.
(ii) Australia Post pricing policies.
(iii) letter volume weightings according to the 2017/18 annual intra-segment Australia Post product mix.
(iii) successful completion of any regulatory/governmental processes for any proposed price changes where required.

The inflationary component of the real price variables constructed is captured by recognised projections on the consumer price index (CPI), which are presented in Table 2.3.1.

Commonwealth Budget projections were used to capture inflationary effects.

Table 2.3.1: Consumer price index projections.

Projecting institution	18/19	19/20	20/21	21/22
Commonwealth Budget (CPI)*[11]	**2.00%**	**2.25%**	**2.50%**	**2.50%**
	2018	**2019**	**2020**	
Westpac[12]	2.10%	1.70%	1.50%	
International Monetary Fund[13]	2.16%	2.31%	2.51%	

**** Denotes variable chosen as the basis for CPI projections.***

[9] The results of these tests are presented in Section C.7 in Appendix C of this report. Due to the small sample size available any interpretation of the reported price elasticities for the Regular and Priority services should be treated with due caution.
[10] Projections on the long-run letter volume drivers identified have also been evaluated for potentially distortive swings. While not reported here, they are available from Diversified Specifics on request.
[11] See Commonwealth of Australia 2018 (bibliography).
[12] See Westpac Banking Corporation 2018 (bibliography).
[13] See International Monetary Fund 2018 (bibliography).

After 2007/08 there were increasingly regular nominal price increases across all letter segments. This is in contrast with the preceding period, where there tended to be small incremental decreases in real price due to the nominal annual rises in the CPI.

The change in Australia Post's pricing strategy reinforces the need for structural break tests to focus the time frame examined on the period after the start of the GFC, or at a minimum to isolate the effects of the GFC using a dichotomous variable technique.

International studies have questioned the relevance of incremental price changes as a driver of letter volume fluctuations in an environment characterised by aggressive rates of electronic substitution.[14]

In this situation, the senders are confronted with a choice between the near-zero cost option of choosing an electronic channel to communicate their message and the positive costs associated with the act of sending a letter. As the net benefit in cost will always favour the electronic alternative, subsequent incremental price increases become irrelevant as a catalyst to shift to digital options.

The argument is, senders are not framing their decisions about mail based on incremental changes in price because the net difference between the two modes of communication will always be positive. In some cases, a sender's decision to persist with letters will also be driven by non-price factors such as convenience, technological availabilities, current and future penetration levels, security, performance and the behaviour of the recipient.

Despite a positive cost differential that favours electronic modes of communication, senders also value the retention of a relationship with the recipient via the letter because of its comparative effectiveness. A letter captures the attention of the recipient and facilitates reach in a manner that some digital alternatives have not yet achieved.

While there is an element of truth to each of these arguments, there is also a fundamental law of economics that states prices cannot continue to increase *ad infinitum* without an eventual volume decline.

The January 2016 price increases were not merely incremental. Future letter volume demand updates should continue to monitor the long run impact of these price increases in future years.

However, the statistical findings in this report reinforce the dominant electronic substitution effect as causing a greater proportion of the letter volume decline, as the estimated price elasticities have remained inelastic despite this large variation in nominal price.[15]

The estimation of long-run price elasticities is fundamental to this research and must reflect the set of choices confronting the sender in the current substitutive environment.

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[14] For a discussion see Bozzo et al 2014 and Cigno et al 2014 (bibliography).

[15] While the estimated Print Post price elasticity is also inelastic, there are no prior demand studies conducted on this letter segment and therefore there is no basis for comparison.

Individual price points and their proposed rates of change from October 2019 are provided in Table B.2.2 of Appendix B. By weighting the complete set of anticipated price changes across the entire projection horizon by the 2017/18 annual intra-segment volume mix, a set of weighted future nominal price change projections were developed.

Deflating these weighted future nominal price projections results in the projected set of real price change variables as used in the letter volume projection exercise. Table 2.1.3 contains the proposed real price change projections that are utilised along with other inputs supplied by Australia Post over the projection horizon.

For each of the key letter segments, an alternate projection scenario was generated to show letter volume fluctuations when price increases were not imposed. By contrasting these zero-price growth scenarios with counterparts that incorporate the price increases, the split between price and substitution effects generated by the letter volume projection effort can be quantified.

2.3.2 Substitution

There is no single variable that precisely measures the phenomena of electronic substitution away from the traditional letter item.

Rather, multiple electronic communication channels emerge at different times, each at varying stages of development and penetration.

In his 2016 paper, Nikali articulates the difficulties of quantifying electronic substitution as a single variable within econometric postal demand studies:

> *"During the past twenty years, many electronic channels have appeared to challenge paper publications. Their number is increasing and their use is becoming more and more common. When we study the changes in paper communication from the perspective of digitization, one of its most difficult phenomena is to find an indicator that in the best possible way describes its substitution (Nikali, 2014a). In reality, there are many alternative channels for paper communication, their number is increasing the whole time and their meanings in the substitution process also change with time. However, it is not possible to include many variables explaining substitution in the model describing total demand; it is better to make up a combined indicator."*[16]

Embodying this vast array of emerging threats into an econometric analysis is limited by the availability of few, if any empirical observations.

Technological change, while necessary, is not a sufficient condition for substitution because it is the behaviours of senders and receivers that dictate the ultimate success or failure of each channel via their willingness to accept a given communication platform.

Quantifying substitution depends directly on the nature of this interaction between technological advances and the behavioural changes made by senders and receivers.

[16] See Nikali 2016, which references Nikali 2014 (bibliography).

For the Other small letter segment direct proxies are readily available, such as using cheque volume numbers to illustrate how bill payments via posted letter have migrated to alternative technologies including phone and internet.

To obtain projections on cheque volume declines for this research, a choice between accelerating, diminishing or adopting a constant rate of decline was required. The January 2002 to June 2018 monthly series on the Total Number of Cheques and Direct Entry Payments as sourced from the Reserve Bank of Australia provided the basis for this decision.[17] Cheque volumes have registered an increasingly rapid decline over this time period, reaching a maximum annual fall of -21.0% in 2016/17.

Diversified Specifics chose not to extrapolate this increasing decline in cheque volumes forward however as the 2017/18 decline (-19.6%) was softer than the previous 12 months. The alternative scenario that was adopted is consistent with the technique previously employed by Diversified Specifics, fix the annual cheque volume decline across the entire projection timeframe at this most recent annual rate of -19.6%.[18]

Selecting this constant rate avoids any assumptions about the direction of future movements of this proxy for the Other small letter substitution variable where a certain degree of uncertainty presently exists.

For other segments such as PreSort small letter volumes, measuring the electronic substitution of bill presentment-type mail away from the traditional letter item requires a more nuanced approach.

Successful bill presentment platforms represent the next wave of substitution and are expected to have a substantial impact on PreSort small letter volumes over the projection horizon. It is therefore necessary to capture the forces of aggressive present and future rates of electronic substitution with variables that reflect the changing nature of technology and behaviour in this space.

Tablets, smartphones and cloud technology are now making increasing use of wireless broadband capabilities as the number and reach of communication applications grows throughout the letter volume projection horizon.[19]

Additionally, evidence is suggesting that machine to machine (M2M) technologies are beginning to emerge and impact the billing process.[20] M2M technologies transmit sensor data to an internal machine-based system using public networks such as cellular or Ethernet capabilities to enhance the cost-effectiveness of an interaction. Computer programs and applications then assist a network device in interpreting data and ultimately making decisions triggering a pre-programmed, automated response.

[17] Reserve Bank of Australia (2017), Total Number of Cheques, Cheques and Direct Entry Payments – C6.
[18] A similar approach was employed in Diversified Specifics 2015. p.36 (bibliography).
[19] Projections for the anticipated expansion of mobile broadband subscriptions can be found in Ericsson 2017 (bibliography).
[20] See https://internetofthingsagenda.techtarget.com/definition/machine-to-machine-M2M

In doing so M2M technologies, sometimes referred to as the *'Internet of Things (IoT)'* represent the next wave of substitutive downside for PreSort small letter volumes. M2M technology allows for the continual electronic monitoring of devices and this can avoid any unnecessary transaction costs associated with the billing process. Machine telemetry or connectivity instead dictates the need for the provision of additional or extended services conveyed directly via the devices themselves rather than through the mail. This is highly likely to impact letter volume segments such as PreSort small as the structured delivery of transactional communications is reconfigured.

Gartner projects by 2020 there will be over 20 billion devices inter-connected across the globe. Such devices extend beyond the realm of smartphones to include smart cars, door locks, smoke detectors, robots, streetlights, heart monitors, trains, turbines, refrigerators, toasters and televisions all transmitting data via the cloud to centralised monitors and amongst each other. [21] McKinsey's Global Institute report, *The Internet of Things: Mapping the value beyond the hype* conducts a bottom-up analysis to estimate the total potential economic impact of this these type of applications at between $3.9 trillion to $11.1 trillion a year by 2025, equivalent to 11% of the global economic output at the maximum bound.[22]

Contained within these device-to-device interactions are software applications that are responsible for notifying and billing the end consumer. In the same way that direct debit facilities eschew the need for letter-based bill presentments, so too does M2M technology economise on transaction costs by either facilitating billing and presentment type communications directly through the device itself or implicitly charging for the service via a pre-approved user pays arrangement. The linking of real-time banking sector data with customers via their smartphones provides an example. Financial institutions can monitor account balances in real time with phone-based banking applications then automatically allowing for notifications to be sent directly to the recipient's smartphones via a threshold-based algorithm. Therefore, when an account is overdrawn or if there has been unusual spending (indicative of possible fraud) the customer can rectify the problem immediately without the need for any letter of advisement nor any direct human involvement by the bank in the initial detection.

Internationally firms are investing heavily in M2M technology. Examples include Apple's Homekit, the $3.2 billion purchase by Google for the home automation company Nest Labs and IBM's Almaden lab in California. Domestically, Telstra offers a dedicated M2M Control Centre that provides Australian business customers with the ability to harness this evolving technology.[23] The emergence of M2M technology distinguishes itself from the communications explosion of the 1990's when behavioural changes by consumers such as the acquisition of a mobile phone or acceptance of an additional credit card which reflected lifestyle changes that increased letter-based bill or presentment type mail. In this case however presentments, notifications and billing are embedded within the device-to-device communications so the provision of new services or changes are not organically accompanied by any growth in paper-based communications that could typically include Australia Post's PreSort small letter service.

[21] See Gartner.com, specifically: https://www.gartner.com/newsroom/id/3165317

[22] See McKinsey.com, specifically https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world

[23] See https://enterprise-support.telstra.com.au

The procedure for using anticipated mobile wireless growth to quantify the multiple waves of actual and likely substitution is discussed in Diversified Specifics (2015). This research uses the same methodological approach to develop projections on the core electronic substitution variable – global mobile traffic in the Asia Pacific region.[24] To account for the additional emergence of M2M technology an augmented approach is however applied to this variable into the projection horizon. Global mobile traffic annual projections for the Asia-Pacific region are increased by a growth factor equivalent to the anticipated annual growth in M2M Global mobile traffic.[25]

Global mobile traffic annual projections for the Asia-Pacific region are generated by Cisco, starting in 2011 and extending to 2020.[26] Using this data and these techniques resulted in projected growth in the core substitution variable of 88.8% in 2017/18, 83.2% in 2018/19 and 83.2% in 2019/20. The annual growth rates in the variable constructed align with those of the global mobile traffic projections for the Asia-Pacific region the over the projection period.

Intuitively, this supports the rationale that infrastructure – in the form of the number of connections – predates the traffic flows that will drive the next wave of electronic alternatives to the traditional letter item.

The augmented M2M annual projections for the Asia-Pacific region data, are also based on the Cisco figures, and are used to complement the projected expansion in the substitution variable as given by Global mobile traffic annual projections alone. Cisco project M2M technology to grow by 104% (2017), 78% (2018), 61% (2019) and 51% (2020).[27] The augmentation procedure results in annual increases in the substitution variable for PreSort small letters of 261% (2018/19), 261% (2019/20), 221% (2020/21) and 200% (2021/22).

This need for an augmentation in the letter volume projection period is also driven by the intangible element that suggests the forces of electronic substitution should accelerate at a rate more intensive than the pure technological growth variable that is ultimately used in the projection process. This intangibility stems from the group most likely to lead the adoption of new digital platforms – the millennials. Born from the 1980s into the early 2000s, millennials generally have a greater knowledge, dependence and expectation of communicating via the new technology platforms. As a generation, they possess the all-round skills to navigate through and digitise their entire set of communication activities.

These are indicators that technological change and behavioural adaptations are now occurring at an increasingly rapid rate within the billing process. This requires a tighter focus on letter volume trends to assess any divergence from the patterns displayed within any substitution variable that has been chosen.

In periods of rapid technological change there are always questions about the extent to which future changes in demand will be reflective of historical fluctuations.

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[24] See Diversified Specifics 2015 (bibliography).
[25] As given by the 2016-2020 annual average M2M technology growth rate of 74% based on data contained in Table 5, p.36 of Cisco 2016 (bibliography). Augmentation utilising the average annual growth rate then allows projection forward into t periods or to 2021/22 as is required by this letter volume study.
[26] See Cisco 2012 and Cisco 2016 (bibliography). The methodology used involves interpolating the series from annual to quarterly and extrapolating the projections to correspond with the projection horizon of this study.
[27] See Cisco 2016 (bibliography).

This is especially true the longer the projection period, as a constantly evolving postal environment characterised by a diverse number of technological developments is more likely to experience unexpected changes.

The projection horizon for this econometric study runs from 2018/19 to 2021/22 and therefore requires supplementation of baseline projections with additional intelligence on very recent and emergent trends (where available).

Further discussion pertaining to the choice of an appropriate substitution variable for the purposes of the econometric analysis is contained in Appendix A.

2.4 DATA ISSUES

Several enhancements have been made in this study to ensure the econometric letter volume baseline is reliable and robust.

The scope of letter volume segments analysed has been extended beyond that of previous demand studies conducted by Diversified Specifics to include econometric modelling of Print Post.

This segment contains predominantly magazines and catalogues; therefore, recent demand studies assessing declines in magazine subscription rates were used as a starting point for determining the set of hypothesised Print Post volume drivers.

When considering all letter segments, the quantification of the real price variables has become increasingly complex in recent years because of the expanded range of letter services offered by Australia Post. As an example, components of some segments are priced according to 'Regular' and 'Priority' delivery timetables.

Following from Diversified Specifics (2015) differing price points for alternate weight increments are again incorporated into the weighted price indices used as the lead pricing variables for econometric testing.

Letter volume demand studies in this series have always been premised on obtaining appropriate data to test the hypotheses developed. In some cases, the desired data was either not publicly available or possessed a redundancy issue.

Additionally, for some of the explanatory variables assessed previously, data sources had been discontinued or were not available on a quarterly basis. Such data was either omitted from the analytical process or interpolated to conform to the data frequency of the underlying time frames used. Where data limitations are known to exist, Diversified Specifics has noted and documented them.

Sections 2.4.1, 2.4.2 and 2.4.3 provide examples of several data issues encountered in the estimation and projection process that are additional to the points raised above and require a more detailed explanation.

2.4.1 Closure of the Medium Letter Service

Over the course of previous modelling efforts Diversified Specifics has included the entire set of Medium sized letter volumes within the PreSort large letter volumes. At a letter product-specific level this included the *PreSort Medium Regular* and *PreSort Medium Priority* services.

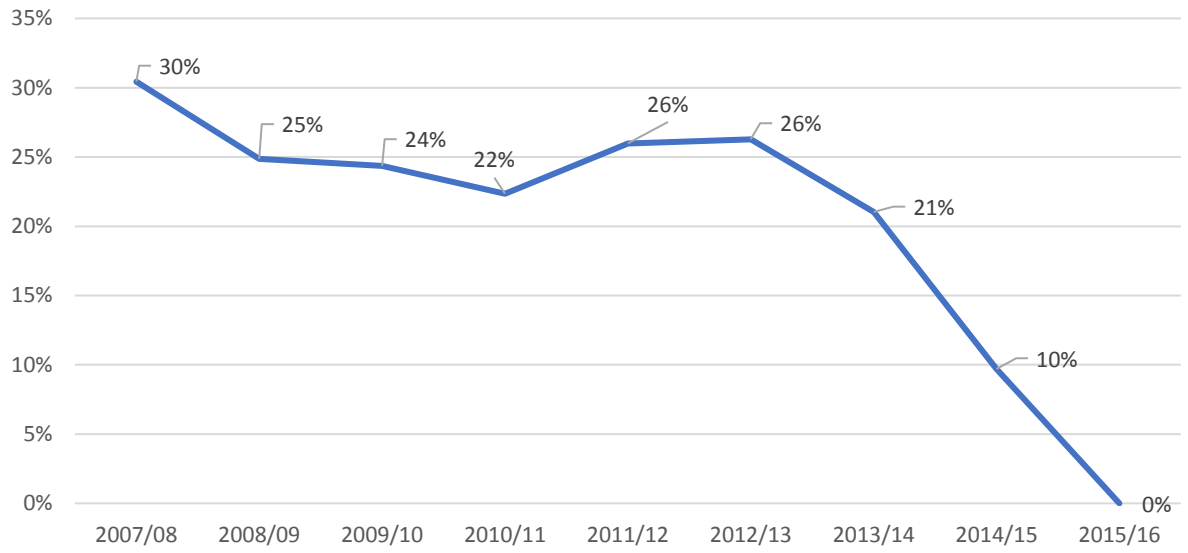
In 2014, the *PreSort Medium Priority* service ceased, followed by the closure of the *PreSort Medium Regular* service in 2015. The resultant redirection of this significant proportion of volume contained within the PreSort large letter segment is inconclusive based upon intelligence received from Australia Post.

Chart 2.4.1 illustrates that combined 'Medium' volumes constituted around one-quarter of all PreSort large letter volumes. Investigations by Australia Post to determine which alternative letter service the Medium sized letter volumes transitioned into proved inconclusive.

Diversified Specifics' response to accounting for the impact of this substantial change in volume was to develop a dichotomous variable designed to pinpoint the date of the Medium letter service closure.

Of the variables tested, the date selected as the turning point for closure of the Medium service was the June quarter of 2014, when the Priority component ceased.

Chart 2.4.1: Total Medium volumes as a percentage of total PreSort large letter annual volumes.



This dichotomous variable was statistically significant and is contained within the error correction component of the preferred PreSort large letter vector error correction model as presented in Table C.1.4 of Appendix C.

2.4.2 Improving projection robustness

The methodological approach for each segment makes use of the Clements-Hendry adjustment factor, which is a tool to improve letter volume projection accuracy.

A layer of Clements-Hendry intercept correction adjustments for ensuring the robustness of time-series projections was undertaken and follows the methodologies outlined in Clements and Hendry (1996).[28]

The approach is based on the projection error of the last one-step ahead projection error arising from estimating the model within the sample. The point of division between actual values and projected values is June 2018; therefore, the adjustment is designed to capture any momentum effects of additional falls in letter volumes from potentially increasing substitution effects over this period beyond the impact captured by the substitution variable in the estimated model.

This adjustment value is then applied to the intercept of the model which, in turn, affects the out-of-sample projections from September 2018 to June 2022.

Section C.6.1 in Appendix C discusses these techniques in further detail.

[28] See Clements and Hendry 1996 and Ericsson 2016 (bibliography).

2.4.3 Print Post sample size

The contents of a typical Print Post item have undergone a significant structural shift in recent years as consumers of written content are now demanding less of the subscription-based publications that require a postal component. Demand has shifted towards the usage of digital content alternatives. The popularity of smartphones and tablets has ensured these electronic options have access to increased rates of readership penetration.

In response to these changes a structural break test across post 2006 Print Post volumes can be utilised to isolate the timeframe that best corresponds to the current environment. Diversified Specifics have truncated the timeframe rather than deploy a dichotomous variable aimed at imbedding the break within the model. This decision was motivated by an acknowledgement of the rapidly changing landscape for published materials where digital alternatives to physical magazines have gained considerable momentum very recently. That timeframe covers the September 2014 to July 2018 period with a quarterly frequency and results in the VECM presented in Table C.1.5 of Appendix C.

The VECM elasticity point estimates are consistent with the theory and existing intelligence on the role of electronic substitution during this period. However, in constructing the VECM over a short period there are potential small sample size issues from the estimation of a multivariate model. To determine the robustness properties of the VECM results, a single equation method based on dynamic least squares was also constructed which has the advantage of mitigating potential small sample size issues and improving the overall precision of the long-run parameter estimates. The dynamic ordinary least squares results presented in Table 2.4.1 provide strong support for the VECM long-run parameter estimates despite estimation across a relatively short time frame.

Table 2.4.1: Print Post alternate model – Dynamic ordinary least squares

Dependent Variable: LOG(VOLUME_SA)
Method: Dynamic Least Squares (DOLS)
Sample: 9/01/2014 6/01/2018
Included observations: 16
Cointegrating equation deterministics: C
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(REALPR)	-0.390436	0.196270	-1.989277	0.0870
LOG(MOBILE)	-0.134592	0.022751	-5.915858	0.0006
C	4.011815	1.269023	3.161342	0.0159

R-squared	0.978193	Mean dependent var	3.782712
Adjusted R-squared	0.953270	S.D. dependent var	0.130216
S.E. of regression	0.028149	Sum squared resid	0.005547
Long-run variance	0.000264		

3. OTHER SMALL LETTERS

3.1 BACKGROUND

The Other (Ordinary) small letter segment consists of full-rate business mail, cheque payments and other consumer correspondence that satisfies the relevant small letter category size and weight requirements.

In terms of volume, the dominant letter service sub-categories in this segment are *Metered Imprint Charge Regular Letters* and *Ordinary Stamped Regular Letters*, as shown in Table 3.1.1.

Table 3.1.1: Letter services comprising the Other (Ordinary) small letter segment.

