Bulletin

SEPTEMBER QUARTER 2015

Reserve Bank

Contents

Article

Appendix

The *Bulletin* is published under the direction of the Publications Committee: Christopher Kent (Chair), Andrea Brischetto, Jacqui Dwyer, Marion Kohler, David Orsmond, Peter Stebbing and Paula Drew (Sectretary).

The *Bulletin* is published quarterly in March, June, September and December and is available at www.rba.gov.au. The next *Bulletin* is due for release on 17 December 2015.

For printed copies, the subscription of A$25.00 pa covers four quarterly issues each year and includes Goods and Services Tax and postage in Australia. Airmail and surface postage rates for overseas subscriptions are available on request. Subscriptions should be sent to the address below, with cheques made payable to Reserve Bank of Australia. Single copies are available at A$6.50 per copy if purchased in Australia.

Copies can be purchased by completing the publications
order form on the Bank's website or by writing to:

Mail Room Supervisor
Information Department
Reserve Bank of Australia
GPO Box 3947
Sydney NSW 2001

Bulletin Enquiries

Information Department
Tel: +61 2 9551 9830
Facsimile: +61 2 9551 8033
Email: rbainfo@rba.gov.au

The graphs in this publication were generated using Mathematica.

The contents of this publication shall not be reproduced, sold or distributed without the prior consent of the Reserve Bank and, where applicable, the prior consent of the external source concerned. Requests for consent should be sent to the Head of Information Department at the address shown above.

ISSN 0725–0320 (Print)
ISSN 1837–7211 (Online)

Print Post Approved
PP 243459 / 00046

Banknote Stakeholder Engagement

Amanda Evans, Greg Gallagher and Amanda Martz*

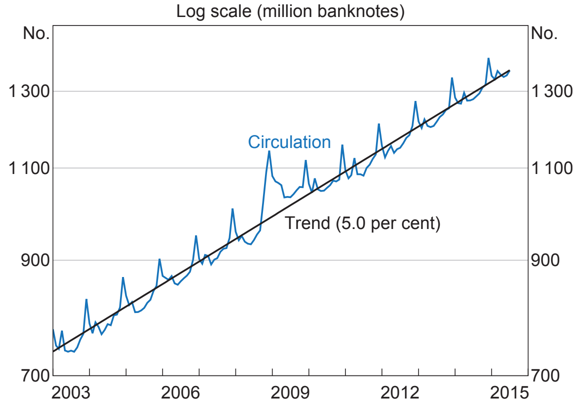
The Reserve Bank has a responsibility to ensure confidence in Australia's banknotes as a secure method of payment and a store of wealth. One of the ways in which the Bank does this is by providing education and training to people who handle cash regularly in their jobs, and the public in general, so that they can easily check the authenticity of their banknotes. In the lead-up to the next generation of Australian banknotes, this work will be crucial to ensure public confidence in the new banknote series. It is also important to engage with key stakeholders who produce and use machines that will accept the new banknotes. This article outlines the work that the Bank has undertaken to establish suitable communication channels and engage with key stakeholders in preparation for the Next Generation Banknote (NGB) program.

Introduction

Banknotes continue to be an important method of payment and store of wealth for Australians. Despite the increased use of electronic payment options, the value of banknotes in circulation has consistently grown by 5 per cent each year over the past 12 years (Graph 1). In addition, surveys show that cash accounts for almost half of all transactions and continues to be the most frequently used payment method for day-to-day transactions, particularly those of low value (Meredith, Kenney and Hatzvi 2014) (Graph 2). This suggests that banknotes are likely to remain an important part of the payments landscape for the foreseeable future.

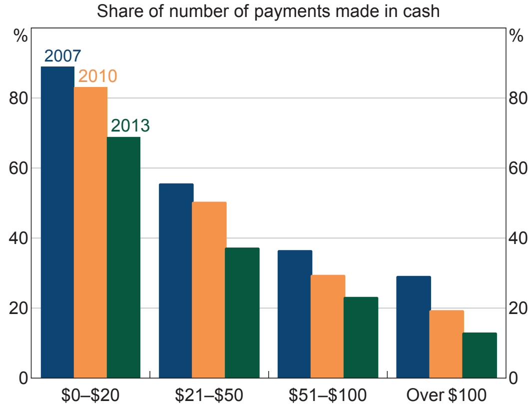
To ensure the public remains confident in banknotes as a means of payment and store of wealth, the Reserve Bank works to develop and issue banknotes with security features that are easy to use and difficult to copy. Public engagement plays a crucial role in the effectiveness of the security features, including by helping the public and cash-handling

Graph 1
Number of Banknotes in Circulation
Log scale (million banknotes)



Source: RBA

Graph 2
Use of Cash by Payment Value
Share of number of payments made in cash



Sources: Colmar Brunton; Roy Morgan Research

* The authors are from Note Issue Department.

businesses to recognise genuine banknotes. This is particularly the case for the NGB program, which is focused on upgrading the security features on Australian banknotes (Kim and Turton 2014). Further, effective engagement will promote acceptance of the new banknote series by the public and understanding that both series of banknotes are able to be used in transactions, and allow machines – such as automated teller machines (ATMs), self-service checkouts and vending machines – to accommodate the new banknotes.

This article discusses the initiatives implemented in recent years to engage with a wide range of stakeholders including banknote equipment manufacturers, retail organisations, financial institutions, schools and the vision-impaired community.

Channels of Engagement

For several years the Reserve Bank has been enhancing a number of elements of its key means of communication regarding banknotes. In part, this has been done in anticipation of the new banknote series. The aim of this program is to establish communication channels that the public are aware of and trust to obtain information on banknotes.

Public engagement

The Bank receives around 1 500 banknote-related enquiries annually. These cover a range of topics including how to handle damaged banknotes, how to purchase numismatic products, the rules governing the reproduction of banknote images, the legal tender status of banknotes, and details of the number of banknotes produced and in circulation. A considerable number of questions also relate to how to identify a counterfeit and what to do if one is received.

In addition to fielding public enquiries, presentations are given to various stakeholder groups, including primary and high school students, English as a Second Language groups and other special interest groups. Many of these are given in the Bank's Museum of Australian Currency Notes, located in its Head Office in Sydney. These presentations provide a valuable opportunity to share information about the security features and production process of Australia's banknotes, and for Bank staff to answer questions directly from the public. As well as assisting the public with their enquiries, this very direct engagement provides insights into the level of community awareness about banknotes and helps the Bank improve its communication.