Letter services classified into the Other small segment	Volume proportions within the Other small letter segment	
	2016/17	2017/18
Ordinary Stamped Regular	32%	28%
Ordinary Stamped Priority	1%	1%
Local Rate Regular	1%	1%
Local Rate Priority	0%	0%
Metered Imprint Charge Regular	40%	41%
Metered Imprint Charge Priority	8%	7%
Clean Regular	11%	11%
Clean Priority	3%	4%
Reply Paid Regular	3%	3%
Reply Paid Priority	1%	2%
Imprint Cash Regular	1%	0%
Imprint Cash Priority	0%	1%
Prepaid Envelope Regular	0%	1%

Table 3.1.2 shows the annual percentage changes since 2000/01 for each of the hypothesised Other (Ordinary) small letter volume drivers considered in this study.

Fundamental to previous efforts in modelling the contents of the Other (Ordinary) small letter segment was the monitoring of declines in the number of transactions associated with paper-based modes of bill payments, such as cheques and money orders.

Declines associated with this type of mail have been well documented by Diversified Specifics in previous research and underlined by a behavioural shift towards phone and internet-based channels to settle a bill or invoice.[29]

Consequently, cheques have diminished in importance as a mode of bill payment while alternatives such as direct debit transfers have increased in popularity, reflecting an increased tendency for bill recipients to settle outstanding transactions via non-paper based platforms.

[29] See Diversified Specifics 2015 (bibliography).

Table 3.1.2: Percentage changes, Other (Ordinary) small letter volumes and hypothesised drivers.

	2016/17 % change	2017/18 % change	Average annual % change	
			2000/01 to 2007/08	2007/08 to 2017/18
Other (Ordinary) small letter volumes	-18.8	-10.2	-1.7	-9.9
Cheque volumes	-21.0	-19.6	4.7*	-14.7
Direct entry payments for debit transfers	13.0	4.5	23.3*	7.5
Australian non-farm GDP	1.8	3.2	3.6	2.6
Real price of Other (Ordinary) small letters	15.4	0,5	-1.5	5.2
Estimated Australian population	1.7	N/A	1.4	N/A
Delivery service performance - small	-0.3	0.6	0.2	0.3

***** The average annual growth rate for these variables is calculated from 2002/03 due to data availabilities.

Modelling undertaken previously by Diversified Specifics was premised on a continued decline in cheque volumes as a variety of institutions actively announced changes in processes away from the use of cheques. For example, the Australian Tax Office instituted a staged roll-out from July 2014 to June 2016 of mandatory requirements for employers to pay superannuation contributions electronically.[30] These changes directly accelerated Other (Ordinary) small letter volume declines, highlighted in Table 3.1.2 by an annual average fall of 14.7% in cheque volumes across the 2007/08 to 2017/18 period.

Table 3.1.2 also emphasises that the largest annual decline in cheque volumes occurred in 2016/17 with a fall of 21.0%. Compounding this impact is the expanding popularity of direct debit payment facilities, with an increase of 13% in 2016/17 following a sustained period of growth from 2007/08.

Other (Ordinary) small letter volumes declined by -14.5% in 2015/16, when there was a substantive increase in the real price of posting a letter in that category. However, the figures in Table 3.1.2 emphasise the substitutive pressures facing the category the volume declines in the Other (Ordinary) small letter segment remaining severe in 2017/18 when real price increased by only 0.5%.

The substitution of a large portion of the bill payment component of Other (Ordinary) small letter volumes towards electronic channels has altered the content mix within this segment. Once this paper-based bill payment component disappears, future econometric modelling of Other (Ordinary) small letter volume fluctuations will need to be refocused on an alternative set of explanatory drivers. The stabilising of cheque volume declines over the past year may signify the beginning of such a change however future years will convey a more complete picture.

It is reasonable to assume however a larger proportion of the Other (Ordinary) small letter volume now consists of small and medium enterprise bill presentment-type mail, which will eventually lead to more direct comparisons with trends in the PreSort small letter volume segment. As declines in that segment are also expected to accelerate, it is likely that Other (Ordinary) small letter volume reductions will continue over the projection horizon.

[30] Source: The Australian Taxation Office website, www.ato.gov.au

3.2 ELASTICITY ESTIMATES

3.2.1 Overview

The methodological approach to constructing the Other (Ordinary) small letter volume vector error correction model is outlined in Appendix A. Table C.1.1 in Appendix C contains the associated statistical output. The preferred model explains 99.5% of the total quarterly variation in Other (Ordinary) small letter volumes over the June 2002 to June 2018 time frame.[31]

3.2.2 Long-run market-based volume drivers and elasticity estimates

The historical demand drivers together with the demand elasticities are presented below.

1. **Electronic substitution away from traditional modes of bill payments.**

Reductions in cheque volumes broadly suggest a movement away from using the traditional mail item for bill payments, which leads to declining Other (Ordinary) small letter volumes.

Elasticity:[32] A 1% decrease in cheque volumes was associated with a 0.56% decrease in Other (Ordinary) small letter volumes on average in the long-run.

Recent trend: Cheque volumes have decreased at an annual average rate of -14.7% from 2007/08 to 2017/18 and by -19.6% in the 12 months to 30 June 2018.

2. **Real price.**

Rational economic theory suggests the real cost (i.e. price adjusted for inflationary effects) of sending Other (Ordinary) small letter mail will be inversely related to demand.

Price changes over the examined time frame have been significantly associated with demand responses in the contrary direction.

Elasticity: A 1% increase in the real price of sending Other (Ordinary) small letters was associated with a 0.42% decrease in Other (Ordinary) small letter volumes on average in the long-run.

Recent trend: The real price of an Other (Ordinary) small letter item has increased at an annual average rate of 5.2% from 2007/08 to 2017/18. However, this statistic is largely a function of the substantive increase in January 2016. In 2017/18 the real price of an Other (Ordinary) small letter item increased by 0.5%.

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[31] Based upon Adjusted R-squared calculations:

$$\bar{R}^2 = 1-(1-R^2)\frac{T-1}{T-K-1} \text{ where } R^2 = \frac{\text{Explained sum of squares}}{\text{Total of sum of squares}} = 1-\frac{\sum e_t^{\,2}}{\sum (Y_t-\bar{Y})^2}$$

[32] All elasticities are estimated at their mean and are applicable only to the time frame over which the econometric models have been developed. In interpreting the elasticities within this report it is assumed all other factors are held constant.

3.3 BASELINE PROJECTIONS

3.3.1 Preamble

The statistically significant Other (Ordinary) small letter volume drivers over the time frame from June 2002 to June 2018 are:

- **substitution** – in the vector error correction models (VECM), bill payments-type substitution away from the traditional mail item is captured by cheque volumes. Cheque volume declines are used as a proxy for declines in all traditional forms of bill payments and, inversely, the growth in popularity of direct debit payment options.

- **real price** – a combination of inflationary real price changes and nominal price increases.

3.3.2 Driver projections used

A series of projected values on each of the drivers within the VECM framework is required for projection. These include the following.

- Cheque volume declines were set at the most recent (2017/18) observed annual rate of decline of -19.6% for each year in the out of sample projection period to June 2022.

- CPI projections of 2.00% at 2018/19, 2.25% at 2019/20 and 2.50% for both 2020/21 and 2021/22 are derived from the Commonwealth Budget data.

- Nominal increases in the price of various products included in this segment were provided by Australia Post. To derive a single tractable nominal price variable, the inputs on the individual price points were weighted based on 2017/18 volume proportions. For comparative purposes, an alternative price variable was constructed to model the scenario where letter prices do not increase over the projection period.

- Other small letter volume projections do not include the impact of any unanticipated spike in mailings as a result of a given event (such as a Federal election) and these volumes should be factored into any off-model augmentations undertaken.

- The error correction component of the VECM is augmented with two dichotomous variables to capture the effects of the GFC and the relatively large increase in the basic postage rate price occurring in the March quarter of 2016.

- The contingencies examined do not account for any changes in demand resulting from any variations in Australia Post's required Other (Ordinary) small letter delivery service standards. Nor do the scenarios illustrate any possible cross-segment volume migration that would be expected across the Regular and Priority services.

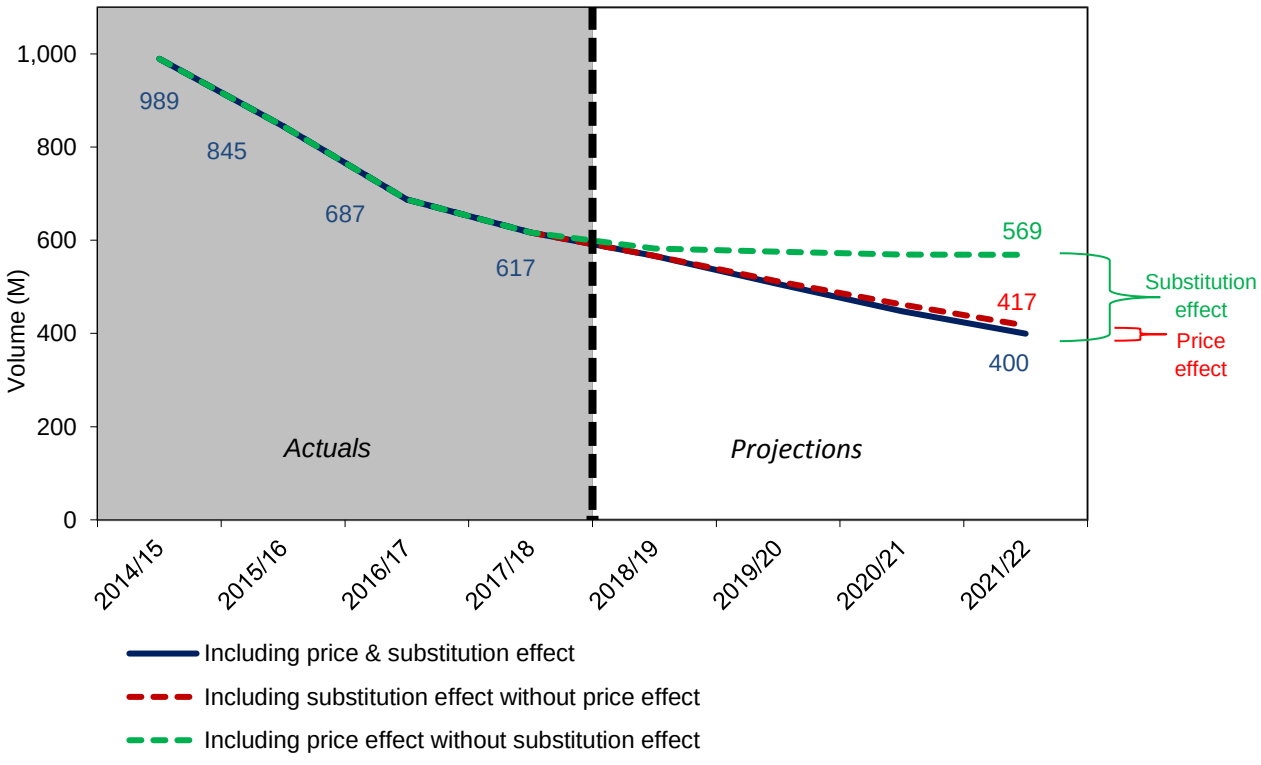
3.3.3 Econometric baseline volume projections

Other (Ordinary) small letter *ex-ante* baseline projections are presented in Table 3.3.3.1 and Chart 3.3.3.1. Continued Other (Ordinary) small letter volume declines of more than 8% per annum are predicted over the projection horizon. Based upon the differing scenario projections, the dominant driver of downward Other small letter volumes is electronic substitution as emphasised in Chart 3.3.3.1.[33]

Table 3.3.3.1: Other (Ordinary) small letter volumes econometric projected percentage changes.

	Baseline projected volume change (%)
2018/19	-8.2
2019/20	-10.1
2020/21	-12.0
2021/22	-10.8

Chart 3.3.3.1: Other (Ordinary) small letter volumes (Seasonally Adjusted) Historical and projected



[33] The substitution effect depicted in Chart 3.3.3.1 (and associated charts in the sections to follow) was derived by fixing the substitution variable at its June 2018 level for the duration of the projection horizon whilst allowing the price variable to change. The chart facilitates a direct visual comparison of the proportion of the letter volume decline attributable to the contemplated price changes as against the significantly larger proportion estimated to be attributable to the effects of electronic substitution. Given the nature of the modeling there is also an autoregressive trend component that is not reported to avoid possible confusion. Note: After study completion Australia Post revised the 2017/18 figure from 617m to 612m. The 617 has been retained here for consistency.

4. PRESORT SMALL LETTERS

4.1 BACKGROUND

The PreSort small letter segment consists of bulk (300+) lodgements of:

- business transactional letters such as bills, statements, share notices and letters advising customers of price increases, policy changes, etc.

- direct mail including promotional letters, brochures and other addressed promotional material that satisfies the relevant small letter category size and weight requirements.

In volume terms, the dominant product category within the PreSort small letter segment is business transactional letters, which tend to reside in the *PreSort Regular* service as highlighted in Table 4.1.1.

Table 4.1.1: Letter services comprising the PreSort small letter segment.

Letter services classified Into the PreSort small segment	volume proportions within the PreSort small letter segment	
	2016/17	2017/18
PreSort Regular	65%	65%
PreSort Priority	14%	14%
Charity Mail Priority	0%	0%
Charity Mail Regular	7%	7%
Promo Post Regular	14%	13%
Promo Post Priority	0%	0%

Table 4.1.2 shows the annual percentage growth rates since 2000/01 for each of the hypothesised PreSort small letter volume drivers.

Although a large price change for PreSort small letters occurred in January 2016, PreSort small letter volumes have continued to decline at an accelerating rate in 2017/18.

This contrasts with the pre-2007/08 period, when fluctuations in PreSort small letter volume were positively associated with upward movements in the level of Australian non-farm gross domestic product (GDP).

In that period, bill presentment-type mail thrived on the number of bills and statements generated by increases in telecommunications connections for services such as the internet and mobile phones. Additionally, communications generated by the financial sector were rising as the quantity of bank accounts and credit cards grew, stimulating increases in paper-based statements sent through Australia Post's PreSort small letter service.

The GFC in 2007/08 altered this situation as the level of economic activity stagnated, reducing the quantity of bill presentments in the first instance because of the downturn in the business cycle.

A secondary impact of the GFC was to refocus business strategies towards cost containment. Organisations could no longer achieve their profit aspirations through sales alone and sought other mechanisms to maintain profit margins.

Table 4.1.2: Percentage changes – PreSort small letter volume and hypothesised drivers.

	2016/17 % change	2017/18 % change	Average annual % change	
			2000/01 to 2007/08	2007/08 to 2017/18
PreSort small letter volumes	-7.5	-10.3	2.7	-4.8
Australian non-farm GDP	1.8	3.2	3.6	2.6
Advertising industry health measure	10.0	6.3	-4.3	2.1
Credit card volumes	1.8	-1.2	5.6	1.8
Retail trade industry	1.7	2.4	5.2	2.4
Real price of PreSort small letters	15.0	6.9	-2.8	6.4
Estimated Australian population	1.7	N/A	1.4	N/A
Business confidence	-1.7	-2.6	-0.3	1.4
Domestic broadband index	4.1	7.1	66.7*	10.0
Mobile wireless broadband	87.1	93.0	N/A	61.0**
Delivery service performance - small	-0.3	0.6	0.2	0.3

* The average annual growth rate for these variables is calculated from 2002/03 due to data availabilities.
** The average annual growth rate for these variables is calculated from 2011 due to data availabilities.

As a result, after 2007/08 a wave of new bill presentment platforms and strategies were developed, beginning a period of sustained decline for PreSort small letter volumes. Indeed, there was an average annual volume decline of 4.8% in this segment between the 2007/08 and 2017/18.

The cost containment strategies affecting PreSort small letter volumes were not confined to electronic alternatives. Consolidation of multiple messages into a single mail item and rationalisation practices that reduced billing frequencies also became increasingly popular after 2007/08.

Moreover, a 'real' evaluation of the 2017/18 decline necessitates the subtraction of the unique PreSort small letter volumes attributable to the marriage equality survey, which took place in the latter half of 2017.[34]

Electronic substitution away from the PreSort small letter item for bill presentment-type communications does not mirror the near-complete erosion of paper-based bill payment-type mailings within the Other small letter segment. However, in 2017/18 PreSort small letter annual volume declines exceeded that of its Ordinary (Other) counterpart for the first time. This result suggests the process of electronic substitution within bill presentments is gathering momentum and further PreSort small letter volume declines can reasonably be expected over the projection horizon.

The source of the accelerating reductions tends to be industries where senders are motivated to reduce the transaction costs associated with sending an invoice or statement. They use a

34 Such calculations represent an off-model augmentation that falls outside the scope of the econometric analysis conducted within this research project.

range of tactics to motivate some form of behavioural shift by the recipient to encourage use of electronic platforms.[35]

In previous research, Diversified Specifics has outlined the rationale behind how PreSort small letter volumes diverted from the GDP trend after the GFC of 2007/08.[36]

Despite this, econometric modelling for PreSort letter volumes must always monitor links to the general health of the Australia economy as extreme fluctuations in GDP have historically affected volume movements across several letter segments.

Fundamentally, the quantity of transactional mail will always be dependent in some way on the number of transactions that take place within the economy. However, the reality in the current postal environment is that the forces of electronic substitution, consolidation and rationalisation are largely offsetting those traditional income effects. Electronic substitution consistently represents the dominating statistical driver across all letter volume segments.

The exclusion of an income variable from the preferred econometric model for PreSort small letter volumes reflects the crowding-out effect of bill presentment electronic substitution. However, it does not diminish the economic significance of the association.

Future research should maintain a close watch on dramatic changes in the level of domestic economic activity as this can still play an important role in defining the speed of letter volume declines for segments such as PreSort small letters.

This speed is a direct function not only of the extent of transactional communication item reductions when in cyclical decline, but also the behavioural changes on the part of organisations that will, in times of contracting economic growth, have a greater propensity to economise on their transaction costs by reducing their exposure to paper-based mail.

It is in these times that organisations will be more readily committed to developing alternative modes of bill presentment to the further detriment of PreSort small letter volumes.

[35] Examples of these push and pull tactics can involve the imposition of a surcharge for the provision of a paper-based bill or the compulsory use of a direct debit arrangement as a condition of a new service agreement or product offering.

[36] See Diversified Specifics 2015 (bibliography).

4.2 ELASTICITY ESTIMATES

4.2.1 Overview

The methodological approach to constructing the PreSort small letter volume dynamic ordinary least squares model is outlined in Appendix A. Table C.1.2 in Appendix C contains the associated statistical output. The PreSort small letter model explains 96.4% of the total quarterly variation in PreSort small letter volumes over the time frame from December 2007 to June 2018.

4.2.2 Long-run market-based volume drivers and elasticity estimates

These are the historical demand drivers together with the demand elasticity.

1. **Real price.**

The real cost (i.e. price adjusted for inflationary effects) of sending a PreSort small letter is inversely related to demand. Price changes in the examined time frame are significantly associated with demand responses in the contrary direction.

Elasticity: A 1% increase in the real price of sending a PreSort small letter was associated with a 0.24% decrease in PreSort small letter volumes on average over the long-run.

Recent trend: The real price of a PreSort small letter decreased at an annual average rate of -2.8% from 2007/08 to 2017/18. This average is largely influenced by the January 2016 rate rise. In 2017/18 the real price of a PreSort small letter increased by 6.9%.

2. **Electronic presentments substitution facilitated by mobile broadband growth.**

The effects of structural changes caused by substitution, consolidation and rationalisation on bill presentment volumes gained impetus following the GFC in 2007/08. Growth in mobile wireless broadband traffic within the Asia-Pacific region is used as a proxy for these effects.

Although this research assumes all structural change losses are substitutive, efforts at individually identifying the substitution, consolidation and rationalisation components should be made to form additional intelligence that might provide further insights into the exact nature of the volume losses.

Acknowledging the existence of consolidation and rationalisation pressures, Diversified Specifics has defined all bill presentment volume losses under the term ‘substitution’ purely for the purposes of simplifying the downward trends.

Elasticity: A 1% increase in mobile broadband connections was associated with a 0.06% decrease in PreSort small letter volumes on average over the long-run.

Recent trend: Mobile broadband traffic in the Asia-Pacific is projected to have grown by an average 61% a year from 2011 to 2017/18. In 2017/18 this type of traffic was projected to have grown by 93%.

4.3 BASELINE PROJECTIONS

4.3.1 Preamble

The statistically significant PreSort small letter volume drivers over the time frame of the December quarter 2007 to the June quarter of 2018 are:

- **price** – a combination of inflationary real price changes and nominal price increases
- **substitution** – the widespread use of tablets and smartphones in recent times has been facilitated by wireless broadband technology. This creates a wider potential audience for a range of electronic alternatives to traditional modes of bill presentments such as the PreSort small letter.

4.3.2 Driver projections used

A series of projected values on each of the drivers within the dynamic ordinary least squares framework is required for projection. These include the following:

- CPI projections of 2.00% at 2018/19, 2.25% at 2019/20 and 2.50% for both 2020/21 and 2021/22 are derived from the Commonwealth Budget data.
- Nominal increases in the price of various products included in this segment were provided by Australia Post. To derive a single tractable nominal price variable, the inputs on the individual price points were weighted based upon 2017/18 volume proportions. For comparative purposes, an alternative price variable was constructed to model the scenario where letter prices do not increase in the projection period.
- The contingencies examined do not account for any changes in demand resulting from any changes in Australia Post's required PreSort small letter delivery service standards.
- The scenarios constructed do not provide any explicit treatment of possible cross-segment volume migration resulting from the asymmetrical pricing policies across service speeds.
- Mobile broadband traffic growth is set to the anticipated quarterly growth rate derived using projections of global mobile traffic in the Asia-Pacific region. M2M global mobile traffic growth is set to the annual average across the 2016 to 2020 period. This average is 74%.
- PreSort small letter volume projections do not include the impact of any unanticipated spike in mailings as a result of a given event (such as a Federal election) and these volumes should be factored into any off-model augmentations undertaken.
- The model contains two dichotomous variables that capture the effects of the GFC and the relatively large increase in the basic postage rate price occurring in the March quarter of 2016. Although the parameter estimates associated with these variables are statistically insignificant they are included for their economic significance, for consistency with the models philosophies adopted in this research task and due to their requirements in satisfying the tests on cointegration.