The Museum is also open to the public on Australia Day each year. In 2015, there were more than 1 900 visitors on that day, with attendees a mix of family groups, as well as local and international visitors. Visitors to a dedicated banknote section in the Museum were provided with educational materials, shown videos and guided through interactive activities on the banknotes website (banknotes.rba.gov.au).

Online resources

The banknotes website was launched in August 2012. The purpose of this website is to improve the public's awareness of the design and security features of Australia's banknotes in an informative and engaging manner that is readily accessible to all Australians. The website includes short videos and information about the design, production and distribution of Australian banknotes, along with counterfeit detection. In addition to factual information for a general audience, it includes interactive activities and games aimed at younger audiences.

Website activity is largely driven by referrals from news articles, and recently there has been a tendency for social media posts (such as Facebook, Twitter and online discussion boards) to refer to the website to clarify banknote-related information. In 2013, the website was named 'Best New Currency Website' at the Excellence in Currency Awards established by the International Association of Currency Affairs.

In recognition of the influence of social media, the Bank also uses YouTube to share banknote-related videos with a wider audience and has been increasingly using Twitter as a way to direct people to relevant sources of information.

The Bank has also developed online communication tools to assist stakeholder groups with their specific needs:

- An education resource aimed at teaching primary school students about Australia's banknotes was launched in January 2015 (see 'Box A: Engagement with Younger Audiences').
- A law enforcement portal, developed in consultation with law enforcement agencies, was launched in November 2012 to make information about the identification, handling and administration of counterfeit banknotes more readily accessible to police officers.
- A machine-readiness portal was developed in 2014 to provide information to assist manufacturers, distributors and users of banknote processing equipment in the lead-up to the issuance of the new banknote series.

Stakeholder outreach

In recent years, the Bank has established an outreach program designed to identify and utilise opportunities to work with stakeholders to educate their staff, customers and clients about the existing banknotes and their security features. Through the program, the Bank engages with organisations and representative bodies across a range of sectors such as retail, banking and hospitality (fast food, gaming and clubs), as well as groups that represent older generations and people from culturally and linguistically diverse backgrounds.

In addition to serving an educational purpose, this program has provided an opportunity to build relationships with key stakeholders and better understand how to meet their education and training needs. This engagement has also enabled the Bank to establish itself as a primary resource for future enquiries.

An important dimension of this outreach program is the provision of information and training directly to stakeholders both as needed and as new information becomes available. In this respect, the Bank has been increasing its liaison with businesses that handle cash and community groups, with more than 40 presentations relating to the forthcoming new banknote series delivered since 2012. These included 32 presentations to equipment manufacturers and users, and 10 to the vision-impaired community. This engagement also provides important intelligence to the Bank to ensure the continued efficacy of its communication material.

Over the past few years, the Bank has also held a number of workshops on counterfeit deterrence with representatives from state and federal police, commercial banks, retail institutions, casinos and cash-in-transit companies. These workshops were aimed at providing hands-on training and improving working relationships with key stakeholders. They included presentations by Bank staff and the Australian Federal Police. Topics covered were the current counterfeiting situation in Australia, the roles and responsibilities of various stakeholders and counterfeit detection.

Media engagement

The Bank regularly receives enquiries from the media related to banknotes. In response, staff provide background information to journalists, and participate in radio and print interviews. These opportunities are an invaluable channel through which the Bank can reach a wider audience.

Box A
Engagement with Younger Audiences

The Reserve Bank has undertaken a number of initiatives focused on school-age audiences to assist a younger generation to develop an interest in, and familiarity with, Australian currency and to provide them with the knowledge required to identify genuine banknotes. These audiences are also likely to share key messages with their families.

In collaboration with the New South Wales Department of Education and Communities, the Bank developed an online primary school education resource, 'Learning About Banknotes' (banknotes.rba.gov.au/primary-education). It is aimed at educating students about Australia's banknotes through interactive games, activities and stories. This resource has been designed to provide information about banknotes through history and mathematics activities, which are aligned to the Australian curriculum. Activities are mapped to syllabus requirements for Year 2 Mathematics and Years 2 and 3 History, and teaching notes are available to guide teachers through the activities and games. The resource incorporates interactive whiteboard activities to enhance the experience for both teachers and students.

The Bank also conducts regular presentations to school groups in its Museum of Australian Currency Notes. There has recently been a greater focus on targeting younger attendees through additional 'kid-friendly' activities in the Museum on Australia Day. This has included activities specifically designed for children such as activity sheets, a 'Chatterbox' origami game focused on security features, giant puzzles and games from the website.

Surveys and Research

To better understand public attitudes to banknotes and how people perceive banknotes, the Reserve Bank has conducted a number of online surveys and focus group studies. This research has been used to assess the success of the Bank's current education activities and provide feedback to the Bank on potential designs for the new banknote series. Future research will be used to determine the effectiveness of the communication campaign for the new banknote series.

Online surveys

Online surveys conducted in 2010, 2012 and 2014 were aimed at understanding the public's general perceptions of Australia's banknotes, what they know about banknotes, how they check their banknotes for authenticity and how confident they feel about the security of Australia's banknotes. Recently, these surveys have also included questions to assess the level of awareness of the new banknote series.

These surveys indicated a high level of confidence in Australia's current banknotes, with 58 per cent of participants stating that they thought the banknotes were, in general, sufficiently secure against counterfeiting. Furthermore, the perceived likelihood among survey participants that they would receive a counterfeit was low, although 6 per cent thought that they had received a counterfeit at some point.

Reflecting this high level of confidence, the surveys also indicated that there is a degree of complacency among the public about banknote security, with 68 per cent of people rarely or never checking their banknotes carefully to make sure they are genuine. The surveys indicated that 45 per cent of people learnt what they know about banknotes through use and experience, while almost 30 per cent could not recall how they learnt what they know. The majority of respondents (two-thirds) indicated that they would use the internet if they wanted to learn more about Australian banknotes but only one-third knew that the primary source of information was the Bank's website.

The outcomes of this research also revealed that, at the early stage of the next generation banknote program, public awareness of the new banknote series is relatively low, with only 8 per cent of participants in the most recent survey indicating that they had heard of the Bank's program to upgrade the banknotes.

Focus groups

In 2010, group discussions were held with selected members of the public and cash handlers. The objective of this was to investigate the public's knowledge and opinions of Australia's banknotes, their security features and designs, and public awareness and perceptions of counterfeiting. In 2014, a further focus group study was conducted to observe and evaluate the public's reactions to a test note, which included design and security features under consideration for the new banknote series. Notably, most participants agreed that the time was right to increase the security features on our current banknotes and 85 per cent of participants 'liked' the test note – not just for the increased security aspects, but also for its overall appearance.

The viewpoints of specific stakeholders on key aspects of banknote design have also been sought. Most notably, the Bank has been working with the vision-impaired community to seek input on accessibility options for the new banknote series. The Bank had confirmed its intention to retain the accessibility characteristics of Australia's banknotes, including different sizes across banknote denominations, bold and contrasting numerals, and vibrant colours. The Bank also engaged with representatives from the vision-impaired community to assess the efficacy of the accessibility features of the current banknotes and their appetite for additional features. Following this consultation, the Bank has since announced that the new banknotes will include a tactile feature to assist with denominating banknotes (Springer, Subramanian and Turton 2015).

Banknote Equipment Manufacturer Engagement

The number of machines in Australia that process banknotes in one form or another is substantial – it is estimated that there are more than 30 000 ATMs, 8 000 self-service checkouts, 200 000 gaming machines and more than 250 000 vending machines in Australia that will need to be upgraded and reconfigured to ensure that they can accept and dispense the new banknotes (Kim and Turton 2014). Most people encounter machines that process banknotes on a regular basis, in situations such as:

- paying for goods and services at self-service checkouts, transport ticketing machines, parking ticket machines, vending machines and gaming machines
- making withdrawals and deposits via ATMs
- using machines to count, authenticate and store banknotes.

For further details see 'Box B: Banknote Machine Industry'.

The Reserve Bank identified a need to engage closely and regularly with banknote equipment manufacturers (BEMs), machine distributors, and machine deployers and owners in the lead-up to the issuance of the new banknote series to help maintain the ease of use of banknotes as a payment mechanism. In light of the potentially significant upgrades required for machines to process the new banknotes, the Bank launched an engagement program early in the banknote development process, many years before the first new banknotes were due to be issued.

A key objective of this engagement is to achieve a high level of banknote acceptance by machines in the community. At the time of issuance, it will be important for businesses and the public to be able to continue to make payments and withdrawals at machines, and use machines to count, sort and validate banknotes effectively and efficiently. This can be achieved by securing commitment among BEMs, machine distributors, and machine deployers and owners to upgrade the machines as required.

Box B
Banknote Machine Industry

Figure 1: Types of Machine-assisted Transactions

Banking and financial

Machines that allow for cash withdrawals or deposits with or without the need for a teller.

Examples:
- ATMs (deposit and issue)
- Teller assist units
- Change machines
- Currency conversion products

Goods/services vending

Single note validators are often in machines used by the public for purchases from unattended payment terminals.

Examples:
- Self-service checkouts
- Transport ticketing machines
- Parking ticket machines
- Car wash machines
- Gaming machines

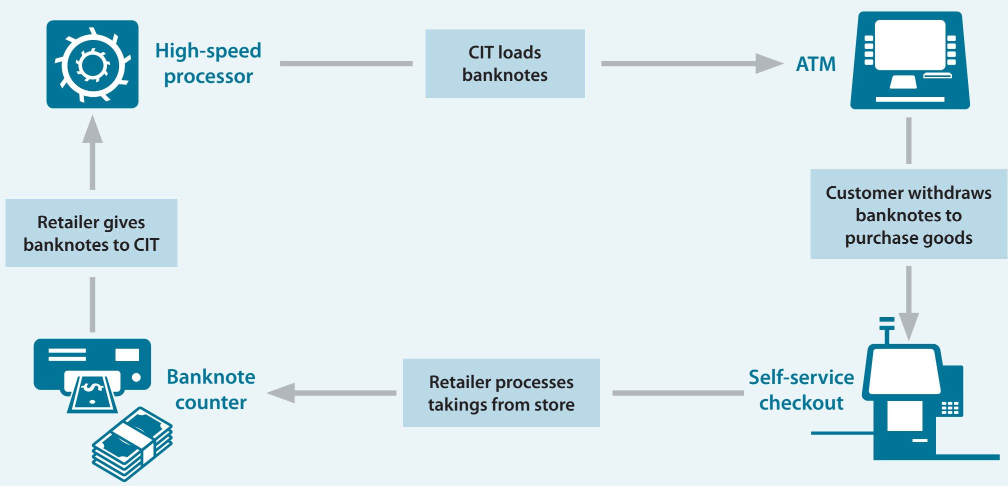
Counting and authentication

Larger machines are used by high-volume cash handlers such as retailers, banks and cash-in-transit (CIT) companies.

Examples:
- High-speed processors
- Desktop processors
- Banknote counters

Source: RBA

Figure 2: Example of a Flow of Banknotes Through Machines

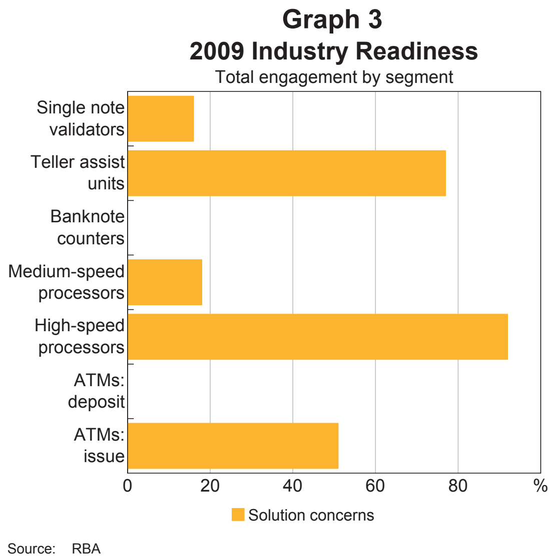


Source: RBA

Machine Readiness Program

A number of steps have been taken by the Reserve Bank over the past six years to identify and engage with the banknote machine industry. This initially included preliminary research with a small number of BEMs, and more recently has expanded as part of a formal Machine Readiness Program.

As of September 2015, the Bank has engaged with all companies that it is aware of as active in the Australian market. It is expected that these companies make up the majority of the industry. The outcomes from this engagement have been positive and the Bank is becoming increasingly confident that most machines will be able to process the new banknotes when the first denomination is issued.