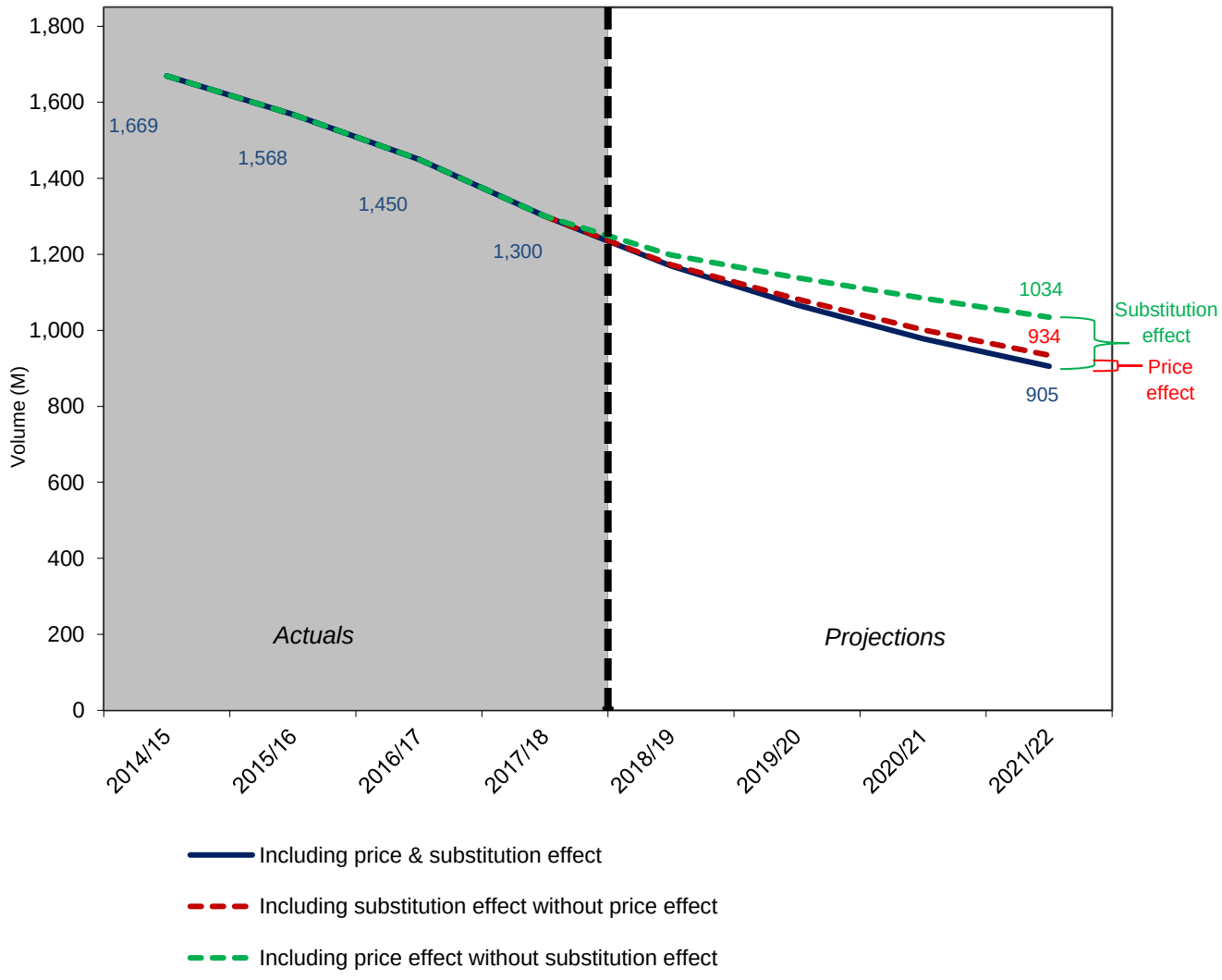
4.3.3 Econometric baseline volume projections

The PreSort small letter *ex-ante* baseline projections are presented in Table 4.3.3.1 and Chart 4.3.3.1. Based upon the differing scenarios, over the projection horizon the dominant driver of downward PreSort small letter volumes is electronic substitution as emphasised in Chart 4.3.3.1.

Table 4.3.3.1: PreSort small letter volumes econometric projected percentage changes.

	Baseline projected volume change (%)
2018/19	-10.0
2019/20	-8.5
2020/21	-8.7
2021/22	-7.4

Chart 4.3.3.1: PreSort small letter volumes (Seasonally Adjusted) Historical and projected.



5. OTHER LARGE LETTERS

5.1 BACKGROUND

The Other (Ordinary) large letter segment consists of full-rate mail up to a maximum size, weight and thickness – 360x260mm, 500g and 20mm respectively.[37]

Volumes are hypothesised to predominantly comprise individual non-standard sized household-to-business, business-to-business and business-to-household mailings, with post traditionally considered an effective channel for larger document delivery. *Metered Imprint Charge Letters* in the 0-250g weight category comprise most of the volumes within the segment, as highlighted in Table 5.1.1.

Table 5.1.1: Letter services comprising the Other large letter segment.

Letter services classified Into the Other large segment	Volume proportions within the Other large letter segment 2016/17	2017/18
Metered Imprint Charge 0-250g Regular	57%	62%
Metered Imprint Charge 0-250g Priority	14%	13%
Metered Imprint Charge 250-500g Regular	4%	4%
Metered Imprint Charge 250-500g Priority	1%	1%
Imprint Cash 0-250g Regular	1%	1%
Imprint Cash 0-250g Priority	0%	0%
Imprint Cash 250-500g Regular	0%	0%
Imprint Cash 250-500g Priority	0%	0%
Ordinary Stamped 0-250g	11%	9%
Ordinary Stamped 0-250g Priority	0%	0%
Ordinary Stamped 250-500g	2%	2%
Ordinary Stamped 250-500g Priority	0%	0%
Local Rate Regular	0%	0%
Local Rate Priority	0%	0%
Clean Small Plus Regular	2%	2%
Clean Small Plus Priority	0%	0%
Reply Paid Regular	3%	3%
Reply Paid Priority	4%	0%
Ordinary Prepaid Envelope 0 250g Regular	0%	2%
Ordinary Prepaid Envelope 250 500g Regular	0%	0%

Forms of substitution away from the Other (Ordinary) large letter item have existed for many years, as email enables senders to transmit files electronically and bypass the traditional postal route. The motivations to switch to an electronic alternative included instantaneous delivery, document archival advantages and a near-zero variable cost of delivery.

Recent progress in web-based technologies combined with an ever-expanding set of users has also enabled platforms for online form completion to gradually replace the need for mailing non-standard size contracts, surveys and applications. Reinforcing this trend has been advances in emulating handwriting via a stylus, touchpad or mouse to incorporate digital signatures into electronic documentation in a legally acceptable manner.

The result has been a large and sustained decline in Other (Ordinary) large letter volumes since 2007/08, as highlighted in Table 5.1.2. Indeed, Other (Ordinary) large letter volumes have experienced an annual average decline of 9.4% since 2007/08.

[37] Examples of which are the rectangular B4 and C4 envelope sizes.

Declines in 2016/17 and 2017/18 of 13.8% and 15.2% respectively emphasise the extent of the acceleration in the impact of substitution.

Large rises in price have also contributed to the volume reductions. However, as with the remaining letter volume segments examined, consistently large declines in Other (Ordinary) large letters have also occurred in periods without an increase in price.

Most recently, the real price of an Other (Ordinary) large letter item rose by a substantive amount in 2016, coinciding with an 11.9% drop in volume. In 2016/17, however, there was a real price increase of 0.1% yet Other (Ordinary) large letter volume declines reached 13.8%.

Table 5.1.2: Percentage changes – Other (Ordinary) large letter volumes and hypothesised drivers.

	2016/17 % change	2017/18 % change	Average annual % change	
			2000/01 to 2007/08	2007/08 to 2017/18
Other (Ordinary) large letter volumes	-13.8	-15.2	1.0	-9.4
Domestic broadband index	4.1	7.1	66.7*	10.0
Mobile wireless broadband	87.1	93.0	N/A	61.0**
Real price of Other (Ordinary) large letters	15.9	0.1	-2.7	5.1
Estimated Australian population	1.7	N/A	1.4	N/A
Australian non-farm GDP	1.8	3.2	3.6	2.6
Delivery service performance - large	0.1	0.5	0.6	0.2
GDP industry sub-segments:				
• **Information Media and Telecommunications**	2.4	2.8	4.7	3.2
• **Finance and Insurance Services**	4.1	3.9	5.9	2.9
• **Public Administration and Safety**	2.1	0.1	2.4	2.3
• **Health Care and Social Assistance**	5.9	6.4	4.7	4.9
• **Education and Training**	1.9	2.1	2.0	2.2

* The average annual growth rate for these variables is calculated from 2002/03 due to data availabilities.
** The average annual growth rate for these variables is calculated from 2011 due to data availabilities.

The set of alternatives to the Other (Ordinary) large letter item now includes cloud storage facilities and USB flash drives, with each providing a wider and more flexible set of options for the storage and delivery of non-standard size documentation.

The inability to email very large documents, which previously stymied their electronic exchange, is being rapidly remedied by larger fixed and wireless broadband gigabyte allowances and file sharing/transfer services such as Dropbox, iCloud and OneDrive.

The expected continuing decline in Other (Ordinary) large letter volumes over the projection horizon is therefore best captured by a rapidly expanding technology variable such as mobile wireless broadband growth.

5.2 ELASTICITY ESTIMATES

5.2.1 Overview

The methodological approach to constructing the Other (Ordinary) large letter volume vector error correction model is outlined in Appendix A. Table C.1.3 in Appendix C contains the associated statistical output. The Other (Ordinary) large letter model explains 98.4% of the total quarterly variation in this segment's volumes over the June 2002 to June 2018 time frame.

5.2.2 Long-run market-based volume drivers and elasticity estimates

These are the historical demand drivers together with the relevant demand elasticity.

1. **Real price.**

The real cost (i.e. price adjusted for inflationary effects) of sending Other (Ordinary) large letter mail is inversely related to demand. Price changes in the examined time frame have been significantly associated with demand responses in the contrary direction.

Elasticity: A 1% increase in the real price of sending Other (Ordinary) large letters was associated with a 0.60% decrease in Other (Ordinary) large letter volumes on average in the long-run.

Recent trend: The real price of an Other (Ordinary) large letter increased at an annual average rate of 5.1% from 2007/08 to 2017/18. This average is largely as a result of the January 2016 set of postage increases. In 2017/18 the real price of an Other (Ordinary) large letter increased by 0.1%.

2. **Electronic document substitution through wireless broadband growth.**

There are difficulties in specifying a precise measure of electronic substitution for this letter volume category, which largely consists of a broad range of non-descript and ad-hoc mailings. What is certain is that fixed/wireless mobile broadband connections have increased dramatically over recent years. This transformation has occurred in conjunction with behavioural change among those wishing to communicate a message and who now rely on tablets and smartphones, which use these technological advances. In such an environment, electronic documentation formats that can be emailed such as PDF files thrive at the expense of communications through regular non-standard sized paper mail channels.

In turn, variations in letter volumes are explained to a statistically significant degree via the inverse association that Other (Ordinary) large letter volumes have with the levels of growth in the wireless mobile broadband index.

Elasticity: A 1% increase in mobile broadband connections was associated with a 0.09% decrease in Other (Ordinary) large letter volumes on average over the long-run.

Recent trend: Mobile broadband traffic in the Asia-Pacific is projected to have grown by an average 61% a year from 2011 to 2017/18. In 2017/18 this type of traffic was projected to have grown by 93%.

5.3 BASELINE PROJECTIONS

5.3.1 Preamble

The statistically significant Other (Ordinary) large letter volume drivers from the June quarter of 2002 to the June quarter of 2018 are:

- **substitution** – in the Other (Ordinary) large letter model, substitution is captured by the mobile broadband traffic growth in the Asia-Pacific region variable. This is used as a proxy for growth in electronic data interchange (EDI) technology, email transmission of larger documents and the proliferation of online form facilities

- **price** – a combination of inflationary real price changes and nominal price increases.

5.3.2 Driver projections used

A series of projected values on each of the drivers within the VECM framework is required for projection. These include the following:

- CPI projections of 2.00% at 2018/19, 2.25% at 2019/20 and 2.50% for both 2020/21 and 2021/22 are derived from the Commonwealth Budget data.

- Nominal increases in the price of various products included in this segment were provided by Australia Post. To derive a single tractable nominal price variable, the inputs on the individual price points were weighted based on 2017/18 volume proportions. For comparative purposes, an alternative price variable was constructed to model the scenario where letter prices do not increase in the projection period.

- The contingencies examined do not account for any changes in demand resulting from any changes in Australia Post's required Other large letter delivery service standards.

- The scenarios constructed do not provide any explicit treatment of possible cross-segment volume migration resulting from the asymmetrical pricing policies across service speeds.

- The mobile broadband traffic growth rate is set to the anticipated quarterly growth rate derived using projections of global mobile traffic in the Asia-Pacific region.

- The error correction component of the VECM is augmented with two dichotomous variables to capture the effects of the GFC and the relatively large increase in the basic postage rate price occurring in the March quarter of 2016.

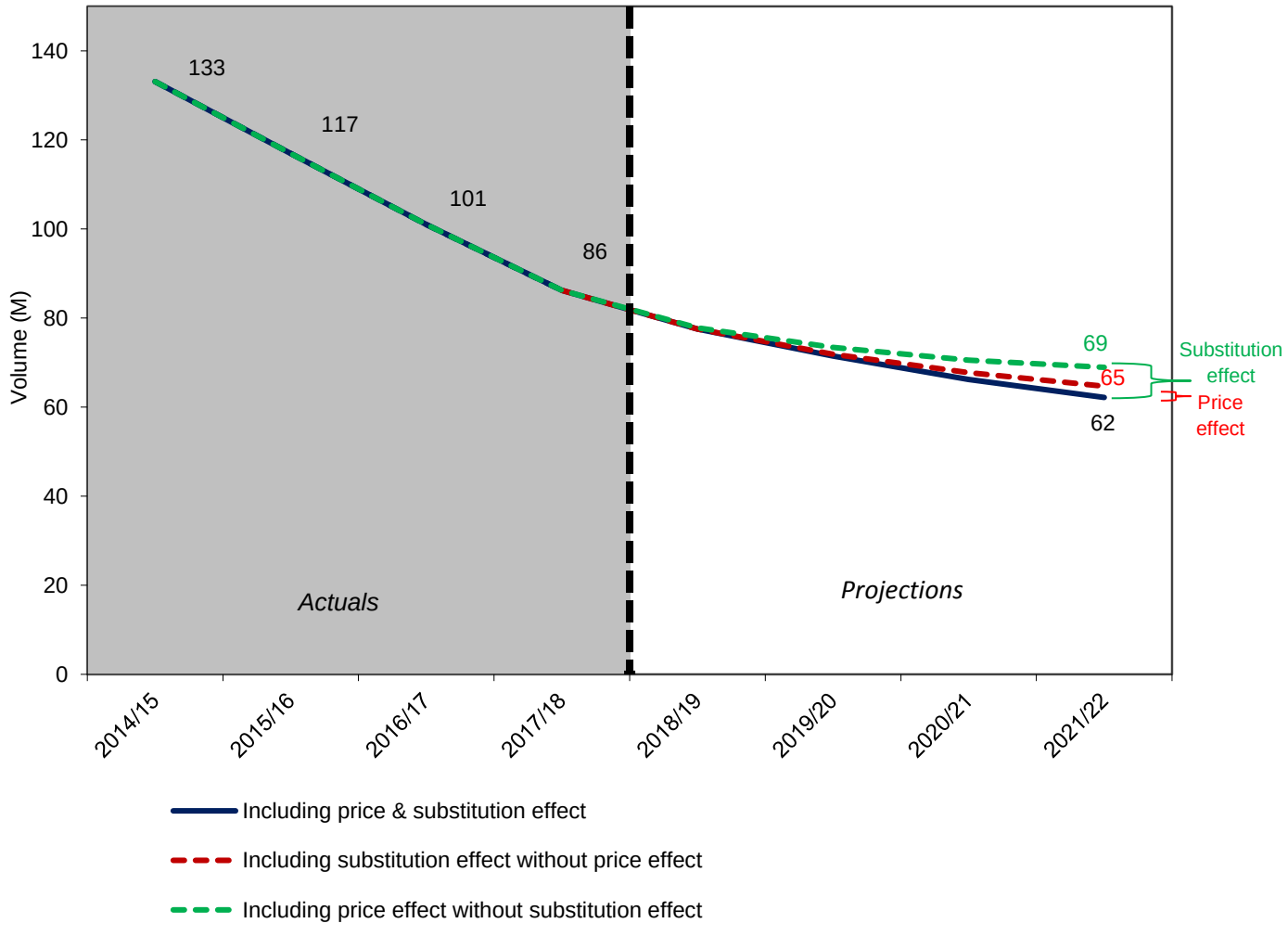
5.3.3 Econometric baseline volume projections

Other (Ordinary) large letter *ex-ante* baseline projections are presented in Table 5.3.3.1 and Chart 5.3.3.1. Based upon the differing scenarios, over the projection horizon the dominant driver of downward Other large letter volumes is electronic substitution as emphasised in Chart 5.3.3.1.

Table 5.3.3.1: Other (Ordinary) large letter volumes econometric projected percentage changes.

	Baseline projected volume change (%)
2018/19	-10.1
2019/20	-7.6
2020/21	-7.3
2021/22	-6.2

Chart 5.3.3.1: Other (Ordinary) large letter volumes (Seasonally Adjusted) Historical and projected.



6. PRESORT LARGE LETTERS

6.1 BACKGROUND

The PreSort large letter segment consists of bulk (300+) lodgements of large letter mail that satisfies the relevant large letter category size and weight requirements.

Volumes in this segment are assumed to consist of bulk non-standard sized letter items emanating from business and the public sector that may represent prospectuses, annual reports, promotional material, etc.

PreSort Small Plus Regular and *PreSort Large Regular 0-250g* constitute the majority of the PreSort large letter segment, as shown in Table 6.1.1.

Table 6.1.1: Letter services comprising the PreSort large letter segment.

Letter services classified Into the PreSort large segment	Volume proportions within the PreSort large letter segment 2016/17	2017/18
PreSort Medium Regular	0%	0%
PreSort Large 0-250g Regular	39%	49%
PreSort Small Plus Regular	43%	33%
PreSort Large 250-500g Regular	4%	4%
PreSort Small Plus Priority	6%	5%
PreSort Large 0-250g Priority	8%	9%
PreSort Medium Priority	0%	0%
PreSort Large 250-500g Priority	1%	0%

Table 6.1.2 shows the annual percentage growth rates since 2000/01 for each of the hypothesised PreSort large letter volume drivers. The table also illustrates a strong association between volumes in this segment and the level of economic activity before 2007/08.

Given the majority of PreSort large letter volumes tend to be bulk business-related documents, an average annual growth in volume of 2.2% over the 2000/01 to 2007/08 period reflected strong average annual growth in non-farm GDP of 3.6% over the same period.

However, two critical changes ensured a divergence in the long-run association between the health of the Australian economy and PreSort large letter volume movements.

As with most letter segments, the 2007/08 GFC affected business behaviour relating to cost containment. The production of large, higher-cost publications for bulk distribution became a target for savings.

Magnifying this impact was the *Corporations Legislation Amendment (Simpler Regulatory System) Act 2007,* which began to reduce the number of paper-based company annual reports mailed directly to shareholders.

The PreSort large letter service was traditionally used to deliver these communications, but the new Act required companies to mail a hard copy of annual financial reports to eligible shareholders on an opt-in basis only.

Table 6.1.2: Percentage changes – PreSort large letter volumes and hypothesised drivers.

	2016/17 % change	2017/18 % change	Average annual % change	
			2000/01 to 2007/08	2007/08 to 2017/18
PreSort large letter volumes	-25.3	-25.1	2.2	-12.0
Advertising industry health measure	10.0	6.3	-0.4	2.1
Real price of PreSort large letters	17.8	13.5	-3.5	6.7
Paper as an input cost for direct mail	-1.3	-4.7	-0.1	0.0
Estimated Australian population	1.7	N/A	1.4	N/A
Australian non-farm GDP	1.8	3.2	3.6	2.6
Domestic broadband index	4.1	7.1	66.7*	10.0
Mobile wireless broadband	87.1	93.0	N/A	61.0**
Delivery service performance - large	0.1	0.5	0.6	0.2
GDP industry sub-segments:				
• **Information Media and Telecommunications**	2.4	2.8	4.7	3.2
• **Finance and Insurance Services**	4.1	3.9	5.9	2.9
• **Public Administration and Safety**	2.1	0.1	2.4	2.3
• **Retail Trade**	1.7	2.4	5.2	2.4

* The average annual growth rate for these variables is calculated from 2002/03 due to data availabilities.
** The average annual growth rate for these variables is calculated from 2011 due to data availabilities.

This change, combined with a tendency for companies to reduce transaction costs plus the real price increase in postage, acted to reduce the quantity of annual reports sent via post.

It should be noted that the 12.0% average annual decline in PreSort large letter volumes since 2007/08 was accelerated by the closure of the *Medium Letter Regular* and *Priority* services in 2013/14 and 2014/15.