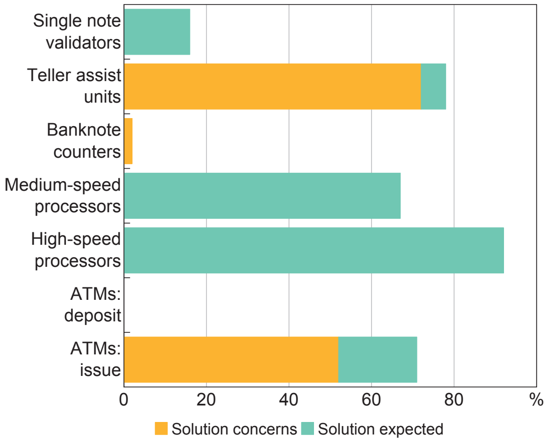
Research stage

In 2009, a small number of key BEMs were invited to participate in an initial trial. The purpose of the trial was to test the capabilities of existing equipment to process test notes with features similar to those being planned for the new banknote series. The BEMs participating in the trial represented key manufacturers of ATMs, teller assist units, medium- and high-speed processors, and single note validators. While the BEMs acknowledged that the Bank had made many decisions to minimise the impact of the change on the industry, the feedback also suggested that the industry would be challenged by the new banknotes. As shown in Graph 3, at that time participants had concerns about processing the new banknotes.

In 2011, the Bank invited the same BEMs to participate in a second trial. The test notes provided to BEMs in this second trial addressed some of the issues raised during the earlier engagement. The feedback was more positive than that received in 2009 and some BEMs were becoming increasingly confident that there were solutions to address the processing challenges. The other BEMs, however, still had concerns about the capability of their machines to process the test notes. The differentiating factor between the two groups of BEMs – those that were gaining confidence and those that were not – was related to the manner in which banknotes moved through their machines. The BEMs whose machines processed banknotes short edge first were more confident, while BEMs that still had concerns processed banknotes long edge first.

In response to this feedback, the Bank approached the BEMs again in 2012 with a new feature that could be incorporated into the banknotes to assist machines that processed banknotes long edge first. At this point, an additional three BEMs were invited to participate. Indications of success continued to increase. Overall, with the exception of banknote counters, there was at least one manufacturer in each industry segment the Bank had engaged with that expected to be able to develop a solution to process the new banknotes (Graph 4). This positive feedback gave the Bank confidence to proceed with its chosen banknote features.

Graph 4
2012 Industry Readiness
Total engagement by segment



Source: RBA

Readiness stage

In order to assist the broader industry to prepare machines for the new banknotes, it was necessary to establish an accurate assessment of the machines in use and the manufacturers that were active in the Australian market. To this end, in late 2012 the Bank surveyed a number of stakeholders – retailers, financial institutions, independent ATM deployers, public transport operators, gaming venues and BEMs – to identify as many organisations as possible that were active in the Australian market.

On the basis of the results of this survey, the Bank expanded its engagement with the BEMs to a wider number of organisations in early 2013. The Bank held a number of information sessions where manufacturers and distributors were notified of the impending new banknote series and provided with details about the planned banknote features and a broad timeline. These sessions were followed up with bilateral discussions and an additional information session in mid 2014 to provide attendees with further detailed technical information about the new banknotes. As of September 2015, the Bank had engaged with 54 BEMs and machine distributors.

In addition to the information sessions, the Bank provided all BEMs and distributors with access to sample notes and banknotes that were close to the final design. Specifically, the Bank adopted a three-phase approach to assist the industry to prepare their machines for the new banknotes:

- Phase 1 – developing processing capabilities

  BEMs and distributors were offered sample notes in October 2014. These sample notes had features similar to those planned for the new banknote series. While they did not have the same design as the final banknotes, they incorporated all of the intended security features. The sample notes were provided so that BEMs could develop their capability to transport the new banknotes through their machines. To date, 30 companies have requested Phase 1 sample notes.

- Phase 2 – confirming processing capabilities

  In December 2014, BEMs and distributors were offered the opportunity to access Phase 2 sample notes, which more closely resembled the final banknote design. This material assisted BEMs and distributors to confirm whether their machines could process the new banknotes. Owing to the greater security surrounding the Phase 2 sample notes, participants were required to conduct testing in either the Bank's Sydney or Craigieburn facilities. On rare occasions where transporting large and expensive machines posed a significant logistical challenge, testing was conducted outside the Bank, with appropriate security arrangements in place. To date, 20 companies have accessed Phase 2 sample notes.

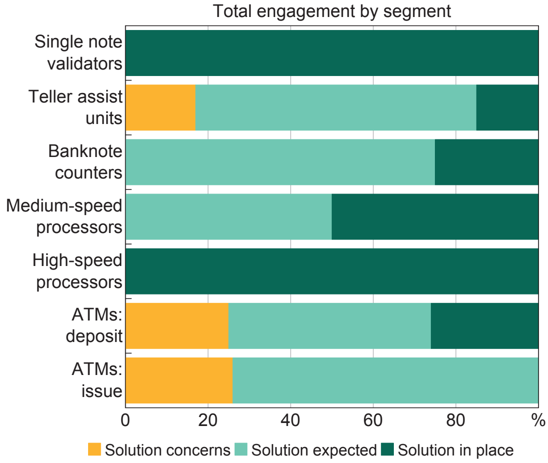
- Phase 3 – developing authentication models

  The final phase of the Machine Readiness Program involves participants using actual banknotes to ensure that their machines can distinguish between genuine banknotes and potential counterfeits. Most machines that accept banknotes undertake a thorough examination of the banknote to determine its authenticity. Banknotes that fail this examination are rejected by the machine. BEMs develop complex algorithms to assist with this process, and they need access to actual banknotes to ensure that these algorithms function accurately. This phase will also provide a final opportunity to test, and, if necessary, refine, the transportation systems within machines. The Bank's objective is to provide actual banknotes to BEMs and distributors at least six months prior to issuing the new banknotes into the community, which the BEMs have indicated will allow sufficient time for them to develop and deploy new authentication models.

Current industry readiness

After six years of engagement with the industry, the current state of machine readiness appears to be positive. A number of BEMs have developed solutions to process the new banknotes (Graph 5). Overall, the Bank expects that all validators and high speed processing machines will be capable of accepting and processing the new banknotes. According to BEMs, the validators utilised in most machines that are used directly by the public (such as ticketing, vending and gaming machines) will be ready for the new banknotes.

Graph 5
2015 Industry Readiness
Total engagement by segment



Source: RBA

There is still work to be done with some ATMs, teller assist units, banknote counters and medium-speed processors. The BEMs nevertheless indicate that solutions are progressing well and the expectation is that most machines will be ready for the issuance of the first denomination.