Further discussion of this impact and the methodology for limiting any interpretive distortions concerning the closure is contained in Section 2.4.1.

As a result of an expanding set of choices for electronic alternatives, PreSort large letter volumes are likely to continue to decline across the letter volume projection horizon.

6.2 ELASTICITY ESTIMATES

6.2.1 Overview

The methodological approach to constructing the PreSort large letter volume vector error correction model is outlined in Appendix A. Table C.1.4 in Appendix C1 contains the associated statistical output. The PreSort large letter model explains 98.0% of the total quarterly variation in segment volumes over the time frame from September 2009 to June 2017.

6.2.2 Long-run market-based volume drivers and elasticity estimates

These are the historical demand drivers together with the demand elasticity.[38]

1. **Electronic substitution of bulk large documentation via mobile broadband growth.**

Substitutive pressures on PreSort large letter volumes have intensified since the passing of the *Corporations Amendments Act 2007,* which encouraged migration to online alternatives to the PreSort large letter. This has combined with an increase in the ability of senders to transmit bulk-produced documentation via electronic means such as via the cloud, email and web portals. Growth in wireless mobile broadband traffic across the Asia Pacific region is used as a proxy for these structural change effects.

Elasticity: A 1% increase in mobile broadband connections was associated with a 0.40% decrease in PreSort large letter volumes on average over the long-run.

Recent trend: Mobile broadband traffic in the Asia-Pacific is projected to have grown by an average 61% a year from 2011 to 2017/18. In 2017/18 this type of traffic was projected to have grown by 93%.

2. **Annual report dissemination (seasonal)**

While the seasonal nature of annual report dissemination eliminates it from the feasible set of drivers, *per se*, it should be noted that bulk mail-outs of annual reports occur in the month of October as a result of the legislative requirement for most publicly listed companies to lodge by 30 September each year.

PreSort large letter volumes in the December quarter are typically 18.1% higher than the quarterly average due to annual report-type mail. However, since the enactment of the *Corporations Amendments Act 2007* there has been a pronounced shift in seasonality from the December quarter to the September quarter. This shift, evident in Table A.5 of Appendix A emphasises a decreasing reliance on annual report type mailings within the PreSort large letter segment.

[38] Although real price registered as a statistically insignificant driver of PreSort large letter volumes it was included in the demand equation for both consistency and for its economic significance. The insignificant elasticity indicated a 1% increase in the real price of sending a PreSort large letter was associated with a 0.41% decrease in PreSort large letter volumes on average in the long-run.

6.3 BASELINE PROJECTIONS

6.3.1 Preamble

The PreSort large letter volume drivers over the time frame from September 2009 to June 2018 are:

- **substitution** – mobile wireless broadband traffic is used as a proxy for the increasing popularity of alternative electronic channels that allow for the receipt and evaluation of non-standard sized bulk documents. This variable also intends to capture the impact of the relaxed requirements for listed companies to send annual reports via the traditional large letter service

- **price** – a combination of inflationary real price changes and nominal price increases.[39]

6.3.2 Driver projections used

A series of projected values on each of the drivers within the VECM framework is required for projection. These include the following:

- CPI projections of 2.00% at 2018/19, 2.25% at 2019/20 and 2.50% for both 2020/21 and 2021/22 are derived from the Commonwealth Budget data.

- Nominal increases in the price of various products included in this segment were provided by Australia Post. To derive a single tractable nominal price variable, the inputs on the individual price points were weighted based upon 2017/18 volume proportions. For comparative purposes, an alternative price variable was constructed to model the scenario where letter prices do not increase in the projection period.

- The scenarios constructed do not provide any explicit treatment of possible cross-segment volume migration resulting from the asymmetrical pricing policies across service speeds.

- The mobile broadband traffic growth rate is set to the anticipated quarterly growth rate derived using projections of global mobile traffic in the Asia-Pacific region.

- The error correction component of the VECM is augmented with two dichotomous variables to capture the effects of the closure of the Medium letter product service and the relatively large increase in the basic postage rate price occurring in the March quarter of 2016.

[39] Included for economic rather than statistical significance.

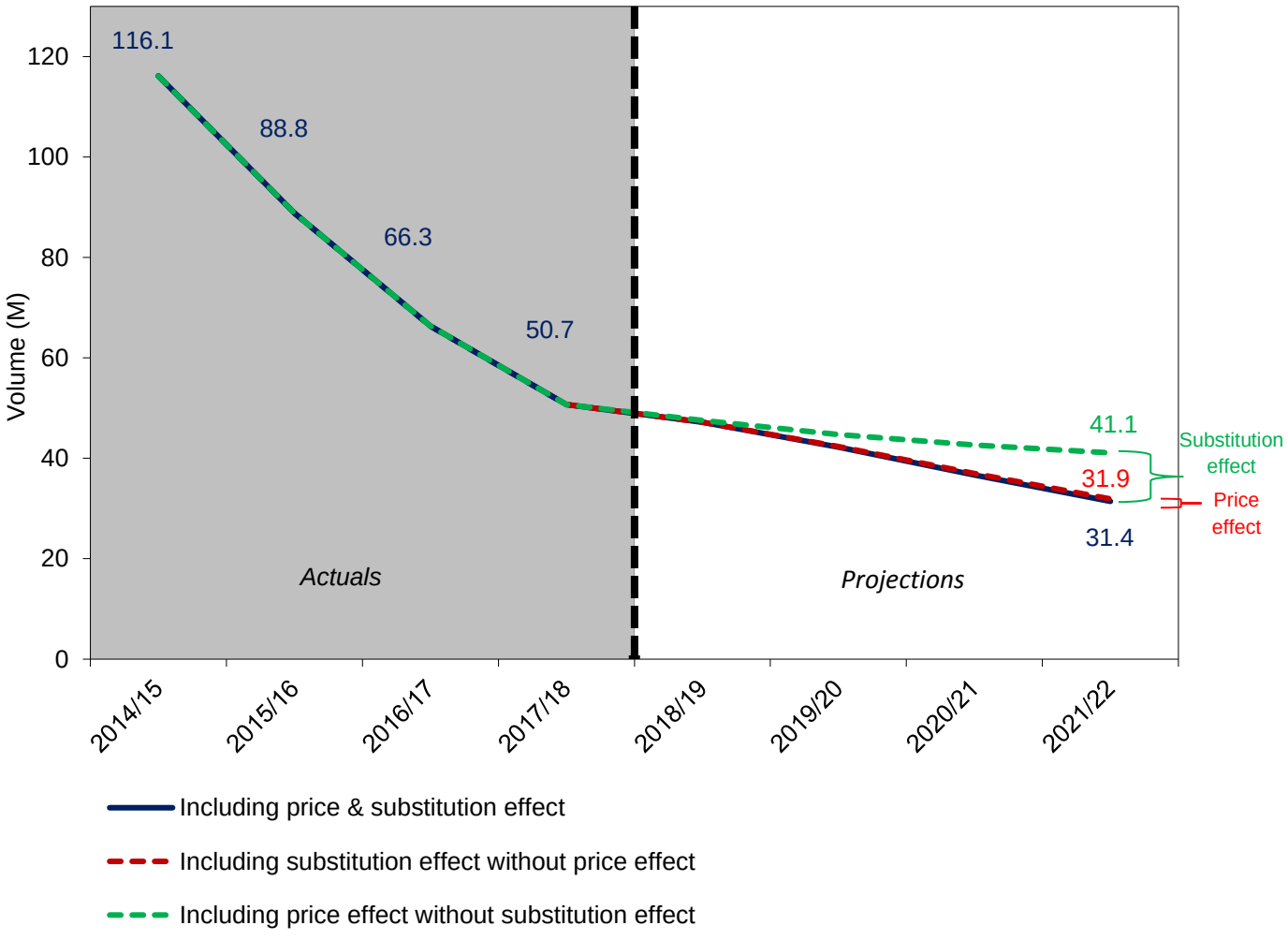
6.3.3 Econometric baseline volume projections

The PreSort large letter *ex-ante* baseline projections are presented in Table 6.3.3.1 and Chart 6.3.3.1. Based upon the differing scenarios, over the projection horizon the dominant driver of downward PreSort large letter volumes is electronic substitution as emphasised in Chart 6.3.3.1.

Table 6.3.3.1: PreSort large letter volumes econometric projected percentage changes.

	Baseline projected volume change (%)
2018/19	-7.0
2019/20	-10.5
2020/21	-13.1
2021/22	-14.3

Chart 6.3.3.1: PreSort large letter volumes (Seasonally Adjusted) Historical and projected.



7. PRINT POST

7.1 BACKGROUND

Print Post consists of lodgements that satisfy the relevant category content, size and weight requirements for the publication to be published at least twice a year.

Volumes are assumed to consist of bulk non-standard sized letter items emanating from business and the public sector such as magazines and catalogues, etc.

The dominant sub-category is *Print Post <500g*, as depicted in Table 7.1.1.

Table 7.1.1: Letter services comprising the Print Post segment.

Letter services classified Into the Print Post segment	volume proportions within the Print Post segment	
	2016/17	2017/18
Print Post Standard Size	10%	5%
Print Post < 500g	88%	91%
Print Post > 500g	3%	5%

Table 7.1.2 shows the annual percentage changes since 2000/01 for each of the hypothesised Print Post volume drivers considered in this study. The table also highlights the accelerating declines experienced by the Print Post service since 2007/08, with volumes falling at an annual average of 5.8%.

Declines in 2016/17 and 2017/18 have been more pronounced at 10.6% and 9.9% respectively.

The demand for magazines has undergone a significant structural shift in recent years and this has ramifications for generating a relevant econometric model. Underlining this change is the shifting behaviours associated with consumers of magazine content who now demand less of the subscription-based magazines that require a postal component because they are increasingly likely to view similar content:

- freely available in digital form on the internet;
- replicated by the publisher as a digital alternative to its printed magazine;
- through an increasing amount of time dedicated to social media activities; and
- freely available for ‘pick-up’ in printed form in and by the large supermarket chains.

In response to these changes a structural break test across post 2006 Print Post volumes can be utilised to isolate the timeframe that best corresponds to the current environment. That timeframe covers the September 2014 to July 2018 period with a quarterly frequency. To confirm the robustness of the model parameters and mitigate concerns associated with a small sample size, an alternate dynamic ordinary least squares model specification was also generated. This yielded a similar set of elasticities to the vector error correction model. These issues are discussed in Section 2.4.3.

The drivers of demand are expected to reflect the demand for the contents of a Print Post item and therefore studies focusing on recent trend movements in magazine demand can provide valuable insights for this initial modelling effort.

Table 7.1.2: Percentage changes – Print Post volumes and hypothesised drivers.

	2016/17 % change	2017/18 % change	Average annual % change	
			2000/01 to 2007/08	2007/08 to 2017/18
Print Post volumes	-10.6	-9.9	N/A	-5.8
Advertising industry health measure	10.0	6.3	-0.4	2.1
Real price of Print Post mail items	6.3	5.8	N/A	2.5
Paper as an input cost	-0.2	1.3	0.7	0.8
Estimated Australian population	1.7	N/A	1.4	N/A
Consumer sentiment index	0.7	1.6	0.4	-0.2
Australian non-farm GDP	1.8	3.2	3.6	2.6
Domestic broadband index	4.1	7.1	66.7*	10.0
Mobile wireless broadband	87.1	93.0	N/A	61.0**

* The average annual growth rate for these variables is calculated from 2002/03 due to data availabilities.
** The average annual growth rate for these variables is calculated from 2011 due to data availabilities.

In 2016, Nikali assessed the key factors and relative importance of demand drivers for publications in Finland by extending on his 2014 research regarding similar issues.[40]

Declines in Finland broadly reflect the Australian trends depicted in Table 7.1.2, with the market for magazine subscriptions since 2008 falling by 40%.

Nikali noted in 2008 that "a decisive turn towards a rapid reduction of the market occurred", and that it was more dramatic than in any era across the 80-year period where tractable data was available.

Nikali's econometric investigations reveal similarities in approach to Diversified Specifics' methodology for the general modelling of letter volume demand. That is, he identified magazine subscriptions as being driven primarily by GDP growth before the 2007/08 GFC, from which point electronic substitution and price become the dominant demand drivers. Of these, "in the reduction of the demand for magazines, substitution has by far been the greatest factor".[41]

In the Australian case, recent evidence by Roy Morgan suggests magazine readership levels are on the rise. However, due to the impact of digital options this does not translate into increases in subscription-based magazine readership linked to Print Post volumes.[42]

In certain industries consumer preferences have shifted away from a need to '*own*' content towards a desire to '*access*' it. CD sales are diminishing as Spotify and iTunes subscriptions rates grow. DVD sales have also suffered as Netflix, Stan and Foxtel on Demand increase in

[40] See Nikali 2016 and Nikali 2014 (bibliography).
[41] See Nikali 2016 (bibliography).
[42] See Roy Morgan 2017a (bibliography)

popularity. So too have digital versions of popular magazines provided an alternate medium for consuming written content to the detriment of posted magazine subscription sales.

Emerging from this environment have been cessations of print-based magazine runs, reductions in the frequency of publications and an adjustment of subscription contract periods.[43] In many cases, such changes have affected the retail price of a publication and in turn affected the demand for the contents of a Print Post item.

Table 7.1.3 permits an examination of the top 9 Australian print-based magazines based upon readership rates.[44] The growth tends to reside in those magazines provided free of charge and without a postal delivery requirement; for example, Coles and Fresh. However, the remaining magazines on this list that are circulated via a postal delivery channel or through a retail channel are in volume decline.

Table 7.1.3: Top 9 Australian magazines by readership.[45]

Magazine	Year to September 2017	
	Volume ('000)	% Volume change
COLES MAGAZINE	3,975	8.3
FRESH	3,828	17.0
MOTORING CLUB	2,711	-2.4
BETTER HOMES AND GARDENS	1,728	-6.8
WOMEN'S WEEKLY	1,479	-10.3
WOMAN'S DAY	1,282	-3.8
NEW IDEA	1,094	-4.0
NATIONAL GEOGRAPHIC	1,048	-3.6
THAT'S LIFE	670	-2.5

In 2013, Elkelä also focused on the indirect impact of social media on the demand for magazines, identifying behavioural changes on the part of the Finnish population.[46]

In Finland, social media usage levels increased to an average of an hour every day. This decreased the time available for other forms of relaxation such as reading magazines, which contributed further to the decline in magazine sales. Indeed, as consumers are increasingly utilising their time allocations differently similar trends can impact attention towards other types of publications contained within the Print Post category such as catalogues and direct mail.

The price of a Print Post mail item has increased by 2.5% since 2007/08; however, this statistic must be qualified by two distortive effects. First, in 2015/16, 2016/17 and 2017/18 the real price of a typical Print Post letter item increased by 7.6%, 6.3% and 5.8% respectively. Second, there have been market-based changes to the supply of magazines in response to electronic substitutes that might be offering similar content at no cost to the reader.

[43] Factors also acknowledged in Finland by Nikali 2016.

[44] Readership does not precisely reflect circulations (volumes distributed) and therefore the numbers quoted do not exactly align with Print Post volumes.

[45] Table 7.1.3 utilised data from Roy Morgan 2017b (bibliography).

[46] See Elkelä and Nikali 2013 (bibliography).

Nikali's econometric modelling of magazine subscription demand found an extremely inelastic price elasticity of demand that was statistically insignificant in explaining falling volumes. He concluded that the price of magazines had not been an important factor guiding demand.[47]

Table 7.1.2 shows that the cost of paper has increased by an average annual rate of 0.8% since 2007/08. This directly contributes to the overall cost of producing a magazine, catalogue or publication and such input cost increases could dissuade publishers from continuing with a printed offering when compared with the cost of a digital alternative.

It is fair to conclude that publications contained within a typical Print Post item will continue to face considerable obstacles over the next decade as they compete with digital alternatives.

The media is undergoing a period of disruption as it attempts to maintain contact with their audience via platforms that will best maximise their advertising revenues. These disruptions not only result in a movement away from a printed medium but also drive decisions regarding the interactions between the traditional and digital formats on offer.

Catalogues for instance are a channel designed to encourage sales and assist in maximising eCommerce sales. However, continued catalogue demand will be dependent upon:

1) an ability to achieve these goals relative to the online alternatives; and

2) the degree of consumer willingness to receive approaches via print-based forums.

This impact, by direct association, will influence future quantities of publications delivered and Print Post volumes can reasonably be expected to continue to decline across the projection horizon.

[47] See Nikali 2016 (bibliography).

7.2 ELASTICITY ESTIMATES

7.2.1 Overview

The methodological approach to constructing the Print Post volume vector error correction model is outlined in Appendix A. Table C.1.5 in Appendix C contains the associated statistical output.[48] The Print Post model explains 90.8% of the total quarterly variation in Print Post volumes in the time frame from September 2014 to June 2018.

7.2.2 Long-run market-based volume drivers and elasticity estimates

These are the historical demand drivers together with the demand elasticity.

1. **Real price**

The real cost (i.e. price adjusted for inflationary effects) of sending a Print Post mail item is inversely related to demand. Price changes in the examined time frame are significantly associated with demand responses in the contrary direction.

Elasticity: A 1% increase in the real price of sending a Print Post mail item was associated with a 0.34% decrease in Print Post volumes on average over the long-run.

Recent trend: The annual average growth in the real price of a Print Post mail item increased by 2.5% over the 2007/08 to 2017/18 period. This average is largely influenced however by the increases across the 2015/16 to 2017/18 period. In 2017/18, the real price of a Print Post mail item increased by 6.3%.

2. **Magazine and publication-type substitution via mobile broadband growth**

Magazines and similar publications have faced increasing competition from online platforms where alternative content might be freely available. Moreover, traditional magazine brands are now replicating their own content in electronic form.

Growth in wireless mobile broadband penetration levels is used as a proxy for the effects of these structural changes, because laptops, tablets and smartphones provide access to material that was formerly available only on a printed page.

Elasticity: A 1% increase in wireless mobile broadband connections was associated with a 0.14% decrease in Print Post mail volumes on average in the long-run.

Recent trend: Mobile broadband traffic in the Asia-Pacific is projected to have grown by an average 61% a year from 2011 to 2017/18. In 2017/18 this type of traffic was projected to have grown by 93%.

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[48] Econometric modelling at Australia Post for all segments except for Print Post has spanned a 17-year period. Over that time each model has benefited by numerous updates and revisions that have generated a significant knowledge base regarding the factors that drive letter volume demand for any one segment. The modelling of Print Post mail volumes however remains in its infancy and when combined with the relatively small sample size of the model the associated elasticity estimates should be treated with all due caution given the possible presence of latent effects.

7.3 BASELINE PROJECTIONS

7.3.1 Preamble

The Print Post volume drivers over the September 2014 to June 2018 timeframe are:

- **real price** – a combination of inflationary real price changes and nominal price increases

- **magazine and publication-type substitution** – mobile wireless broadband traffic is used as a proxy for the recent wave of electronic alternatives to the print-based magazine.

7.3.2 Driver projections used

A series of projected values on each of the drivers within the VECM framework is required for projection. These include the following:

- CPI projections of 2.00% at 2018/19, 2.25% at 2019/20 and 2.50% for both 2020/21 and 2021/22 are derived from the Commonwealth Budget data.

- Nominal increases in the price of various products included in this segment were provided by Australia Post. To derive a single tractable nominal price variable, the inputs on the individual price points were weighted based on 2017/18 volume proportions. For comparative purposes, an alternative price variable was constructed to model the scenario where letter prices do not increase in the projection period.

- The contingencies examined do not account for any changes in demand resulting from any changes in Australia Post's required Print Post delivery service standards.

- The scenarios constructed do not provide any explicit treatment of possible cross-segment volume migration resulting from the asymmetrical pricing policies across service speeds.

- The mobile broadband traffic growth rate is set to the anticipated quarterly growth rate derived using projections of global mobile traffic in the Asia-Pacific region.

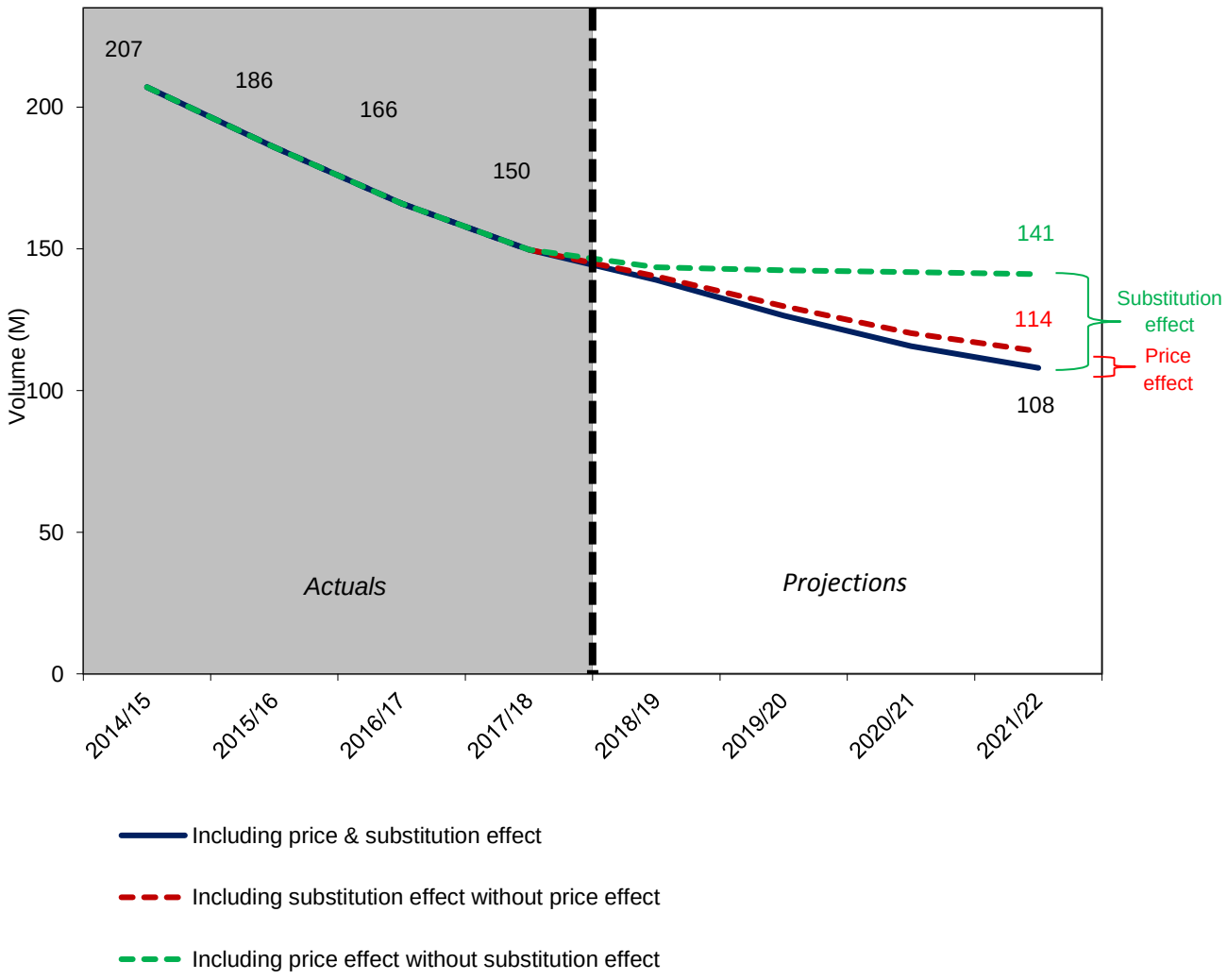
7.3.3 Econometric baseline volume projections

The Print Post *ex-ante* baseline projections are presented in Table 7.3.3.1 and Chart 7.3.3.1. Based upon the differing scenarios, over the projection horizon the dominant driver of downward Print Post volumes is electronic substitution as emphasised in Chart 7.3.3.1.