Engagement with owners and deployers of machines

While it is important that manufacturers develop effective solutions to process the new banknotes, the final stage in the machine readiness process is to upgrade machines deployed in the community. This is a large logistical challenge shared by machine manufacturers, deployers and owners. The Bank has little influence over the decisions by businesses to upgrade individual machines. But by communicating early and frequently with the deployers and owners of machines about the new banknote series, it can help to create an environment where owners and manufacturers can establish a streamlined approach to upgrading machines. Approaching the industry early has also removed some of the 'surprise' element associated with the upgrade.

To date, the Bank has presented to more than 150 stakeholders in the banknote equipment industry, both bilaterally and through representative industry associations, which have also passed information to their members.

Future Activities

Engagement with banknote stakeholders covers a range of communication channels and continues to expand into new areas. In the lead-up to the issuance of the new banknote series, which is scheduled to commence in late 2016, there is expected to be increased engagement with the public and key stakeholders, including BEMs, commercial banks, retailers and special interest groups.

There will be considerable interest in the new banknotes and the rationale behind the change. As part of a public awareness campaign, the Reserve Bank is planning a number of communication activities utilising a combination of media channels to deliver key messages about the new banknotes to the community. This public awareness campaign, along with the supporting engagement activities, will help inform the public about the new banknote series, the security features on the banknotes and where to go for more information.

Providing adequate and effectively targeted information will reduce the risk of confusion among the public and cash-handling businesses about Australia's banknotes and increase their confidence in the ability to recognise and authenticate a genuine banknote. It will also provide an opportunity to explain that both the exisiting series and new series of banknotes will be able to be used in transactions.

Engagement and consultation with stakeholders that the Bank has identified as having specific requirements will also continue. The Bank will continue to engage with the vision-impaired community to provide tailored information about the tactile feature so that users remain confident when using Australia's banknotes. The Bank will also ensure that its websites meet best practice standards for accessibility so all members of the public can obtain information about banknotes.

The Bank will move into Phase 3 of the Machine Readiness Program as the issuance date for the new banknote series draws closer. This engagement represents a crucial step in preparing machines to be ready for when the new banknotes begin circulating. Early engagement with key business sectors will also be required to provide industry with a level of understanding that will assist in driving awareness among other important groups. Ultimately, these activities will help to ensure the public are fully informed of the new banknote series and remain confident in Australia's banknotes as a secure and stable payment method.

References

Kim E and T Turton (2014), 'The Next Generation Banknote Project', RBA *Bulletin*, March, pp 1–11.

Meredith J, R Kenney and E Hatzvi (2014), 'Cash Use in Australia', RBA *Bulletin*, June, pp 43–54.

Springer K, P Subramanian and T Turton (2015), 'Australian Banknotes: Assisting People with Vision Impairment', RBA *Bulletin*, March, pp 1–12.

Housing Wealth Effects: Evidence from New Vehicle Registrations

Christian Gillitzer and Jin Cong Wang*

This article investigates the relationship between housing wealth and consumption using postcode-level variation in housing prices and new passenger vehicle registrations as a proxy for consumption at a postcode level. It is estimated that a one per cent increase in housing wealth is associated with about half a per cent increase in new passenger vehicle registrations – the consumption indicator. But because new vehicle consumption is likely to be particularly sensitive to changes in housing wealth, the results suggest a relatively modest relationship between housing wealth and total consumption.

Introduction

Understanding the magnitude of the relationship between housing prices and consumption is important because it informs the extent to which developments in the housing sector can have broader macroeconomic effects. There is general agreement among policymakers and academics that there is a positive correlation between housing prices and consumption, but there is disagreement on the magnitude of the relationship. Some have argued that housing wealth is akin to financial wealth, which suggests a potentially large effect of housing wealth on consumption (e.g. Case, Quigley and Shiller 2005). Others argue that housing wealth is fundamentally different from financial wealth because home owners are both owners of housing assets and consumers of housing services (e.g. Sinai and Souleles 2005; Buiter 2010). A home owner could sell their house following a rise in housing prices and realise a capital gain, but they would then have to rent, and may not be better off if higher housing prices are indicative of higher expected future rents. But even if changes in housing prices have little effect on lifetime net wealth, higher housing prices may facilitate an increase in consumption by relaxing collateral constraints (Iacoviello 2004). Since theory can rationalise both a large and small relationship between housing prices and consumption, identifying its magnitude is ultimately an empirical question.

Much of the literature has used time-series variation to estimate the relationship between housing prices and consumption, either at a national or state level (e.g. Dvornak and Kohler (2007) for Australia). A limitation of this approach is the difficulty of separating the direct effect of housing prices on consumption from 'third factors'. For example, a rise in expected future incomes may lead to a greater preparedness to pay more for housing (and therefore higher housing prices) and to spend more on non-housing consumption, which would produce a positive correlation between housing prices and consumption in the absence of any direct effect. This article revisits the relationship between housing prices and consumption using cross-sectional postcode-level variation in housing prices. By using cross-sectional variation, we can control for any economy-wide third factors that could otherwise cause comovement between housing prices and consumption.[1]

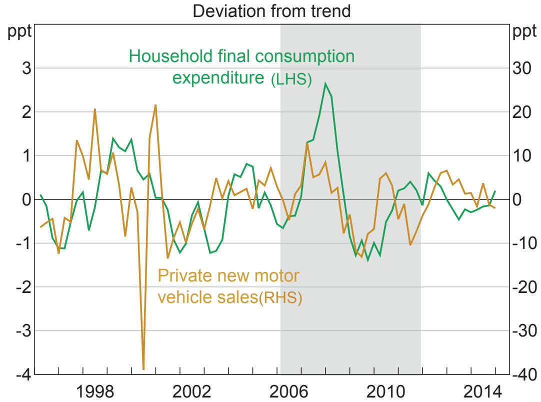
* The authors are from Economic Group. This article is based on Gillitzer and Wang (2015), by the same authors. Please refer to the paper for details on data, sources and methodology.

1 This methodology implicitly relies on there being relatively few home owners moving between postcodes over the sample period, or on those leaving a postcode being economically similar to those who enter.

Housing Price and Consumption Data

Unit record data on property sales for Sydney, Melbourne and Brisbane are used to measure housing price changes by postcode. The housing price data are adjusted to account for variation in the size and type of housing sold in each postcode. A limitation of the methodology is the absence of a comprehensive measure of consumption at the postcode level. Instead, new passenger vehicle registrations are used as the proxy for consumption. These are available annually at the postcode level. Vehicle registration data are administrative records rather than survey-based, and therefore have low measurement error.[2] The approach here relies on new vehicle registrations being a suitable proxy for total consumption. Reassuringly, the cyclical behaviour of new vehicle sales and total consumption are similar (Graph 1).[3]

Graph 1
Consumption and Private Motor Vehicle Sales*
Deviation from trend



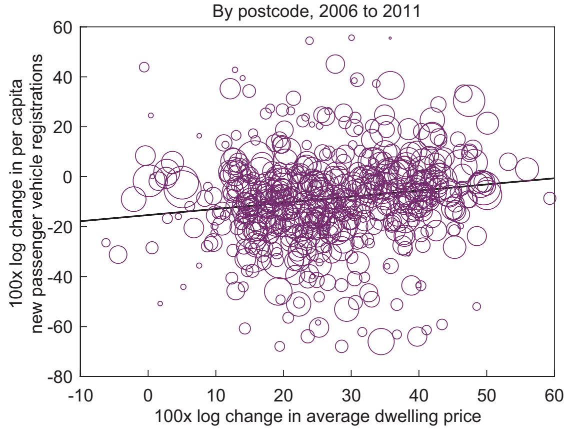
* Series have been de-trended using a Hodrick-Prescott filter with a smoothing parameter λ = 1 600, as is standard for quarterly frequency data

Sources: ABS; FCAI/VFACTS; Gillitzer and Wang (2015)

Descriptive Analysis

A postcode-level plot indicates that growth in per capita new passenger vehicle registrations was generally a bit higher in postcodes experiencing relatively high housing price growth over the period 2006 to 2011 (Graph 2). Attention is restricted to this time period in Graph 2 to align with the Census of Population and Housing (the Census), which is the source for postcode-level data used in the next section. The wide variation in housing price growth across postcodes evident in Graph 2 is highly informative for this analysis; average housing price growth from 2006 to 2011 was 28 per cent with a standard deviation of 11 per cent. However, the small number of postcodes that experienced a fall in average housing prices between 2006 and 2011 limits the scope of the data to determine whether new vehicle registrations respond asymmetrically to rises and falls in housing prices. The line of best fit shown in Graph 2 indicates that (other things equal) each 1 percentage point increase in housing prices is associated with a 0.24 per cent increase in new passenger vehicle registrations per capita.

Graph 2
New Passenger Vehicle Registrations and House Price Growth*
By postcode, 2006 to 2011



* Size of circles is proportional to postcode population in 2006 and the regression line is population weighted; a small number of extreme observations have been excluded from the figure

Sources: ABS; APM; FCAI/VFACTS; Gillitzer and Wang (2015)

2 Disaggregated consumption data are difficult to come by, and new vehicle registrations are the only high-quality postcode-level consumption measure available in Australia.

3 Graph 1 shows aggregate vehicle *sales* data because the postcode-level *registration* data used in this analysis are unavailable at a quarterly frequency. The introduction of the GST in July 2000 caused a substantial re-timing of purchases.

Regression Analysis

Specification

Having established some preliminary evidence of a relationship between housing prices and new vehicle registrations, a regression framework is now used to provide more formal evidence. This allows the relationship between housing prices and new vehicle registrations to be estimated by controlling for other determinants of new vehicle registration growth. A rich set of postcode-level controls from the Census is used: income, housing tenure type, usual monthly mortgage repayments, educational attainment, and the unemployment rate.

This leads to the following regression:

$$\Delta c_{i,2006-11} = \alpha + \beta\left(\Delta hp_{i,2006-11} \times s^{own}_{i,2006}\right) + \Sigma_j \gamma_j X_{i,j} + \varepsilon_i \quad (1)$$

where $\Delta c_{i,2006-11}$ is the log change in per capita new passenger vehicle registrations in postcode i between 2006 and 2011, $\Delta hp_{i,2006-11}$ is the log change in housing prices over the same period, $s^{own}_{i,2006}$ is the share of households in postcode i owning their home outright or with a mortgage, each $X_{i,j}$ is a control variable for postcode i (e.g. the unemployment rate in postcode i), α is a constant term, and β is the relationship between gross housing wealth and per capita new passenger vehicle registrations. As both the proxy for consumption and housing prices are expressed as log changes, the coefficient β can be interpreted as an elasticity. Housing price growth is scaled by the share of households owning their home in each postcode under the assumption that new vehicle registrations for renters is unaffected by fluctuations in housing prices, a restriction that cannot be rejected.[4] Without accurate data on housing leverage by postcode, the focus is on gross, rather than net, housing wealth throughout.

New passenger vehicle registrations are expressed in per capita terms to control for differences in population growth across postcodes and the equation is estimated using weighted least squares, using the 2006 population for each postcode as weights. This makes postcodes with a large population relatively more influential in estimating the regression parameters, which is appropriate because each postcode-level observation represents an average over a relatively large number of households. To reduce the influence of extreme observations, postcodes experiencing a change in per capita new vehicle registrations greater than 75 per cent in magnitude between 2006 and 2011 are excluded. Postcodes with more than three times the national average level of per capita new vehicle registrations are also excluded because these postcodes are likely to contain a large number of business registrations, which introduce noise into our data.[5]

The set of controls $X_{i,j}$ includes the change in all relevant Census variables between 2006 and 2011, and the level of each variable in 2006. The set of controls also includes each postcode's distance to the central business district (CBD), and an indicator variable for waterfront postcodes. These geographic variables absorb any predictable variation in relative housing price growth that is correlated with proximity to the CBD or the waterfront. They also allow for the possibility that households living in postcodes at greater distances from the CBD have a higher average level of per capita new vehicle registrations than households in inner city postcodes, possibly because of a greater need for private transportation.

Results

The first column in Table 1 reports the coefficient estimate β for Equation (1) excluding the control

4 This was tested by augmenting the right-hand-side of Equation (1) with the term $\left(\Delta hp_{i,2006-11} \times s^{rent}_{i,2006}\right)$, where $s^{rent}_{i,2006}$ is the share of households in 2006 in postcode i who rented their home. The point estimate of the coefficient on this term is negative, consistent with higher housing costs making aspiring home owners worse off, but the effect is not statistically significantly different from zero.

5 These sample restrictions result in the exclusion of 30 postcodes. The OLS estimate for the elasticity of new vehicle registrations with respect to housing wealth is larger if outliers are not removed, but quantile regression estimates using the full set of data are similar; in both cases, the estimated effects remain statistically significantly different from zero.