Table 7.3.3.1: Print Post volumes econometric projected percentage changes.

	Baseline projected volume change (%)
2018/19	-7.1
2019/20	-8.7
2020/21	-8.8
2021/22	-6.6

Chart 7.3.3.1: Print Post volumes (Seasonally Adjusted) Historical and projected.



8. CONCLUSION

8.1 FINAL REMARKS

The goal of this research was to develop a set of econometric models that identify and quantify the impact of Australia Post's letter volume demand drivers in the recent past. The inherent statistical associations contained within the models were then used to project baseline letter volume movements within each of the key segments into the future.

In most cases the models account for the recent acceleration in letter volume declines, which have been shaped by a more intensive period of technological change since the global financial crisis of 2007/08.

The development and penetration of an ever-expanding range of electronic communication platforms has resulted in a strong and sustained movement away from the traditional letter item. This trend has been compounded by the impact of a historically large set of price increases occurring in January 2016.

A primary focus of the research was to assess the dominating factor causing the letter volume declines. Despite recent increases in the price of a typical letter item, the movement away from paper-based modes of communication towards electronic alternatives remains the leading statistical and economic driver. However, technological change is not the sole determinant of the amount of substitutive pressure applied to Australia Post's letter segments. The behaviours of both senders and receivers and their willingness to accept alternative modes of correspondence also play a crucial role in determining the success of a given channel.

Rapid technological change affects all modes of communication, necessitating the regular re-evaluation of all associations. Associations cannot be expected to remain constant; despite this, accelerated letter volume declines are almost certain to continue.

To add a further layer of complication, there is no singular measurement of electronic substitution across all categories of letter mail or over time. Rather, substitution is defined by a variety of electronic communication channels that emerge because of technological and behavioural change. These changes affect letter volume segments at different times, diffusing their effects in a variety of ways.

The variables used to quantify future rates of electronic substitution are likely to change as each individual technology reaches its saturation point. At this stage, the variable then becomes no longer a suitable proxy for the continual declines in letter volumes and a new emerging technology-related variable will be required to take its place. This has implications for projecting, especially for the bill presentment component of the PreSort small letter segment where accelerated declines are occurring with an intensity that is atypical of historical trend data.

In a time of rapid technological change, projections generated from econometric models based on empirical data can quickly become obsolete. Although the econometric letter volume projections have been very successful over the short term, the use of augmentation based on institutional and industry-level intelligence represents a sound and standard way of correcting for errors when projecting letter volume movements beyond a couple of years.

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APPENDIX A

ECONOMETRIC PROCESS

A.1 Methodological approach

The econometric analysis presented in this Appendix represents the culmination of 20 years of modelling letter volumes by Dr. Chris Paterson and Diversified Specifics within the global postal industry.

During this period Diversified Specifics has identified several key letter volume drivers which have been utilised to construct various scenarios as regards real price variations; the effects of the macroeconomy (especially during the GFC commencing in 2007/08); and the role of electronic substitution in framing the current postal landscape.

The core econometric methodology is premised on specifying a dynamic set of models that allows for both long-run and short-run movements combined with their interaction effects on letter volumes.

Formally this modelling framework is underlined by a vector error correction model (VECM) which explicitly models the dynamic trends contained within letter volume movements and their key drivers while the long-run and short-run interactive effects are captured by error-correction components. For letter segments where the sample size is restricted as a result of either data availability or the effects of structural change, a single equation approach is adopted based on dynamic ordinary least squares (DOLS).

The VECM is a special case of a slightly more general dynamic model known as a vector autoregression, or VAR, as it imposes a set of cross-equation restrictions on the parameters of the VAR caused by the long-run component of the model impacting upon all variables within the dynamic system.

In implementing the dynamic VECM for each letter segment the following econometric methodological framework is followed:

1. The base model of each letter volume segment consists of a dynamic multivariate framework which has been developed and refined over successive letter volume demand updates. In recent times, for all segments the statistically significant drivers of letter volumes have traditionally been real price and electronic substitution, lagged dynamic variables as well as variables capturing changes in the economic landscape within Australia such as the effects of the GFC. The identification of a broad array of additional yet potential letter volume drivers that include factors pertaining to alternate measures of electronic substitution, the economic environment, delivery service performance, population size and a general set of variables that might result in letter volume fluctuations are then tested for statistical relevance. Once this testing is complete the result is a revised set of narrowly defined statistical drivers within a parsimonious framework for each letter volume segment.

2. An important set of variables investigated relate to those attempting to quantify the effects of electronic substitution. These variables are inherently difficult to measure as the factors affecting the substitution between letter volumes and the emergence of new technologies for transmitting information are extremely broad. Indeed, quantitative data-based variable availabilities are often very limited. There is also the added dimension that the technological landscape, their penetration rates and the way technological change impacts letter volumes is continually evolving. For these reasons identifying variables and constructing a consistent series to measure substitution provides additional challenges.

3. In determining the long-run drivers of letter volumes, an exhaustive set of unit root tests are conducted to classify variables in terms of their stochastic trend behaviour.

4. Related to the determination of the stochastic trend properties of the key variables in the model, tests for structural breaks are performed. This permits an identification of the dramatic changes in segmented letter volumes investigated over the last 20 years caused by external shocks to the Australian economy as well as the more recent substitutive effects on letter volumes arising from the emergence of new technologies. The outcomes of these tests when applied to each letter segment are used to determine whether the VECMs require augmentation directly to account for structural change effects not captured directly by the drivers of the specified models, and to identify the choice of estimation periods.

5. The dynamics of the VECM are formally tested using various information criteria based on methods given by Akaike, Hannan-Quinn and Schwarz. In implementing these tests, the lag length criteria are based on the VAR which is appropriate as the dynamics are determined before the identification of the long-run properties of the model.

6. The next phase of the econometric analysis involves establishing the presence of a long-run relationship amongst the drivers. As the drivers are identified to be integrated processes based on the unit root tests, the establishment of a long-run relationship is equivalent to testing for cointegration amongst all the drivers within each segment. The cointegration tests are based on the tests proposed by Johansen (1995) which is appropriate for the VECM framework adopted here as these tests represent a multivariate test of cointegration that are applied to a sequence of VECM specifications beginning with the unrestricted VAR model. In choosing these subset specifications, an allowance for intercepts in both long-run and short-run specifications is adopted for maximum flexibility.

7. Having established the presence of a long-run cointegrating equation the VECM is then estimated to derive point estimates of the long-run and short-run parameters, including the estimates of the error-correction parameters which control the dynamic equilibrium properties of the model.

8. For certain letter segments the VECM is refined in terms of sample and variable selection because of the economic and statistical significance of parameter estimates as well as whether the parameter estimates conform to economic theory in terms of the signs and magnitudes as determined from standard demand theory. For some of the segments, there have been dramatic changes in the time series properties of letter volumes resulting in changes in the choice of the starting date to estimate the parameters of the VECMs. Following the methodological approach adopted in previous price notifications these choices are based on the results of structural break tests which are discussed in detail below. For some segments this restriction in sample size results in the adoption of a single cointegrating approach based on a DOLS estimator.

9. Diagnostic tests are applied to each estimated VECM including within sample goodness of fit tests and tests for weak and strong exogeneity.

10. The final stage of the econometric analysis involves undertaking various scenario tests to project future trends in letter volumes for each segment. The scenarios are based on a combination of the historical trends identified in the variables of the VECM together with assumed future patterns that the drivers may follow. These future patterns are based on proposed future price changes and other inputs given by Australia Post in addition to projections on consumer price movements as obtained from the Commonwealth Budget. Some of the driver sensitivity analyses are also performed upon the electronic substitution variables. In performing the scenario analysis the Clements-Hendry (1996) adjustment procedure is adopted to improve the accuracy of the scenarios. Formally, the approach is based on the projection error of the last one-step ahead projection error arising from estimating the model within sample (i.e. June 2018). This adjustment value is then simply added on to the intercept of the model which, in turn, impacts the out of sample projections from September 2018 to June 2022. The properties of this approach are highlighted in the Clements-Hendry paper cited within the bibliography.

Whilst the econometric methodology is common across all letter volume segments investigated by Diversified Specifics, nonetheless there are some specific features that are idiosyncratic to modelling each letter volume segment which require additional refinements.

These may include the choice of variables, final model specifications, sample periods, etc. Some of these issues are discussed below with details of the estimated specifications governing all econometric models and test statistic tables contained within Appendix C of this document.

A.2 Structural break testing

Each of the letter volume segments were tested individually for a structural break in the presence of a unit root. These tests serve two purposes. Firstly, to identify the need for structural break dichotomous variables as additional variables in the VECMs. Secondly, for those letter segments where there are dramatic changes in their time series properties. This results in parameter estimates that do not conform to economic theory. The structural break tests are also used as a basis to determine the timeframe that would best reflect recent movements in letter volumes.

For each segment outliers in volumes have previously occurred in 1998/99 and 2001/02 to punctuate the letter volume data. These outliers arose due to Australia Post altering the rules governing lodgement minimums for PreSort bulk mail. As these periods now fall out-of-sample the VECMs no longer require further correction for these instances. Those volume spikes and troughs however reflected cross-segment letter volume migration, not an underlying market trend or a genuine structural break in any of the series.

A.2.1 Other (Ordinary) small

Structural break tests applied to Other small letter volumes provide evidence of a structural break at the end of 2009. This result suggests the need for a dichotomous variable to be included within the VECM specification as substitutive forces had already resulted in a downward trend in letter volumes for this segment prior to the economic slowdown.

Whilst there was an acceleration in that decline following the GFC there was no genuine turning point to motivate an adjustment of the commencement date for the modelling process.

Summary of Other small letter volume structural break test results:

Break point from levels OLS = 2010.00000000
Break point fraction = 58.00000000
Statistic = 0.00861863
Break point from levels GLS = 2010.00000000
Break point fraction = 58.00000000
Statistic = 0.01341719

A.2.2 PreSort small

Structural break tests applied to PreSort small letter volumes provide evidence of a structural break at the end of 2007. The timing of this break corresponds to the period whereby PreSort small letter volumes reached a turning point.

Prior to then letter volumes within this segment trended upwards until 2007 whereupon the GFC acted as a catalyst for the declining volumes that characterised the segment thereafter. This result as with Other small letter volumes suggests the need for a structural break dichotomous variable within the VECM specification.

In estimating the VECM for this letter segment the parameter estimates did pass the commonsense tests based upon economic theory which reflects the dramatic change in the time series properties of this series. Subsequently the timing of the structural break is used to choose the timeframe of the sample for the dynamic model for PreSort small volumes. However, the adoption of the multivariate dynamic model with a shorter timeframe resulted in less precise parameter estimates of the long-run cointegrating equation which was resolved by adopting a single equation approach based on DOLS.

Summary of PreSort small letter volume structural break test results:

Break point from levels OLS = 2008.25000000
Break point fraction = 51.00000000
Statistic = 0.00433706
Break point from levels GLS = 2008.00000000
Break point fraction = 50.00000000
Statistic = 0.00309375

A.2.3 Other (Ordinary) large

Structural break tests applied to Other large letter volumes also provide evidence of a structural break during the GFC between 2008 and 2009. The timing of the break corresponds to when Other large letter volumes begin to trend downwards.

As with the Other small letter volume segment, this result suggests the need for a structural break dummy in the VECM specification rather than a truncation of the examinable timeframe.

Summary of Other large letter volume structural break test results:

Break point from levels OLS = 2009.75000000
Break point fraction = 57.00000000
Statistic = 0.00673078
Break point from levels GLS = 2008.75000000
Break point fraction = 53.00000000
Statistic = 0.00870280

A.2.4 PreSort large

Structural break tests applied to PreSort large letter volumes provide evidence of a structural break between December 2008 and September 2009. The timing of the break represents the observed change in PreSort large letter volumes which then began to trend downwards.

This time series pattern mimics those of the PreSort small segment. As with PreSort small letter volumes this not only suggests the need for a structural break dichotomous variable within the VECM specifications, but it also advocates the need for choosing the sample timeframe for estimating the VECM of PreSort Large volumes based on the date resolved by the structural break tests.

Summary of PreSort large letter volume structural break test results:

Break point from levels OLS = 2009.00000000
Break point fraction = 54.00000000
Statistic = 0.02764513
Break point from levels GLS = 2009.75000000
Break point fraction = 57.00000000
Statistic = 0.03389350

A.2.5 Print Post

The data provided by Australia Post on Print Post volumes commence in 2006, a date much later than that available for the remaining letter segments considered. Structural break tests applied to the remaining segments identify a break at the time of the GFC. It is not feasible to include the possibility of a structural break at the time of the GFC in the case of Print Post as the data for this segment commences just prior to its occurrence. Nonetheless, structural break tests are still performed for this segment to identify the timing of the dramatic changes in the effects of electronic substitution on Print Post in the post GFC period.

The results of the structural break tests identify a break in September of 2014 which is consistent with the recent behavioural change associated with consumers demanding less of published content that requires postal delivery due to the availability and penetration of digital alternatives. Truncating the sample based on these structural break test results generate a sample size that is less than optimal. Issues and tests regarding the robustness of the VECM parameters estimated due to the resultant smaller sample size are discussed in Section 2.4.3.

Summary of PreSort large letter volume structural break test results:

Break point from levels OLS = 2015.00000000
Break point fraction = 34.00000000
Statistic = 0.00325701
Break point from levels GLS = 2014.75000000
Break point fraction = 33.00000000
Statistic = 0.00523482

A.3 Estimating the VECM

In modelling each of the small and large letter volume segments individually using a VECM framework, a VAR is initially estimated to generate the preliminary estimate of the lag structure. This analysis is performed initially for segments over the full sample period which begins in 2002 as this is when data on the substitution variables relevant to recent waves in technology become available. This approach is premised on the property that a VECM is a restricted form of a VAR whereby if the lag structure of a VAR is of order P then the lag structure of the VECM is P-1.

A range of preliminary tests were conducted on a broad set of potential drivers of letters volumes corresponding to each segment. Combining these statistical results with *a-priori* knowledge from previous studies on letter volume demand yielded a set of preferred drivers in the VAR of each segment. Each of the following sub-sections contains a summary of the potential drivers included in the econometric testing process in addition to the rationale behind their inclusion / exclusion within the final model used for projection purposes.

A.3.1. Other (Ordinary) small driver investigations and test results

Table A.3.1 Other (Ordinary) small letter volume potential drivers tested with results

	Statistical significance	Satisfy test of Commonsense	Notes
Cheque volumes	Y	Y	Included in the long run dynamics
Direct entry payments for debit transfers	N		Omitted
Australian non-farm GDP per capita	N		Omitted
Real price of Other (Ordinary) small letters	Y	Y	Included in the long run dynamics
Estimated Australian population		N	Omitted
Delivery service performance - small	Y	Y	No significant impact on the cointegrating equation. Omitted for parsimony
Abnormally large price increase Jan 2016 – Dichotomous	Y	Y	Included in the short run dynamics
Global financial crisis – Dichotomous	Y	Y	Included in the short run dynamics
Marriage equality survey – Dichotomous	N		Omitted

As a result of the above, the preferred Other (Ordinary) small letter volume drivers are:

1. Other (Ordinary) small letter volumes
2. The real price index of Other (Ordinary) small letter volumes
3. Cheque volumes as a proxy for bill payment substitution
4. Dichotomous variable on the January 2016 letter price rise
5. Dichotomous variable denoting the onset of the GFC

A.3.2. PreSort small driver investigations and test results

Table A.3.2 PreSort small letter volume potential drivers tested with results

	Statistical significance	Satisfy test of Commonsense	Notes
Australian non-farm GDP per capita	N	N	Omitted
Advertising industry health measure	N	N	Omitted
Credit card volumes		N	Omitted
Retail trade industry	N	N	Omitted
Real price of PreSort small letters	Y	Y	Included
Estimated Australian population	N	N	Omitted
Business confidence	N	N	Omitted
Domestic broadband index	Y	Y	Inferior statistical indicators point towards mobile wireless and a more appropriate measure of substitution. Omitted
Mobile wireless broadband	Y	Y	Included
Delivery service performance - small	N	N	Omitted
Abnormally large price increase Jan 2016 - Dichotomous	N	Y	Included. Required to satisfy the cointegration tests and for consistency.
Global financial crisis – Dichotomous	N	Y	Included. Required to satisfy the cointegration tests and for consistency.
Marriage equality survey – Dichotomous	N		Omitted
Federal Elections – Dichotomous	N		Omitted

As a result of the above, the preferred PreSort small letter volume drivers are:

1. PreSort small letter volumes
2. The real price Index of PreSort small letter volumes
3. Mobile broadband growth as a proxy for bill presentment substitution
4. Dichotomous variable on the January 2016 letter price rise
5. Dichotomous variable denoting the onset of the GFC

A.3.3. Other (Ordinary) large driver investigations and test results

Table A.3.3 Other (Ordinary) large letter volume potential drivers tested with results

	Statistical significance	Satisfy test of Commonsense	Notes
Domestic broadband index		N	Omitted
Mobile wireless broadband	Y	Y	Included in the long run dynamics
Real price of Other (Ordinary) large letters	Y	Y	Included in the long run dynamics
Estimated Australian population		N	Omitted
Australian non-farm GDP per capita	N		Omitted
Delivery service performance - large		N	Omitted
GDP industry sub-segments:			
• **Information Media and Telecommunications**		N	Omitted
• **Finance and Insurance Services**		N	Omitted
• **Public Administration and Safety**		N	Omitted
• **Health Care and Social Assistance**		N	Omitted
• **Education and Training**		N	Omitted
Abnormally large price increase Jan 2016 - Dichotomous	Y	Y	Included in the short run dynamics
Global financial crisis – Dichotomous	Y	Y	Included in the short run dynamics

As a result of the above, the preferred Other (Ordinary) large letter volume drivers are:

1. Other (Ordinary) large letter volumes
2. The real price index of Other (Ordinary) large letter volumes
3. Mobile broadband growth as a proxy for electronic document transmission substitution
4. Dichotomous variable on the January 2016 letter price rise
5. Dichotomous variable denoting the onset of the GFC

A.3.4. PreSort large driver investigations and test results

Table A.3.4 PreSort large letter volume potential drivers tested with results

	Statistical significance	Satisfy test of Commonsense	Notes
Advertising industry health measure	N	N	Omitted
Real price of PreSort large letters	Y	Y	Included in the long run dynamics
Paper as an input cost for direct mail		N	Omitted
Estimated Australian population	Y	N	Omitted. Nonsensical own elasticity and resultant price elasticity.
Australian non-farm GDP per capita	Y	N	Omitted. Nonsensical own income elasticity and resultant price elasticity.
Domestic broadband index		N	Omitted
Mobile wireless broadband	Y	Y	Included in the long run dynamics
Delivery service performance - large		N	Omitted
GDP industry sub-segments:			
• **Information Media and Telecommunications**		N	Omitted
• **Finance and Insurance Services**		N	Omitted
• **Public Administration and Safety**	Y	N	Omitted. Nonsensical own income elasticity and resultant price elasticity.
• **Retail Trade**		N	Omitted
Abnormally large price increase Jan 2016 - Dichotomous	Y	Y	Included in the short run dynamics
Closure of the medium letter service - Dichotomous	Y	Y	Included in the short run dynamics

As a result of the above, the preferred PreSort large letter volume drivers are:

1. PreSort large letter volumes
2. The real price index of PreSort large letter volumes
3. Mobile broadband growth as a proxy for bulk electronic document transmission substitution
4. Dichotomous variable on the January 2016 letter price rise
5. Dichotomous variable denoting the closure of the medium letter service

A.3.5. Print Post driver investigations and test results

Table A.3.5 Print Post volume potential drivers tested with results

	Statistical significance	Satisfy test of Commonsense	Notes
Advertising industry health measure		N	Omitted
Real price of Print Post mail items	Y	Y	Included in the long run dynamics
Paper as an input cost	N		Omitted
Estimated Australian population	N		Omitted
Consumer sentiment index	Y	Y	Omitted due to parsimony and historical volatility.
Australian non-farm GDP per capita	Y	N	Omitted. Also cointegration test not satisfied using this variable.
Domestic broadband index		N	Omitted
Mobile wireless broadband	Y	Y	Included in the long run dynamics
Abnormally large price increase Jan 2016 - Dichotomous	N/A	N/A	Omitted

As a result of the above, the preferred Print Post volume drivers are:

1. Print Post mail volumes
2. The real price index of Print Post mail volumes
3. Mobile broadband growth as a proxy for bulk electronic publication transmission substitution

A.4 Comments on the choice of the substitution variable

An important feature of the letter volume empirical analysis conducted by Diversified Specifics over the last 17 years is the increasing importance of a tendency for electronic substitution away from the traditional mail item arising from emergent technologies.