Table 1: Housing Wealth and New Vehicle Registration Growth[(a)]
Dependent variable: 100 x change in log per capita new passenger vehicle registrations between 2006 and 2011

	OLS (1)	OLS (2)	Median regression (3)
Change in the log of the dwelling price × share of households owning a dwelling	0.48*** (0.08)	0.56*** (0.17)	0.42** (0.17)
Observations	563	526	526
R^2	0.07	0.23	0.17
State fixed effects	No	Yes	Yes
Controls	No	Yes	Yes

(a) ***, ** and * represent statistical significance at the 1, 5 and 10 per cent level, respectively; standard errors are shown in parentheses
Sources: ABS; APM; Gillitzer and Wang (2015)

variables, indicating an elasticity of new vehicle registrations with respect to gross housing wealth of about one-half. This is about twice the size of the relationship between new vehicle registrations and housing prices shown by the line of best fit in Graph 2. The effect is larger because only home owners experience an increase in housing wealth when housing prices rise, and the effect of housing wealth on new vehicle registrations is assumed to operate only through home owners.[6]

The second column in Table 1 reports estimates for Equation (1) including the full set of control variables; the regression also includes state fixed effects, to allow for divergent trends in new vehicle registrations in Sydney, Melbourne and Brisbane. For brevity, Table 1 omits the coefficient estimates for the control variables, which are reported in Table A1. The estimated elasticity between new vehicle registrations and housing wealth remains about one-half and is significant at a 1 per cent level.

To assess the extent to which the estimated relationship is driven by large changes in new vehicle registrations, estimates for Equation (1) in the third column using a median regression estimator are reported, which minimises the sum of absolute rather than squared errors, and therefore provides parameter estimates that are less influenced by large changes. The estimated relationship between new vehicle registrations and housing wealth is similar, indicating that the relationship is not driven primarily by postcodes experiencing unusually large changes in new vehicle registrations. Overall, the results indicate a robust cross-sectional relationship between growth in new vehicle registrations and gross housing wealth.

Longevity of the effect

Thus far, the relationship between new vehicle registrations and housing wealth over a five-year period has been estimated. However, the cumulative effect of a change in housing wealth on new vehicle registrations depends on whether the effect on spending is sustained over time. If households use greater housing wealth to fund a one-time increase in current spending, then spending will tend to revert to its prior level in the next period, in which case current new vehicle registration growth will tend to be negatively related to past changes in housing wealth. Conversely, if spending that is funded by an increase in housing wealth is smoothed over time, no relationship between past changes in housing wealth and current new vehicle registration growth should be expected. To

6 Mechanically, gross housing wealth for owner-occupiers in a postcode is equal to the price of housing multiplied by the home ownership share, and so varies less than one for one with housing prices. The correlation between the home ownership rate in 2006 and house price growth for the period 2006 to 2011 is very close to zero.

investigate these possibilities, Equation (1) has been augmented with changes in gross housing wealth over the periods 1996 to 2001 and 2001 to 2006.[7] Estimation results are reported in Table A2.[8]

Growth in new vehicle registrations over the period 2006 to 2011 is negatively related to housing price growth over the period 2001 to 2006, but the sum of the estimated housing price growth coefficients remains positive, and about four-fifths the size of the contemporaneous coefficient alone. This indicates that the contemporaneous relationship between housing wealth and new vehicle registrations is largely sustained over time. Overall, it can be concluded that an increase in housing wealth is associated with an elevated level of new vehicle registrations for a sustained period of time, but that the short-run relationship is likely to be larger than the long-run relationship.

Marginal Propensity to Consume

New vehicles

The estimation results indicate the percentage change in new vehicle registrations associated with a 1 percentage point change in gross housing wealth, but other studies often report estimates in terms of a marginal propensity to consume (MPC) – the change in spending from a dollar change in housing wealth. A straightforward means to infer an MPC for new vehicles from these results is to scale the estimated elasticity by the ratio of the value of new vehicle registrations to housing wealth for home owners. Using ABS household wealth, expenditure and national accounts data, the estimated elasticity for new vehicle registrations implies an MPC for new vehicles of about one-sixth of a cent per dollar increase in gross housing wealth.[9]

A drawback of this approach is that it does not allow for variations in MPCs at different points in the income and wealth distribution and so can be unreliable. An alternative methodology is to re-specify Equation (1) in dollar terms, regressing the dollar change in new vehicle consumption on the dollar change in gross housing wealth. This approach requires the dollar value of new vehicle consumption to be estimated, which is done by scaling the quantity of new vehicle registrations by an estimate of the average price of a new passenger vehicle; a number of additional assumptions are detailed in Gillitzer and Wang (2015). The results indicate an average MPC for new vehicles of about one-sixteenth of a cent per dollar increase in gross housing wealth, a bit less than half the estimate inferred from the elasticity estimate. The difference between these estimates arises because of variations in MPCs by income groups, which the preferred methodology takes into account. As is shown in Gillitzer and Wang (2015), the relationship between new vehicle registrations and housing wealth is smaller for high-income postcodes than it is for low-income postcodes. A common percentage change in housing prices results in large dollar increases in housing wealth for high-income postcodes, because high-income households tend to own relatively expensive homes, but a relatively modest change in new vehicle registrations.

Aggregate consumption

To infer an MPC for total consumption from the estimated MPC for new vehicle consumption, an assumption needs to be made about whether the relationship between new vehicle consumption and housing wealth is different to the relationship

7 The postcode-level correlation in house price growth between these five-year periods is low, providing statistical power for this analysis.

8 Housing price data for a smaller number of postcodes is available prior to 2006. The first column in Table A2 reports estimates excluding changes in gross housing wealth prior to 2006 for comparison with the results in the second column of Table 1. Reassuringly, the smaller dataset makes little difference to the main parameter of interest.

9 This calculation uses data from the latest 2009–10 ABS Household Expenditure Survey, and the 2009–10 ABS Household Wealth and Wealth Distribution data. The elasticity of new vehicle registrations with respect to gross housing wealth is assumed to be 0.45, and vehicle consumption is assumed to be 2.9 per cent of total consumption, its average since 2000 based on national accounts data. The price of new vehicles is assumed to be unaffected by changes in housing prices.

between total consumption and housing wealth. Assuming that new vehicle and total consumption have the same sensitivity to a change in housing wealth, the estimated MPC for new vehicle consumption can simply be scaled by the ratio of total consumption to new vehicle consumption. Doing so implies an MPC for total consumption of about 2 cents per dollar change in gross housing wealth. For comparison, Dvornak and Kohler (2007) report an MPC for total consumption of 3 cents per dollar change in housing wealth.