These technologies are constantly evolving presenting challenges for the construction of time series methods to adequately reflect their advances; how these advances impact upon the behavioural patterns of companies and individuals; and the way these changes translate in their impact upon letter volume fluctuations.

In the case of Other (Ordinary) small letter volumes, declines in cheque volumes have served as a reliable proxy variable for the effects of bill payments type substitution over a relatively long period of time. This is also true for the current empirical analysis of this segment.

With respect to bill presentments and PreSort letter volumes in general, more recently, time series data on the growth of the mobile and wireless broadband platforms have become available. Various measurements and projections on these variables are available both domestically and internationally.

In all cases the electronic substitution variables require some element of construction as the data is often annual (or bi-annual) which necessitates interpolation methods to convert the data into a quarterly frequency.

Splicing techniques are also utilised to combine several data sets to obtain a continuous time series that ultimately facilitates the estimation of the VECMs over the full range of the sample. Similar techniques are common practice for letter volume demand in studies internationally when dealing with the construction of an appropriate substitution variable, see Nikali (2016) as listed within the bibliography of this document for an example.

The initial broadband series employed by Diversified Specifics as a bill presentment substitution proxy in earlier empirical analyses of letter volumes was based on fixed-line broadband growth.

Subsequently information on projections of mobile broadband growth in the Asia Pacific region as generated by Cisco became available permitting a gradual melding with the original fixed-line broadband data to obtain an alternative substitution variable that reflected changes in technology as well as changes in substitutive trends.[49]

For the PreSort small / large and Other large letter volume segments the constructed mobile/fixed-line broadband variable more adequately proxied changes in the technological and behavioural landscape associated with these three segments. Additionally, from a statistical perspective, the point estimates tended to be correctly signed and statistically significant.

[49] See Cisco 2012 and Cisco 2016 (bibliography). Formally this is achieved by appending the growth rate of the mobile wireless broadband series to the fixed-line broadband series. As these are growth rates the resultant splicing of the two series is unit free.

A comparison of these results for all letter segments suggest that the effects of electronic substitution on letter volumes varies across different letter segments, reflecting differences in behavioural attitudes towards the various letter service offerings by Australia Post.

This is particularly the case for PreSort small letter volumes where aggressive substitution has led to sharper falls in letter volumes of this segment. In order to capture these additional substitution effects the mobile wireless based variable was augmented by an additional trend premised on the recent growth rates reported by Cisco (2016). Formally this is achieved by defining an augmented substitution variable given by:

$$MOBILE\_AUG_t = MOBILE_t*(1 + r)^t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where –

- MOBILE denotes the electronic substitution variable employed
- AUG denotes the augmented solution
- r represents the growth rate of the latent substitution variable
- *t* is a time trend that increments by a quarter, which is initialised at *t=0* for the last observation in the sample used to estimate the vector error correction model, namely June 2018.

The value of the quarterly growth rate is r=74%/4, where the value of 74% is based on the annual growth rates of M2M technology reported by Cisco (2016, p.33) for the period 2016 to 2020. In constructing the augmented substitution variable for PreSort small letter volumes, Diversified Specifics does recognise that other potential techniques are available consisting of Kalman filters, as described in Martin et al (2013), and nonparametric methods based on calibration procedures.[50] The approach adopted here is more data-driven which is consistent with the methodology already employed by Diversified Specifics in the construction of the substitution variables.

As another measure of substitution Diversified Specifics also tested the mobile wireless broadband series available from the Australian Bureau of Statistics (ABS). [51]

In the case of the PreSort small segment this series was unable to adequately capture the dynamic growth in neither broadband technologies nor the very recent accelerated declines that have characterised this segment.

Part of the reason for the failing of this series as a measurement proxy is its static nature and plateauing over recent years which reflects subscription rates reaching a natural point of saturation. This contrasts with the measurement objective of the variable which should be to trace the changing behaviour of senders and recipients in deciding between alternative communication channels.

In summary, although difficulties of summarising a wide-ranging number of individual and firm behaviours within a single electronic substitution measure exist, the statistical models, elasticities and projections undoubtedly benefit from augmenting the VECM analysis with some quantification of technological evolution.

[50] See Martin et al 2013 (bibliography).

[51] Australian Bureau of Statistics Reference: Internet Activity, Australia, December 2010 and June 2014.

The choices of electronic substitution variables utilised within this study whilst considered broad measures are applied with consistency and logical changes across many letter volume studies over a long period of time, facilitating comparisons across segments and over time.

Due to the impossibility of developing an all-encompassing measurement of electronic substitution targeted at each specific letter volume segment the estimation of the parameters associated with other downside pressures, such as real price effects should be treated with caution.

The substitution variable chosen consistently registers as the dominant driver of movements away from the traditional letter item within this and previous letter volume demand modelling conducted by Diversified Specifics.

A.5 Comments on the preliminary tests of the VECMs

Determining the optimal lag structures for each of the letter segment specific Vector Autoregression's (VAR's) were based on a joint evaluation of the AIC, SC and HQ statistics.

Cointegration tests amongst the relevant variables were then conducted to determine the actual VECM specification (i.e. Model 3 with P-1 lags).

The choice of Model 3 for the VECM specification allows for intercepts in both the cointegrating equation (long-run relationships) and the error correction equations (short-run relationships).

At all times common sense testing on the parameters of the VECM necessitate that the long-run estimates must conform to recognised economic and intuitive sense.

This implies in the long-run component of the model the parameters for price and substitution should be negative.

The results of the testing phase for the Optimal lag structures and for cointegration are summarised in Table A.5.1.

Detailed statistical output tables are contained within Appendix C.2 on optimal VAR lag structure tests and Appendix C.3 containing the tests for cointegration.

In the case of Other (Ordinary) large letter volumes the optimal lag structure of the VAR is 2 in the case of the SC and HQ criteria, suggesting an optimal lag structure of 1 lag in the VECM. However, this specification failed to satisfy the test of cointegration. By adopting an even tighter lag structure in the VECM of no lags, resulted in an improvement in the precision of the estimates and subsequently the test of cointegration being satisfied.

Table A.5.1. Results of the optimal VAR lag structure and co-integration tests by letter volume segment

Letter volume segment	Optimal VAR lag structure	Co-integration test results
Other (Ordinary) small	AIC: 4; SC: 1; HQ: 3	Zero lags
PreSort small	AIC: 2; SC: 2; HQ: 2	One lag
Other (Ordinary) large	AIC: 3; SC: 2; HQ: 2	Zero lag
PreSort large	AIC: 4; SC: 1; HQ: 1	Zero lags
Print Post	AIC: 4; SC: 1; HQ: 4	Two lags

A.6 Evolutionary Path of Seasonal Factors

Tables A.6.1 through A.6.7 illustrate the year on year progression of seasonal factors for each of the key letter volume segments in addition to the regular and priority speed services. These estimates provide a quantitative summary of how the intra-year letter volume flows have altered for each of Australia Post's key letter segments since 1995/96.

Table A.6.1. Other (Ordinary) small letter volumes - Quarterly seasonal factors by year

	Q1	Q2	Q3	Q4	AVGE
1995			99.1	114.3	106.7
1996	90.3	96.1	99.3	114.1	100.0
1997	90.7	95.5	100.0	113.5	99.9
1998	91.4	94.6	100.8	113.2	100.0
1999	91.9	93.7	101.0	113.7	100.1
2000	91.8	93.2	100.8	115.1	100.2
2001	90.8	93.1	100.7	115.9	100.1
2002	90.3	92.9	100.9	115.9	100.0
2003	90.1	93.1	101.0	115.4	99.9
2004	90.5	93.4	100.8	115.0	99.9
2005	90.5	94.2	100.4	114.7	100.0
2006	90.4	94.8	100.3	114.4	100.0
2007	89.9	95.6	100.1	114.2	100.0
2008	89.8	96.0	100.2	113.8	99.9
2009	89.9	96.2	100.4	113.1	99.9
2010	90.5	96.0	100.9	112.0	99.9
2011	91.1	96.1	101.4	110.7	99.8
2012	91.6	96.5	102.0	109.0	99.8
2013	92.2	97.3	102.6	106.7	99.7
2014	92.9	98.5	103.2	104.0	99.6
2015	94.1	99.3	103.7	101.8	99.7
2016	95.1	99.8	103.9	100.6	99.8
2017	95.8	99.7	104.1	100.3	100.0
2018	95.9	99.8			97.9
AVGE	**91.6**	**95.9**	**101.2**	**111.4**	

Table A.6.2. Other (Ordinary) large letter volumes - Quarterly seasonal factors by year

	Q1	Q2	Q3	Q4	AVGE
1995			102.2	109.2	105.7
1996	90.0	98.4	102.6	109.1	100.0
1997	90.0	98.1	103.1	108.8	100.0
1998	89.9	97.8	103.7	108.6	100.0
1999	90.0	97.2	104.6	108.3	100.0
2000	90.2	96.4	105.5	108.0	100.0
2001	90.4	95.7	106.3	107.6	100.0
2002	90.5	95.4	106.6	107.3	100.0
2003	90.6	95.5	106.8	106.8	99.9
2004	90.9	95.8	106.7	106.0	99.9
2005	91.3	96.4	106.5	105.3	99.9
2006	91.7	97.2	105.9	104.8	99.9
2007	92.0	97.7	105.5	104.5	99.9
2008	92.3	98.0	105.0	104.6	100.0
2009	92.5	97.9	104.8	104.8	100.0
2010	92.6	97.9	104.5	105.0	100.0
2011	92.9	97.5	104.3	105.4	100.0
2012	93.0	97.2	104.1	106.0	100.1
2013	92.9	96.8	104.1	106.5	100.1
2014	92.6	96.8	104.0	106.7	100.0
2015	92.4	96.7	104.2	106.7	100.0
2016	92.3	96.7	104.4	106.6	100.0
2017	92.3	96.7	104.5	106.6	100.0
2018	92.1	96.8			94.5
AVGE	**91.5**	**97.0**	**104.8**	**106.7**	

Table A.6.3. PreSort small letter volumes - Quarterly seasonal factors by year

	Q1	Q2	Q3	Q4	AVGE
1995			105.3	103.1	104.2
1996	95.6	96.1	105.2	102.9	100.0
1997	95.6	96.6	104.9	102.6	99.9
1998	95.7	97.4	104.2	102.3	99.9
1999	95.8	98.4	103.4	102.1	99.9
2000	95.9	99.2	102.6	101.9	99.9
2001	96.1	99.7	102.2	101.9	100.0
2002	96.3	99.7	102.1	102.0	100.0
2003	96.2	99.6	102.4	101.9	100.0
2004	96.1	99.4	102.7	101.9	100.0
2005	96.0	99.3	102.9	101.9	100.0
2006	95.9	99.3	102.9	102.0	100.0
2007	95.7	99.2	103.1	102.0	100.0
2008	95.7	98.9	103.5	101.8	100.0
2009	95.7	98.6	104.1	101.4	100.0
2010	95.8	98.4	104.8	100.8	99.9
2011	96.1	98.2	105.4	100.0	99.9
2012	96.5	98.0	105.8	99.5	99.9
2013	96.7	98.1	105.8	99.2	100.0
2014	96.8	98.3	105.7	99.1	100.0
2015	96.8	98.6	105.5	99.1	100.0
2016	96.6	98.8	105.4	99.2	100.0
2017	96.4	99.2	105.2	99.2	100.0
2018	96.3	99.4			97.8
AVGE	**96.1**	**98.6**	**104.1**	**101.2**	

Table A.6.4. PreSort large letter volumes - Quarterly seasonal factors by year

	Q1	Q2	Q3	Q4	AVGE
1995			99.4	121.6	110.5
1996	83.4	95.7	98.8	122.8	100.2
1997	82.6	95.6	98.5	123.7	100.1
1998	81.9	95.7	98.6	124.1	100.1
1999	81.4	96.3	98.5	123.5	99.9
2000	82.3	95.3	99.1	122.9	99.9
2001	83.3	94.3	100.1	121.5	99.8
2002	85.1	92.7	101.0	120.8	99.9
2003	85.9	92.1	100.8	121.4	100.1
2004	85.9	91.4	100.9	122.6	100.2
2005	84.9	90.9	102.1	122.4	100.1
2006	84.3	90.3	104.4	120.6	99.9
2007	84.5	89.5	107.2	118.3	99.9
2008	84.9	88.6	109.9	116.0	99.8
2009	85.6	87.6	112.5	113.5	99.8
2010	86.5	87.0	114.0	111.8	99.8
2011	87.4	86.5	114.8	111.1	99.9
2012	87.8	86.3	114.7	111.5	100.1
2013	87.7	85.8	115.1	111.9	100.1
2014	87.3	85.1	115.5	112.6	100.2
2015	86.8	84.5	116.0	113.2	100.1
2016	86.3	84.2	116.0	114.0	100.1
2017	85.7	84.1	116.1	114.3	100.1
2018	85.5	84.0			84.8
AVGE	**85.1**	**89.7**	**106.7**	**118.1**	

Table A.6.5. Print Post volumes - Quarterly seasonal factors by year

	Q1	Q2	Q3	Q4	AVGE
2006			103.8	106.9	105.3
2007	93.9	96.4	97.8	112.5	100.2
2008	92.0	96.6	103.0	109.1	100.2
2009	90.3	97.9	103.6	107.3	99.8
2010	91.2	98.3	106.4	104.3	100.1
2011	92.0	99.7	100.8	107.1	99.9
2012	93.0	98.8	101.1	107.4	100.1
2013	92.7	98.8	101.8	105.5	99.7
2014	95.2	93.8	104.8	104.1	99.5
2015	90.4	103.8	104.1	103.2	100.4
2016	95.2	96.7	105.4	102.7	100.0
2017	95.3	96.7	104.8	104.3	100.3
2018	92.8	98.6			95.7
AVGE	**92.8**	**98.0**	**103.1**	**106.2**	

Table A.6.6. Regular speed volumes - Quarterly seasonal factors by year

	Q1	Q2	Q3	Q4	AVGE
2014	94.7	100.4	105.0	99.9	100.0
2015	94.7	100.4	105.0	99.9	100.0
2016	94.7	100.4	105.0	99.9	100.0
2017	94.7	100.4	105.0	99.9	100.0
2018	94.7	100.4			97.5
AVGE	**94.7**	**100.4**	**105.0**	**99.9**	

Table A.6.7. Priority speed volumes - Quarterly seasonal factors by year

	Q1	Q2	Q3	Q4	AVGE
2014	93.0	94.8	109.4	102.7	100.0
2015	93.0	94.8	109.4	102.7	100.0
2016	93.0	94.8	109.4	102.7	100.0
2017	93.0	94.8	109.4	102.7	100.0
2018	93.0	94.8			93.9
AVGE	**93.0**	**94.8**	**109.4**	**102.7**	

APPENDIX B

DATA AND DATA DESCRIPTIONS

B.1 Internal Australia Post data

Australia Post supplied the letter volume and revenue data to Diversified Specifics in the form of revenue-based volumes since 1995. Information on the proposed percentage changes in the price of individual letter services were also supplied by Australia Post and are presented in Table B.2.2.

B.2 Externally sourced data

To facilitate association testing and the generation of econometric models, Diversified Specifics obtained variables from a variety of external sources. Each variable that was sourced and assessed is outlined in Table B.2.1. Variables obtained were used to test developed hypothesis in an unbiased and structured manner.

Externally sourced variables outlined below that were not included in the final econometric models, were not found to be statistically significant in relation to segment-specific volume movements or did not meet the test of common-sense based on the accepted principles of economic theory.

Table B.2.1 Externally sourced data descriptions

Volume predictor	Variable	Series timeframe utilised (Data frequency)	Data source
Australian Non-farm GDP	Australian Non-farm GDP	September 1995 to June 2018 – Quarterly series	Gross Domestic Product minus Agriculture, Forestry and Fishing (A), Cat. No. 5206.0 Table 6 Gross Value Added by Industry, Australia, Chain volume measures, Australian Bureau of Statistics
Advertising Industry Health Measure	S&P/ASX 200 Consumer Discretionary Index	September 1995 to June 2018 – Quarterly series	Created by Diversified Specifics. Original Data from Media Index: Investweb.com and S&P/ASX 200 Consumer Discretionary Index: Investing.com
Credit Card Volumes	Credit Card Volumes	July 1995 to June 2018 – Monthly series	Number of Accounts, Credit and Charge Card Statistics - C1, Reserve Bank of Australia
Cheque Volumes	Cheque Volumes	January 2002 to June 2018 – Monthly series	Total Number of Cheques, Cheques and Direct Entry Payments - C6, Reserve Bank of Australia
Real Price of Other (Ordinary) Small Letters	Real Price of Other (Ordinary) Small Letters	September 1995 to June 2018 – Quarterly series	Nominal price of Other (Ordinary) Small Letters: Australia Post; CPI: ABS Cat. No. 6401.0 TABLES 1 and 2. All Groups, Index Numbers and Percentage Changes , Consumer Price Index, Australian Bureau of Statistics
Real Price of Other (Ordinary) Large Letters	Real Price of Other (Ordinary) Large Letters	September 1995 to June 2018 – Quarterly series	Nominal price of Other (Ordinary) Large Letters: Australia Post; CPI: ABS Cat. No. 6401.0 TABLES 1 and 2. All Groups, Index Numbers and Percentage Changes , Consumer Price Index, Australian Bureau of Statistics
Real Price of PreSort Small Letters	Real Price of PreSort Small Letters	September 1995 to June 2018 – Quarterly series	Nominal price of PreSort Small Letters: Australia Post; CPI: ABS Cat. No. 6401.0 TABLES 1 and 2. All Groups, Index Numbers and Percentage Changes , Consumer Price Index, Australian Bureau of Statistics
Real Price of PreSort Large Letters	Real Price of PreSort Large Letters	September 1995 to June 2018 – Quarterly series	Average Revenue Factors: Letters Group, Australia Post; CPI: ABS Cat. No. 6401.0 TABLES 1 and 2. All Groups, Index Numbers and Percentage Changes , Consumer Price Index, Australia Bureau of Statistics

Volume predictor	Variable	Series timeframe utilised (Data frequency)	Data source
Domestic Broadband Index	Domestic Broadband Index	March 2002 to June 2018 – Quarterly series	Created by Diversified Specifics. Original Data from ABS Internet Activity, Australia, December 2009, December 2012, and June 2018 and Snapshot of Broadband data, ACCC
Information Media and Telecommunications Industry	Information Media and Telecommunications Industry	September 1995 to June 2018 – Quarterly series	Information media and telecommunications (J), Cat. No. 5206.0 Table 6 Gross Value Added by Industry, Australia, Chain volume measures, Australian Bureau of Statistics
Finance and Insurance Services Industry	Finance and Insurance Services Industry	September 1995 to June 2018 – Quarterly series	Financial and insurance services (K), Cat. No. 5206.0 Table 6 Gross Value Added by Industry, Australia, Chain volume measures, Australian Bureau of Statistics
Public Administration and Safety Industry	Public Administration and Safety Industry	September 1995 to June 2018 – Quarterly series	Public administration and safety (O), Cat. No. 5206.0 Table 6 Gross Value Added by Industry, Australia, Chain volume measures, Australian Bureau of Statistics
Rental, Hiring & Real Estate Services Industry	Rental, Hiring & Real Estate Services Industry	September 1995 to June 2018 – Quarterly series	Rental, hiring and real estate services (L), Cat. No. 5206.0 Table 6 Gross Value Added by Industry, Australia, Chain volume measures, Australian Bureau of Statistics
Retail Trade Industry	Retail Trade Industry	September 1995 to June 2018 – Quarterly series	Retail trade (G), Cat. No. 5206.0 Table 6 Gross Value Added by Industry, Australia, Chain volume measures, Australian Bureau of Statistics
Wholesale Trade Industry	Wholesale Trade Industry	September 1995 to June 2018 – Quarterly series	Wholesale trade (F), Cat. No. 5206.0 Table 6 Gross Value Added by Industry, Australia, Chain volume measures, Australian Bureau of Statistics
Health Care and Social Assistance Industry	Health Care and Social Assistance Industry	September 1995 to June 2018 – Quarterly series	Health care and social assistance (Q), Cat. No. 5206.0 Table 6 Gross Value Added by Industry, Australia, Chain volume measures, Australian Bureau of Statistics
Education & Training Industry	Education & Training Industry	September 1995 to June 2018 – Quarterly series	Education and training (P), Cat. No. 5206.0 Table 6 Gross Value Added by Industry, Australia, Chain volume measures, Australian Bureau of Statistics
Manufacturing Industry	Manufacturing Industry	September 1995 to June 2018 – Quarterly series	Manufacturing (C), Cat. No. 5206.0 Table 6 Gross Value Added by Industry, Australia, Chain volume measures, Australian Bureau of Statistics
Australian Population	Estimated Australian Population	September 1995 to June 2018 – Quarterly series	ABS Cat. No. 3101.0 Table 1. Population Change, Summary - Australia ('000)
Paper as an Input Cost	Paper as an Input Cost	July 1995 to June 2018 – Monthly series	15 Pulp, paper and converted paper product manufacturing, ABS Producer Price Index Table 10 and 11 Cat Number 642702
Paper as an Input Cost for Direct Mail	Paper as an Input Cost for Direct Mail	July 1995 to June 2018 – Monthly series	1523 Paper stationery manufacturing, ABS Producer Price Index Table 10 and 11 Cat Number 642704
Business Confidence	NAB Business Confidence Index	April 1997 to June 2018 – Monthly series	Net balance (NSA)+100, NAB business confidence index, investing.com
Consumer Sentiment Index	Consumer Sentiment Index	July 1995 to June 2018 – Monthly series	Monthly Activity Indicators, Westpac-Melbourne Institute consumer sentiment index, H3 Monthly Activity Indicators and G8 Indicators of Spending and Confidence, Reserve Bank of Australia
The Economic Downturn	Economic Downturn	Dichotomous Variable	Internally constructed variable – Diversified Specifics
Mobile Wireless Broadband Connections	Mobile Wireless Broadband Connections	June 2009 to June 2014 – Biannual series; June 2014 – June 2018 Annual series	Australian Bureau of Statistics (2014), ABS Cat No. 81530do001_201406 Internet Activity, Internet subscribers by type of access connection, for ISP's with more than 1,000 subscribers, Mobile Wireless, Australia. Cisco (2012 & 2016), "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update"
Initial Public Offerings	Market Capitalisation associated with Large Initial Public Offerings	September 2007 to June 2018 – Quarterly series	Internally constructed variable – Diversified Specifics using data from the Australian Stock Exchange ASX Top 300 companies and the Australian Financial Review Online

Table B.2.2 Actual & proposed letter price increases as provided by Australia Post

	FY19 - Actual	FY20 - Proposed
	Oct-2018	Jan-2020
Small Letters Ordinary		
Ordinary Stamped	0.0%	10.0%
Ordinary Prepaid Envelope Regular	0.0%	8.0%
Ordinary Stamped Priority	0.0%	6.7%
Metered Imprint Charge Regular	0.5%	6.6%
Metered Imprint Charge Priority	0.3%	4.4%
Imprint Cash Regular	0.0%	10.0%
Imprint Cash Priority	0.0%	6.7%
Clean Regular	0.5%	6.6%
Clean Priority	0.8%	6.8%
Local Rate Regular	0.5%	3.6%
Local Rate Priority	1.0%	4.0%
Reply Paid Regular	1.3%	4.1%
Reply Paid Priority	1.1%	4.4%
Large Letters Ordinary		
Ordinary Stamped 0 250g	0.0%	10.0%
Ordinary Stamped 0 250g Priority	0.0%	8.3%
Metered Imprint Charge 0 250g Regular	0.6%	6.6%
Metered Imprint Charge 0 250g Priority	0.5%	5.4%
Imprint Cash 0 250g Regular	0.0%	10.0%
Imprint Cash 0 250g Priority	0.0%	8.3%
Clean Small Plus Regular	1.9%	4.4%
Clean Small Plus Priority	2.1%	4.4%
Local Rate Regular	2.6%	2.6%
Local Rate Priority	2.8%	3.7%
Reply Paid Regular	2.1%	5.3%
Reply Paid Priority	2.1%	4.2%
Ordinary Stamped 250 500g	0.0%	10.0%
Ordinary Stamped 250 500g Priority	0.0%	9.1%
Metered Imprint Charge 250 500g Regular	1.0%	6.6%
Metered Imprint Charge 250 500g Priority	0.9%	6.0%
Imprint Cash 250 500g Regular	0.0%	10.0%
Imprint Cash 250 500g Priority	0.0%	9.1%
Ordinary Prepaid Envelope 0 250g Regular	0.0%	9.9%
Ordinary Prepaid Envelope 250 500g Regular	0.0%	10.3%
Small Letters PreSort		
PreSort Regular	1.1%	6.6%
PreSort Priority	0.9%	6.5%
Charity Mail Regular	1.8%	3.0%
Charity Mail Priority	2.1%	3.3%
PreSort Promo Mail Regular	1.4%	3.1%
Promo Post Priority	1.3%	3.4%
Sample Post	0.0%	4.0%

	FY19 - Actual	FY20 - Proposed
	Oct-2018	Jan-2020
Large Letters PreSort		
PreSort Small Plus Regular	2.4%	4.3%
PreSort Small Plus Priority	2.6%	4.5%
PreSort Medium Regular	N/A	N/A
PreSort Medium Priority	N/A	N/A
PreSort Large 0 250g Regular	2.2%	4.1%
PreSort Large 0 250g Priority	2.2%	3.9%
PreSort Large 250 500g Regular	2.6%	4.1%
PreSort Large 250 500g Priority	2.3%	3.6%
Charity Mail Regular	2.5%	3.1%
Promo Post Small Plus Large Regular	2.2%	3.4%
Promo Post 0 125 Regular	2.1%	3.3%
Print Post		
Standard Regular	5.6%	4.1%
Standard Regular (Reserved)	5.6%	4.1%
<500g Regular	5.6%	4.1%
250 500g Regular	5.6%	4.0%
250-500g Regular (Non-Reserved)	5.6%	4.0%
>500g Regular	5.0%	4.0%
Contract Publications Regular	2.0%	3.0%
Contract Publications Regular (Reserved)	2.0%	3.0%
Contract Publications Priority	N/A	N/A
>500g Priority	5.0%	4.0%
<500g Priority	5.6%	4.1%
<250g Priority (Reserved)	5.6%	4.1%
251-500g Priority (Non-Reserved)	5.6%	4.1%
Standard Priority	6.0%	7.3%
Standard Priority (Reserved)	6.0%	7.3%

APPENDIX C

KEY STATISTICAL OUTPUTS

C.1 Preferred econometric models for letter volume projection

C.1.1 Other (Ordinary) small letter volumes vector error correction model

The results of the VECM for Other (Ordinary) small letter volumes are given in Table C.1.1.1. The sample period is quarter two 2002 to quarter two 2018, which is the maximum sample period where data on all variables are available. The VECM is also augmented with two dummy variables which capture the effects of the GFC (ECONDOWN) and the relatively large increase in the basic postage rate in January 2016.

Table C.1.1.1. Other (Ordinary) small letter volumes vector error correction model

Vector Error Correction Estimates Sample: 6/01/2002 6/01/2018 Included observations: 65 Standard errors in ( ) & t-statistics in [ ]			
Cointegrating Eq:	CointEq1		
LVOLUME_SA(-1)	1.000000		
LOG(REALPR(-1))	0.417876		
	(0.05490)		
	[7.61218]		
LOG(CHEQVOLU_SA(-1))	-0.561310		
	(0.02336)		
	[-24.0256]		
C	2.582834		
Error Correction:	D(LVOLUME_SA)	D(LOG(REALPR))	D(LOG(CHEQVOLU_SA))
CointEq1	-0.512647	-0.195934	-0.049315
	(0.10148)	(0.09077)	(0.08051)
	[-5.05150]	[-2.15859]	[-0.61254]
C	-0.023932	-0.011038	-0.022263
	(0.00646)	(0.00578)	(0.00513)
	[-3.70401]	[-1.90997]	[-4.34336]
ECONDOWN	0.011663	0.017505	-0.016965
	(0.00945)	(0.00845)	(0.00750)
	[1.23386]	[2.07050]	[-2.26230]
DUM_PRICE	-0.062332	0.430672	-0.051441
	(0.02817)	(0.02520)	(0.02235)
	[-2.21272]	[17.0930]	[-2.30185]
R-squared	0.378076	0.854940	0.260569
Adj. R-squared	0.347489	0.847806	0.224203
Sum sq. resids	0.042764	0.034211	0.026914
S.E. equation	0.026477	0.023682	0.021005
F-statistic	12.36090	119.8385	7.165275
Log likelihood	145.8786	153.1309	160.9278
Akaike AIC	-4.365496	-4.588644	-4.828549
Schwarz SC	-4.231688	-4.454835	-4.694741
Mean dependent	-0.017893	0.006091	-0.033233
S.D. dependent	0.032778	0.060704	0.023848
Determinant resid covariance (dof adj.)		1.61E-10	
Determinant resid covariance		1.33E-10	
Log likelihood		462.3877	
Akaike information criterion		-13.76578	
Schwarz criterion		-13.26399	

C.1.2. PreSort small letter volumes dynamic ordinary least squares model

The results of the dynamic model for PreSort small letter volumes are given in Table C.1.2.1. The sample period begins in quarter four 2007 and ends in quarter two 2018. The choice of starting date is based on results of the structural break tests and the empirical result that estimating the model for the full sample period beginning in 2002 resulted in parameter estimates that either did not conform to the accepted principles of economic theory; were statistically insignificant; or a combination of both.

The results for PreSort small letter volumes are presented for the single equation cointegrating model based on DOLS as the VECM estimates for the smaller sample resulted in less precise estimates. The final estimates presented in Table C.1.2.1. reflect a price and electronic substitution elasticity that are both economically and statistically significant.

This model also is augmented with two dummy variables which capture the effects of the GFC (ECONDOWN) and the large rise in the postal rate during the March quarter of 2016 (DUM_PRICE).

Although the final estimated model in Table C.1.2.1 contains these two dichotomous variables, both exhibit individual statistically insignificance. Nonetheless these variables do have an important effect as their exclusion results in the cointegration test no longer being satisfied. The two variables therefore remain within the preferred model consistent with the remaining models combined with the economic significance of their impact.

Table C.1.2.1. PreSort small letter volumes dynamic least squares model

Dependent Variable: LOG(VOLUME_SA)
Method: Dynamic Least Squares (DOLS)
Sample: 12/01/2007 6/01/2018
Included observations: 43
Cointegrating equation deterministics: C ECONDOWN DUM_PRICE
Fixed leads and lags specification (lead=0, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(REALPR)	-0.235367	0.093362	-2.521012	0.0166
LOG(MOBILE_AUG)	-0.061790	0.014459	-4.273622	0.0001
C	5.691275	0.667878	8.521424	0.0000
ECONDOWN	-0.037683	0.023749	-1.586742	0.1218
DUM_PRICE	-0.101021	0.085711	-1.178625	0.2467

R-squared	0.970867	Mean dependent var	6.086659
Adjusted R-squared	0.964013	S.D. dependent var	0.155716
S.E. of regression	0.029540	Sum squared resid	0.029668
Long-run variance	0.001518		

C.1.3 Other (Ordinary) large letter volumes vector error correction model

The results of the VECM for the Other large letter volume segment are presented in Table C.1.3.1. The sample period covers quarter two 2002 to quarter two 2018, which is the maximum sample period where data on all variables are available. The VECM is also augmented with two dummy variables which capture the effects of the GFC (ECONDOWN) and the relatively large increase in the postage rate, occurring during the March quarter of 2016.

Table C.1.3.1. Other (Ordinary) large letter volumes vector error correction model

Vector Error Correction Estimates Sample: 6/01/2002 6/01/2018 Included observations: 65 Standard errors in ( ) & t-statistics in [ ]			
Cointegrating Eq:	CointEq1		
LVOLUME_SA(-1)	1.000000		
LOG(REALPR(-1))	0.602963		
	(0.07970)		
	[7.56569]		
LOG(MOBILE(-1))	0.089245		
	(0.00902)		
	[9.89852]		
C	-2.282512		
Error Correction:	D(LVOLUME_SA)	D(LOG(REALPR))	D(LOG(MOBILE))
CointEq1	-0.138086	0.032255	-0.502178
	(0.06284)	(0.05982)	(0.06508)
	[-2.19741]	[0.53917]	[-7.71691]
C	0.010113	-0.008688	0.145009
	(0.00815)	(0.00776)	(0.00844)
	[1.24031]	[-1.11929]	[17.1732]
ECONDOWN	-0.036995	0.013415	-0.028483
	(0.01073)	(0.01021)	(0.01111)
	[-3.44813]	[1.31341]	[-2.56354]
DUM_PRICE	-0.081343	0.374227	-0.022713
	(0.04136)	(0.03937)	(0.04283)
	[-1.96683]	[9.50498]	[-0.53033]
R-squared	0.221671	0.611224	0.495921
Adj. R-squared	0.183393	0.592103	0.471130
Sum sq. resids	0.099477	0.090153	0.106678
S.E. equation	0.040383	0.038444	0.041819
F-statistic	5.791010	31.96751	20.00422
Log likelihood	118.4411	121.6398	116.1697
Akaike AIC	-3.521266	-3.619685	-3.451376
Schwarz SC	-3.387457	-3.485877	-3.317568
Mean dependent	-0.013335	0.005118	0.127570
S.D. dependent	0.044688	0.060193	0.057504
Determinant resid covariance (dof adj.)		2.76E-09	
Determinant resid covariance		2.28E-09	
Log likelihood		370.0489	
Akaike information criterion		-10.92458	
Schwarz criterion		-10.42280	

C.1.4. PreSort large letter volumes vector error correction model

The results of the VECM for PreSort large letter volumes are given Table C.1.4.1. The sample period begins in quarter three 2009 and ends quarter two 2018. This choice of starting date is based on results of the structural break tests and the empirical result that estimating the model for the full sample period beginning in 2002 resulted in parameter estimates that either did not conform to economic theory, or were statistically insignificant, or both.

The VECM is also augmented with two dichotomous variables which capture the effects of the large increase in the postage rate within the March 2016 quarter and the closure of the medium letter volume segment (DUM_MEDIAN_CLOSE) as discussed in Section 2.4.1 of this document.

Table C.1.4.1. PreSort large letter volumes vector error correction model

Vector Error Correction Estimates Sample: 9/01/2009 6/01/2018 Included observations: 36 Standard errors in ( ) & t-statistics in [ ]			
Cointegrating Eq:	CointEq1		
LVOLUME_SA(-1)	1.000000		
LOG(REALPR(-1))	0.404684		
	(0.33588)		
	[1.20486]		
LOG(MOBILE(-1))	0.400846		
	(0.07315)		
	[5.47999]		
C	-6.864007		
Error Correction:	D(LVOLUME_SA)	D(LOG(REALPR))	D(LOG(MOBILE))
CointEq1	-0.060385	0.005953	0.193014
	(0.05254)	(0.04553)	(0.03842)
	[-1.14920]	[0.13076]	[5.02440]
C	-0.024031	0.004395	0.175415
	(0.02019)	(0.01749)	(0.01476)
	[-1.19026]	[0.25124]	[11.8841]
DUM_MEDIANCLOSE	-0.002500	0.017639	-0.091911
	(0.03800)	(0.03293)	(0.02778)
	[-0.06578]	[0.53571]	[-3.30817]
DUM_PRICE	-0.139634	0.204769	-0.003413
	(0.05750)	(0.04983)	(0.04204)
	[-2.42822]	[4.10975]	[-0.08117]
R-squared	0.308581	0.399235	0.483234
Adj. R-squared	0.243761	0.342913	0.434787
Sum sq. resids	0.099464	0.074672	0.053164
S.E. equation	0.055752	0.048306	0.040760
F-statistic	4.760551	7.088467	9.974531
Log likelihood	54.96489	60.12530	66.24039
Akaike AIC	-2.831383	-3.118072	-3.457800
Schwarz SC	-2.655436	-2.942126	-3.281853
Mean dependent	-0.029090	0.018413	0.131918
S.D. dependent	0.064110	0.059593	0.054216
Determinant resid covariance (dof adj.)		1.09E-08	
Determinant resid covariance		7.63E-09	
Log likelihood		183.2062	
Akaike information criterion		-9.344790	
Schwarz criterion		-8.684990	

C.1.5 Print Post volumes vector error correction model

The estimated VECM for Print Post volumes are given in Table C.1.5.1. The structural break tests identify a significant break in September 2014, which is chosen as the commencement of the estimation period. This results in a small sample size that spans the third quarter of 2014 to the second quarter of 2018. Practical interpretations of the VECM parameters should be treated with all due caution as a consequence.

Table C.1.5.1 Print Post volumes vector error correction model

Vector Error Correction Estimates Sample: 9/01/2014 6/01/2018 Included observations: 16 Standard errors in ( ) & t-statistics in [ ]			
Cointegrating Eq:	CointEq1		
LVOLUME_SA(-1)	1.000000		
LOG(REALPR(-1))	0.344003		
	(0.08079)		
	[4.25791]		
LOG(MOBILE(-1))	0.143781		
	(0.01095)		
	[13.1294]		
C	-4.309033		
Error Correction:	D(LVOLUME_SA)	D(LOG(REALPR))	D(LOG(MOBILE))
CointEq1	-1.122627	-0.303653	-0.352759
	(0.39997)	(0.80921)	(0.34979)
	[-2.80675]	[-0.37525]	[-1.00849]
C	-0.019699	0.015230	0.146951
	(0.00916)	(0.01853)	(0.00801)
	[-2.15018]	[0.82167]	[18.3417]
R-squared	0.360083	0.009958	0.067726
Adj. R-squared	0.314375	-0.060760	0.001135
Sum sq. resids	0.018800	0.076953	0.014379
S.E. equation	0.036645	0.074139	0.032048
F-statistic	7.877834	0.140810	1.017051
Log likelihood	31.26871	19.99417	33.41381
Akaike AIC	-3.658589	-2.249271	-3.926726
Schwarz SC	-3.562015	-2.152697	-3.830152
Mean dependent	-0.019699	0.015230	0.146951
S.D. dependent	0.044256	0.071985	0.032066
Determinant resid covariance (dof adj.)		2.60E-09	
Determinant resid covariance		1.74E-09	
Log likelihood		93.23110	
Akaike information criterion		-10.52889	
Schwarz criterion		-10.09431	

C.2 Optimal lag structure tests

C.2.1 Other (Ordinary) small letter volumes VAR lag order selection criteria

As presented in Table C.2.1.1, the optimal lag structure of the VAR based on the SC is 1 lag, suggesting that the optimal lag for the VECM is zero lags.

Table C.2.1.1 Other (Ordinary) small letter volumes VAR lag order selection criteria

VAR Lag Order Selection Criteria
Endogenous variables: LVOLUME_SA LOG(REALPR) LOG(CHEQVOLU_SA)
Exogenous variables: ECONDOWN DUM_PRICE C
Sample: 6/01/2002 6/01/2018
Included observations: 62

Lag	LogL	LR	FPE	AIC	SC	HQ
0	166.0616	NA	1.27e-06	-5.066502	-4.757724	-4.945268
1	449.8146	512.5861	1.79e-10	-13.92950	-13.31195*	-13.68703
2	463.2315	22.93866	1.56e-10	-14.07198	-13.14565	-13.70828
3	478.9006	25.27267	1.27e-10	-14.28712	-13.05200	-13.80218*
4	491.6011	19.25559*	1.14e-10*	-14.40649*	-12.86260	-13.80032

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

C.2.2 PreSort small letter volumes VAR lag order selection criteria

For the PreSort small letter volume segment all lag structure statistics suggest 2 lags in the VAR and hence 1 lag in the VECM. These results are summarised in Table C.2.2.1. Whilst the final model for PreSort small letter volumes is based on a DOLS estimator, the optimal choice of lag structure of the VECM is subsequently used to identify the optimal lag structure in designing the DOLS estimator.

Table C.2.2.1 PreSort small letter volumes VAR lag order selection criteria

VAR Lag Order Selection Criteria
Endogenous variables: LVOLUME_SA LOG(REALPR) LOG(MOBILE)
Exogenous variables: ECONDOWN C
Sample: 3/01/2002 6/01/2018
Included observations: 62

Lag	LogL	LR	FPE	AIC	SC	HQ
0	47.09795	NA	5.33e-05	-1.325740	-1.119889	-1.244918
1	359.4334	574.2942	3.00e-09	-11.11075	-10.59612	-10.90870
2	383.7979	42.44147*	1.84e-09*	-11.60638*	-10.78298*	-11.28309*
3	386.8973	5.098934	2.24e-09	-11.41604	-10.28386	-10.97152
4	389.5677	4.134912	2.78e-09	-11.21186	-9.770901	-10.64610

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

C.2.3 Other (Ordinary) large letter volumes VAR lag order selection criteria

Optimal lag results using the SC and HQ suggest a VAR with 2 lags and hence a VECM with 1 lag as illustrated in Table C.2.3.1. However, estimating the VECM with 1 lag results in the model failing the cointegration test. Reducing the lag length to 1 lag in the VAR and hence no lags in the VECM improves the precision of the parameter estimates thereby producing results which do satisfy the cointegration test.

Table C.2.3.1 Other (Ordinary) large letter volumes VAR lag order selection criteria

VAR Lag Order Selection Criteria
Endogenous variables: LVOLUME_SA LOG(REALPR) LOG(MOBILE)
Exogenous variables: ECONDOWN DUM_PRICE C
Sample: 6/01/2002 6/01/2018
Included observations: 62

Lag	LogL	LR	FPE	AIC	SC	HQ
0	32.06694	NA	9.54e-05	-0.744095	-0.435317	-0.622861
1	356.2252	585.5763	3.67e-09	-10.91049	-10.29294	-10.66802
2	377.1841	35.83290	2.51e-09	-11.29626	-10.36993*	-10.93256*
3	387.7383	17.02280*	2.41e-09*	-11.34640*	-10.11128	-10.86146
4	394.9385	10.91647	2.59e-09	-11.28834	-9.744450	-10.68217

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

C.2.4 PreSort large letter volumes VAR lag order selection criteria

As presented in Table C.2.4.1, the optimal lag length of the VAR is 2 based on the SC and HQ statistics, which implies an optimal lag structure of the VECM with one lag. However, this specification did not satisfy the test of cointegration. By choosing an even tighter lag structure on zero lags did result in the revised model specification satisfying the cointegrating test at the 5% significance level.

Table C.2.4.1 PreSort large letter volumes VAR lag order selection criteria

VAR Lag Order Selection Criteria
Endogenous variables: LVOLUME_SA LOG(REALPR) LOG(MOBILE)
Exogenous variables: DUM_MEDIANCLOSE DUM_PRICE C
Sample: 3/01/2002 6/01/2018
Included observations: 62

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-0.551431	NA	0.000273	0.308111	0.616888	0.429345
1	288.0292	521.3069	3.31e-08	-8.710619	-8.093064	-8.468151
2	324.5043	62.36067	1.37e-08	-9.596912	-8.670580*	-9.233211*
3	331.6110	11.46245	1.47e-08	-9.535839	-8.300729	-9.050903
4	344.6865	19.82414*	1.31e-08*	-9.667307*	-8.123419	-9.061137

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

C.2.5 Print Post volumes VAR lag order selection criteria

The lag structure tests of the VAR are given in Table C.2.5.1. These range from a lag of 1 based on the SC, and up to 2 lags based on the AIC and HQ. Choosing the SC lag choice results in a VECM with no lags, a result which is supported by the cointegration tests.

Table C.2.5.1 Print Post volumes VAR lag order selection criteria

VAR Lag Order Selection Criteria
Endogenous variables: LVOLUME_SA LOG(REALPR) LOG(MOBILE)
Exogenous variables: C
Sample: 3/01/2006 6/01/2018
Included observations: 46

Lag	LogL	LR	FPE	AIC	SC	HQ
0	68.84771	NA	1.15e-05	-2.862944	-2.743684	-2.818268
1	259.5654	348.2670	4.25e-09	-10.76371	-10.28667*	-10.58501
2	271.8202	20.77994*	3.71e-09*	-10.90523*	-10.07041	-10.59250*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

C.3 Tests for cointegration

Statistics utilised to conduct the tests for cointegration are summarised across the Tables C.3.1 to C.3.5 contain3ed within this Section.

The cointegration tests applied to each of the the letter segments is based on the Johansen test. The PreSort small letter volume segment represents the exception where the cointegration tests are based on the Engle-Granger and Phillips-Ouliaris statistics as the final cointegration results for this segment are based on the single equation DOLS estimator.

Table C.3.1 Other (Ordinary) small letter volumes unrestricted cointegration rank test

Sample: 6/01/2002 6/01/2018
Included observations: 65
Trend assumption: Linear deterministic trend
Series: LVOLUME_SA LOG(REALPR) LOG(CHEQVOLU_SA)
Exogenous series: ECONDOWN DUM_PRICE
Warning: Critical values assume no exogenous series
Lags interval (in first differences): No lags
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.375923	45.53932	29.79707	0.0004
At most 1	0.182258	14.89298	15.49471	0.0614
At most 2	0.027529	1.814455	3.841466	0.1780

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table C.3.2 PreSort small letter volumes unrestricted cointegration rank test

Cointegration Test - Engle-Granger
Equation: OLS_DYNAMIC
Specification: LOG(VOLUME_SA) LOG(REALPR) LOG(MOBILE_AUG) C ECONDOWN DUM_PRICE
Cointegrating equation deterministics: C ECONDOWN DUM_PRICE
Null hypothesis: Series are not cointegrated
Automatic lag specification (lag=0 based on Schwarz Info Criterion, maxlag=9)

	Value	Prob.*
Engle-Granger z-statistic	-22.58129	0.0456

Cointegration Test - Phillips-Ouliaris
Equation: OLS_DYNAMIC
Specification: LOG(VOLUME_SA) LOG(REALPR) LOG(MOBILE_AUG) C ECONDOWN DUM_PRICE
Cointegrating equation deterministics: C ECONDOWN DUM_PRICE
Null hypothesis: Series are not cointegrated
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)
No d.f. adjustment for variances

	Value	Prob.*
Phillips-Ouliaris z-statistic	-23.38387	0.0370

Table C.3.3 Other (Ordinary) large letter volumes unrestricted cointegration rank test

Sample: 6/01/2002 6/01/2018
Included observations: 65
Trend assumption: Linear deterministic trend
Series: LVOLUME_SA LOG(REALPR) LOG(MOBILE)
Exogenous series: ECONDOWN DUM_PRICE
Warning: Critical values assume no exogenous series
Lags interval (in first differences): No lags
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.535814	59.58515	29.79707	0.0000
At most 1	0.132435	9.699575	15.49471	0.3046
At most 2	0.007134	0.465353	3.841466	0.4951

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table C.3.4 PreSort large letter volumes unrestricted cointegration rank test

Sample: 9/01/2009 6/01/2018
Included observations: 36
Trend assumption: Linear deterministic trend
Series: LVOLUME_SA LOG(REALPR) LOG(MOBILE)
Exogenous series: DUM_MEDIANCLOSE DUM_PRICE
Warning: Critical values assume no exogenous series
Lags interval (in first differences): No lags
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.454842	37.03448	29.79707	0.0062
At most 1	0.329757	15.19403	15.49471	0.0555
At most 2	0.021703	0.789917	3.841466	0.3741

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table C.3.5 Print Post volumes unrestricted cointegration rank test

Sample: 9/01/2014 6/01/2018
Included observations: 16
Trend assumption: Linear deterministic trend
Series: LVOLUME_SA LOG(REALPR) LOG(MOBILE)
Lags interval (in first differences): No lags
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.686189	31.99143	29.79707	0.0275
At most 1	0.502870	13.44801	15.49471	0.0994
At most 2	0.132028	2.265541	3.841466	0.1323

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

C.4 Preliminary PreSort small letter volume models and testing

This section contains the preliminary results of estimating the VECM for the PreSort small letter volume segment using the full sample period, beginning in quarter three 2002. As highlighted in Table C.4.1. the long-run substitution elasticity estimate registers an incorrect sign and is statistically insignificant.

The weak substitution effect is driven by the change in behaviour of PreSort small letter volumes around the time of the GFC as identified within an inspection of the volume data plot for this segment. The results of the structural break tests for PreSort small were therefore employed to identify an alternative commencement date.

The results of using the shorter sample period to estimate the VECM are reported in Table C.4.2. However, Table C.4.3 suggests that the cointegration test was not satisfied at the 5% level for this shorter sample period. By adopting the dynamic single equation estimator to improve the precision of the estimates yielded results that did satisfy the cointegration test. In which case the cointegration results reported in Table C.1.2.1 are considered as the final estimates.

Table C.4.1 PreSort small letter volumes VECM specification using full sample period

Vector Error Correction Estimates Sample (adjusted): 9/01/2002 6/01/2018 Included observations: 64 after adjustments Standard errors in ( ) & t-statistics in [ ]			
Cointegrating Eq:	CointEq1		
LVOLUME_SA(-1)	1.000000		
LOG(REALPR(-1))	0.634966		
	(0.08341)		
	[7.61231]		
LOG(MOBILE(-1))	-0.005051		
	(0.00934)		
	[-0.54066]		
C	-2.635388		
Error Correction:	D(LVOLUME_SA)	D(LOG(REALPR))	D(LOG(MOBILE))
CointEq1	-0.286796	-0.422521	-0.262981
	(0.09611)	(0.13620)	(0.11733)
	[-2.98391]	[-3.10225]	[-2.24140]
D(LVOLUME_SA(-1))	-0.226443	0.272764	0.111005
	(0.12075)	(0.17111)	(0.14740)
	[-1.87531]	[1.59410]	[0.75308]
D(LOG(REALPR(-1)))	0.311152	-0.068337	-0.030427
	(0.08900)	(0.12612)	(0.10865)
	[3.49595]	[-0.54183]	[-0.28005]
D(LOG(MOBILE(-1)))	-0.226777	-0.119081	0.627945
	(0.07566)	(0.10721)	(0.09235)
	[-2.99749]	[-1.11075]	[6.79929]
C	0.043389	0.013783	0.045170
	(0.01231)	(0.01744)	(0.01502)
	[3.52522]	[0.79024]	[3.00634]
ECONDOWN	-0.040484	0.017536	0.002345
	(0.00854)	(0.01210)	(0.01043)
	[-4.74035]	[1.44902]	[0.22489]
R-squared	0.395864	0.219146	0.608580
Adj. R-squared	0.343784	0.151831	0.574837
Sum sq. resids	0.051152	0.102714	0.076224
S.E. equation	0.029697	0.042082	0.036252
F-statistic	7.600981	3.255533	18.03567
Log likelihood	137.4070	115.0980	124.6426
Akaike AIC	-4.106468	-3.409313	-3.707580
Schwarz SC	-3.904073	-3.206917	-3.505185
Mean dependent	-0.006579	0.007308	0.125555
S.D. dependent	0.036660	0.045694	0.055597
Determinant resid covariance (dof adj.)		2.05E-09	
Determinant resid covariance		1.53E-09	
Log likelihood		377.1682	
Akaike information criterion		-11.13026	
Schwarz criterion		-10.42187	

Table C.4.2 PreSort small letter volumes VECM specification using a smaller sample period based on the structural break test

Vector Error Correction Estimates Sample: 12/01/2007 6/01/2018 Included observations: 43 Standard errors in ( ) & t-statistics in [ ]			
Cointegrating Eq:	CointEq1		
LVOLUME_SA(-1)	1.000000		
LOG(REALPR(-1))	0.352032		
	(0.14477)		
	[2.43170]		
LOG(MOBILE(-1))	0.061193		
	(0.02198)		
	[2.78443]		
C	-5.022635		
Error Correction:	D(LVOLUME_SA)	D(LOG(REALPR))	D(LOG(MOBILE))
CointEq1	-0.367471	-0.162638	-0.045572
	(0.09714)	(0.22467)	(0.16328)
	[-3.78300]	[-0.72389]	[-0.27910]
D(LVOLUME_SA(-1))	-0.227784	0.138239	-0.161660
	(0.12942)	(0.29934)	(0.21755)
	[-1.76002]	[0.46180]	[-0.74310]
D(LOG(REALPR(-1)))	0.275511	-0.155685	-0.102570
	(0.07357)	(0.17016)	(0.12366)
	[3.74504]	[-0.91496]	[-0.82945]
D(LOG(MOBILE(-1)))	-0.000262	0.096890	0.704476
	(0.07181)	(0.16610)	(0.12072)
	[-0.00365]	[0.58331]	[5.83585]
C	0.010679	-0.020165	0.022607
	(0.01299)	(0.03004)	(0.02183)
	[0.82231]	[-0.67134]	[1.03564]
ECONDOWN	-0.032101	0.028716	0.015510
	(0.01440)	(0.03331)	(0.02421)
	[-2.22897]	[0.86207]	[0.64068]
R-squared	0.473117	0.071955	0.551672
Adj. R-squared	0.401916	-0.053457	0.491087
Sum sq. resids	0.021684	0.116003	0.061268
S.E. equation	0.024209	0.055993	0.040693
F-statistic	6.644857	0.573749	9.105779
Log likelihood	102.2217	66.16546	79.89002
Akaike AIC	-4.475430	-2.798394	-3.436745
Schwarz SC	-4.229681	-2.552645	-3.190996
Mean dependent	-0.012102	0.013562	0.119829
S.D. dependent	0.031303	0.054554	0.057042
Determinant resid covariance (dof adj.)		3.00E-09	
Determinant resid covariance		1.91E-09	
Log likelihood		248.5732	
Akaike information criterion		-10.58480	
Schwarz criterion		-9.724679	
Number of coefficients		21	

Table C.4.3 PreSort small letter volumes cointegration test using a smaller sample period based on the structural break test

Sample: 12/01/2007 6/01/2018
Included observations: 43
Trend assumption: Linear deterministic trend
Series: LVOLUME_SA LOG(REALPR) LOG(MOBILE)
Exogenous series: ECONDOWN
Warning: Critical values assume no exogenous series
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.283472	29.74397	29.79707	0.0507
At most 1	0.258980	15.41041	15.49471	0.0515
At most 2	0.056967	2.522120	3.841465	0.1123

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

C.5 Preliminary PreSort large letter volume models and testing

This section contains the preliminary results of estimating the VECM for the PreSort large letter segment using the full sample period commencing in quarter four 2002. As highlighted in Table C.5.1 the long-run price elasticity estimate is the correct sign but appears to be biased as the price elasticity is unrealistically high in magnitude. To correct for this bias the strategy was to use the results of the structural break tests to choose a later starting date for the sample period as this would then provide a better way to capture changes in the electronic substitution effects impacting upon this segment over time. The results of using the shorter sample period are reported in Table C.1.4.1.

Table C.5.1 PreSort large letter volumes VECM specification using full sample period

Vector Error Correction Estimates Sample (adjusted): 6/01/2002 6/01/2018 Included observations: 65 after adjustments Standard errors in ( ) & t-statistics in [ ]			
Cointegrating Eq:	CointEq1		
LVOLUME_SA(-1)	1.000000		
LOG(REALPR(-1))	1.653208		
	(0.19383)		
	[8.52918]		
LOG(MOBILE(-1))	0.071705		
	(0.02025)		
	[3.54121]		
C	3.480428		
Error Correction:	D(LVOLUME_SA)	D(LOG(REALPR))	D(LOG(MOBILE))
CointEq1	-0.062332	-0.234962	0.016732
	(0.06872)	(0.05270)	(0.05956)
	[-0.90711]	[-4.45855]	[0.28092]
C	-0.007137	-0.011233	0.121196
	(0.00997)	(0.00764)	(0.00864)
	[-0.71608]	[-1.46962]	[14.0290]
DUM_MEDIANCLOSE	-0.032165	0.062196	0.024074
	(0.02191)	(0.01681)	(0.01899)
	[-1.46779]	[3.70072]	[1.26743]
DUM_PRICE	-0.145244	0.192809	0.005047
	(0.06857)	(0.05259)	(0.05944)
	[-2.11817]	[3.66639]	[0.08492]
R-squared	0.167509	0.408331	0.044246
Adj. R-squared	0.126567	0.379233	-0.002758
Sum sq. resids	0.269214	0.158344	0.202265
S.E. equation	0.066433	0.050949	0.057583
F-statistic	4.091347	14.03274	0.941329
Log likelihood	86.08463	103.3336	95.37733
Akaike AIC	-2.525681	-3.056418	-2.811610
Schwarz SC	-2.391872	-2.922610	-2.677802
Mean dependent	-0.017784	0.008000	0.127570
S.D. dependent	0.071084	0.064665	0.057504
Determinant resid covariance (dof adj.)		3.70E-08	
Determinant resid covariance		3.05E-08	
Log likelihood		285.6864	
Akaike information criterion		-8.328812	
Schwarz criterion		-7.827030	

C.6 Pricing scenarios

The price scenarios applicable to each letter segment are computed by dynamically simulating the pertinent econometric model over the period September 2018 to June 2022. Two simulations are performed for each segment: one with the price increases based on weighted averages of the price points supplied by Australia Post (See Table B.2.2); and one with no price increase. The projection outcomes pertinent to each scenario are presented throughout the body of this document.

C.6.1 Clements-Hendry adjustment procedure

To improve the precision of the price scenarios the Clements-Hendry (1996) adjustment is implemented.

The approach is based on the projection error of the last one-step ahead projection error arising from estimating the model within sample (i.e June 2018), which is designed to capture any momentum effects of additional falls in volumes from potential increased substitution effects over this period over and above the substitution effects captured by the substitution variable in the estimated model.

This adjustment value is then simply added on to the intercept of each estimated VECM in the case of Other (Ordinary) small and large volumes, Presort large volumes and Print Post, which, in turn, impacts the out of sample projections from September 2018 to June 2022 when dynamically simulating the model. In the case of the PreSort small letter volume projections, as a DOLS procedure is adopted, projections are adjusted by the within sample projection error in June 2018.

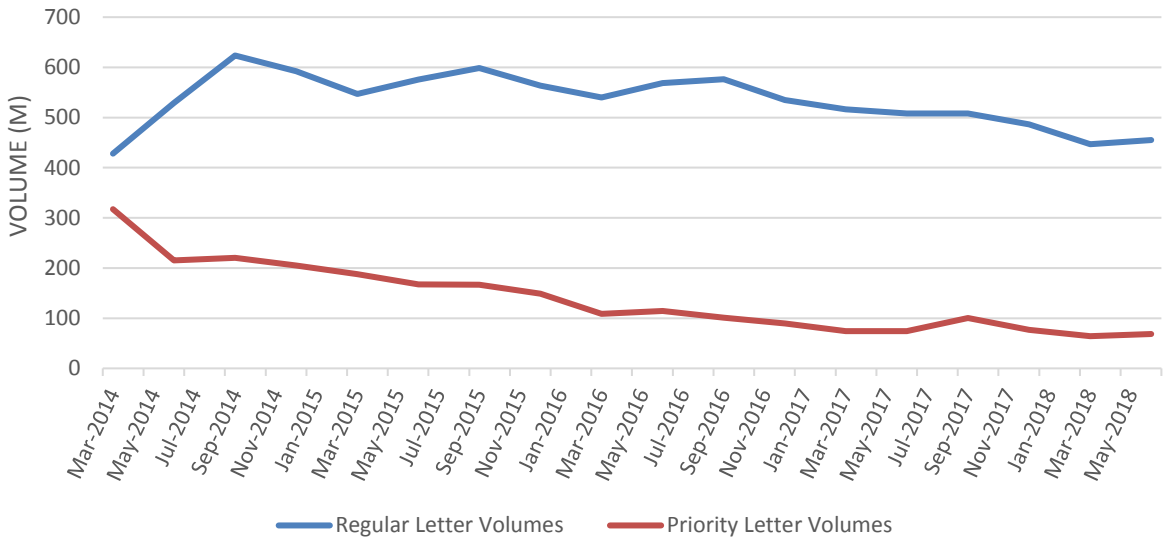
The adjustment values for each segment are as follows, which are expressed in terms of actual seasonally adjusted volumes. For Other (Ordinary) small, PreSort large and Print Post the adjustment factors are positive showing that the projections would be relatively smaller if the adjustment factor is not used. For PreSort small and Other large the adjustment factor is negative showing that projections of volumes are smaller than they would otherwise be if the adjustment factor was not used. The absolute magnitude of the adjustment factor for PreSort small is much larger than it is for the remaining segments which reflects the more aggressive substitution effects impacting this segment.

- **Other (Ordinary) small:** the Clements-Hendry adjustment factor is 5.60.
- **PreSort small:** the Clements-Hendry adjustment factor is -25.49.
- **Other large:** the Clements-Hendry adjustment factor is -2.50.
- **PreSort large:** the Clements-Hendry adjustment factor is 3.23.
- **Print Post:** the Clements-Hendry adjustment factor is 0.85.

C.7 Regular vs Priority Preliminary Price Elasticity Comparisons

Australia Post's timetable for delivering letters has undergone a major realignment since March 2014. This reconfiguration into a dual speed letter service initially resulted in a shift of volumes from the Priority speed into the Regular speed service.[52] Letter volumes from the segments analysed as part of this study were aggregated into Regular and Priority speed groupings to undertake a preliminary assessment to reveal any differences in price effects.[53] Using these aggregations, the initial migration effect is highlighted within Chart C.7.1.

Chart C.7.1: Regular and Priority speed letter volumes



As the price of each speed is accompanied by letter price asymmetries to the customer, an evaluation of the impact upon letter volume demand across each of the delivery speeds represents an important addition to the research. Over the March 2014 to June 2018 timeframe, Diversified Specifics employed DOLS modelling techniques to generate preliminary (indicative) price elasticity estimates for each delivery speed. The models contained drivers common across the majority of the segmented letter volume models such as the real price of a letter and a measure of electronic substitution. Due to the clear inter-relationship between the two speeds, a migration variable was also added to each model. To capture these migration effects the set of Regular letter volumes were used as a driver of Priority letter volumes and vice versa.

Although the timeframe examined is extremely short, the resultant models yield similar price elasticities of -0.84 for the Regular service and -0.80 for the Priority service. Although an increased number of data observations are required to make more definitive statements these estimates provided no early evidence of a statistically significant difference in price elasticities of demand between the two letter speeds. Diversified Specifics will continue to monitor these estimates in future letter volume demand updates.

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[52] Letters sent at the Regular speed take 1-2 business days longer than the estimated delivery times for the Priority service, dependent upon the sender's posting origin and the recipient's destination.

[53] Given the small sample size available interpretations of these results should be treated as indicative only.

APPENDIX D

CAVEATS ON ECONOMETRIC PROJECTIONS

The interpretation of the projections relating to segmented letter volumes via empirical modelling techniques must be conducted with all due caution. The *ex-ante* projections generated in this research undertaking are econometric in nature and they therefore depend heavily upon:

- Accurately projecting future growth rates for each of the exogenous drivers;
- An assumption that prior statistical associations detected by the modelling continues to hold over the projection period (which may not always be the case);
- An assumption of comprehensiveness governing the statistically significant segmented letter volume drivers. That is, there are other variables logically associated with each segment however significant variation over the sampled timeframe may not have been evident. As a consequence, these drivers tend to be excluded from the econometric models; &
- The global and national economy remaining similar to the sampled timeframe.

The methodology employed acknowledges these limitations and the impossibility of embedding all possible contingencies within the *ex-ante* projection estimates. It is therefore recommended that any interpretation of the projection results generated by these models be augmented by further internal and market intelligence. That is, the generation of baseline *ex-ante* projections provided in this document should necessarily represent an initial step in the volume projection process at Australia Post.

Ultimately the baseline must be augmented via further market intelligence on the emerging trends that are not directly measurable within an econometric framework.

The nature of developing econometric models based on historical data also suggests a need for on-going refinements and research to ensure an adequate currency of both the statistical associations and projections produced via the econometric models.

In developing the econometric projections an ideal scenario would involve a longer timeframe, an increased number of observations and greater degrees of freedom.

These considerations were evaluated against the desire to estimate a set of parameters that more accurately reflect the status quo rather than examining a lengthier timeframe where the current forces of substitution, pricing and economic growth do not apply. In this regard a series of structural break tests have in some cases impacted the selection of commencement dates for statistical evaluation and the results of these tests are summarised in Appendix A of this report.