But evidence from the United States (Mian, Rao and Sufi 2013) indicates that new vehicle consumption is much more sensitive to a change in housing wealth than is total consumption. This may be because housing wealth is often used to finance the purchase of durable goods such as new vehicles. This proposition is also supported by the observation that new vehicle sales are much more cyclically sensitive than total consumption (indicated by the respective scales for the lines on Graph 1). Using the estimate from Mian *et al* (2013) on the relative sensitivities of new vehicle and total consumption to a change in housing wealth, the Australian data implies an MPC for total consumption of less than one-quarter of a cent per dollar change in housing wealth.

Conclusion

There is a robust cross-sectional relationship between changes in housing wealth and new vehicle registrations. Even though new vehicle registrations are a relatively narrow measure of consumption, because this measure is available across postcodes, it is well suited to identifying a relationship between housing wealth and consumption.

The preferred estimate suggests that a 1 per cent increase in housing wealth is associated with a one-half per cent increase in new vehicle registrations. Evidence from the United States indicates that new vehicle consumption is particularly sensitive to a change in housing wealth and, under the assumption that this is also true for Australia, the estimates imply that each dollar increase in housing wealth is associated with an increase in total consumption of less than one-quarter of a cent.

References

Buiter WH (2010), 'Housing Wealth Isn't Wealth', *Economics*, 4(22), pp 1–29.

Case KE, JM Quigley and RJ Shiller (2005), 'Comparing Wealth Effects: The stock market versus the housing market', *Advances in Macroeconomics,* 5(1), Article 1.

Dvornak N and M Kohler (2007), 'Housing Wealth, Stock Market Wealth and Consumption: A panel analysis for Australia', *Economic Record*, 83(261), pp 117–130.

Gillitzer C and JC Wang (2015), 'Housing Wealth Effects: Cross-sectional evidence from new vehicle registrations', RBA Research Discussion Paper 2015-08.

Iacoviello M (2004), 'Consumption, House Prices, and Collateral Constraints: A structural econometric analysis', *Journal of Housing Economics*, 13(4), pp 304–320.

Mian A, K Rao and A Sufi (2013), 'Household Balance Sheets, Consumption, and the Economic Slump', *The Quarterly Journal of Economics*, 128(4), pp 1687–1726.

Sinai T and NS Souleles (2005), 'Owner-Occupied Housing as a Hedge against Rent Risk', *The Quarterly Journal of Economics,* 120(2), pp 763–789

Appendix A – Additional Results

Table A1: Housing Wealth and New Vehicle Registration Growth[(a)]
Dependent variable: 100 x change in log per capita new passenger vehicle registrations between 2006 and 2011

	OLS (1)		OLS (2)		Median regression (3)	
Log of the dwelling price × share of households owning a dwelling			12.17*	(6.34)	9.80*	(5.24)
Change in the log of the dwelling price × share of households owning a dwelling	0.48***	(0.08)	0.56***	(0.17)	0.42**	(0.17)
Change in log of median annual income			0.05	(0.10)	0.08	(0.07)
Change in the share of households owning a dwelling			–0.02	(0.38)	–0.20	(0.34)
Change in mortgagor repayment-to-income ratio			–1.12	(31.30)	0.22	(26.19)
Change in the unemployment rate			–0.22	(1.24)	–1.60	(1.05)
Log of median annual income			–2.41	(8.29)	–3.31	(6.46)
Share of households who own a dwelling			–1.73**	(0.79)	–1.34**	(0.68)
Mortgagor repayment-to-income ratio			–5.65	(12.92)	–9.79	(11.81)
Unemployment rate			–2.28***	(0.74)	–1.99***	(0.58)
Share of people with a bachelor's degree or higher			–0.61***	(0.22)	–0.46**	(0.19)
Share of people with a certificate qualification			–1.94**	(0.97)	–1.32*	(0.73)
Distance to CBD			0.20*	(0.12)	0.23**	(0.11)
Waterfront dummy			2.43	(1.75)	0.52	(1.73)
Observations	563		526		526	
R^2	0.07		0.23		0.17	
State fixed effects	No		Yes		Yes	

(a) ***, ** and * represent statistical significance at the 1, 5 and 10 per cent level, respectively; standard errors are shown in parentheses
Sources: ABS; APM; Gillitzer and Wang (2015)

Table A2: Longevity of Housing Wealth Effects[(a)]

Dependent variable: 100 x change in log per capita new passenger vehicle registrations between 2006 and 2011

	OLS (1)		OLS (2)	
Log of the dwelling price × share of households owning a dwelling	11.53	(8.09)	11.59	(8.24)
Change in the log of the dwelling price between 2006 and 2011 × share of households owning a dwelling	0.62***	(0.19)	0.66***	(0.20)
Change in the log of the dwelling price between 2001 and 2006 × share of households owning a dwelling			–0.14	(0.16)
Change in the log of the dwelling price between 1996 and 2001 × share of households owning a dwelling			0.06	(0.07)
Change in log of median annual income	0.07	(0.12)	0.09	(0.12)
Change in the share of households owning a dwelling	–0.24	(0.55)	–0.26	(0.55)
Change in mortgagor repayment-to-income ratio	6.59	(36.82)	13.35	(37.34)
Change in the unemployment rate	-0.23	(1.78)	0.07	(1.76)
Log of median annual income	–3.80	(10.00)	–1.80	(10.15)
Share of households who own a dwelling	–1.61	(1.05)	–1.63	(1.06)
Mortgagor repayment-to-income ratio	–4.25	(15.27)	–3.03	(16.22)
Unemployment rate	–2.46***	(0.89)	–2.23**	(0.91)
Share of people with a bachelor's degree or higher	–0.55*	(0.30)	–0.58*	(0.30)
Share of people with a certificate qualification	–2.05*	(1.07)	–1.98*	(1.07)
Distance to CBD	0.24	(0.15)	0.28*	(0.15)
Waterfront dummy	0.93	(2.38)	0.82	(2.35)
Observations	375		375	
R^2	0.27		0.27	
State fixed effects	Yes		Yes	

(a) ***, ** and * represent statistical significance at the 1, 5 and 10 per cent level, respectively; standard errors are shown in parentheses

Sources: ABS; APM; Gillitzer and Wang (2015)

Long-run Trends in Housing Price Growth

Marion Kohler and Michelle van der Merwe*

This article examines the factors driving long-run trends in Australian housing price growth over the past three decades. During the 1980s, housing prices grew broadly in line with general price inflation in the economy. The period from the 1990s until the mid 2000s saw relatively strong housing price growth associated with a significant increase in the debt-to-income ratio of Australian households. Since the mid 2000s, strong population growth has played an increasing role in explaining housing price growth.

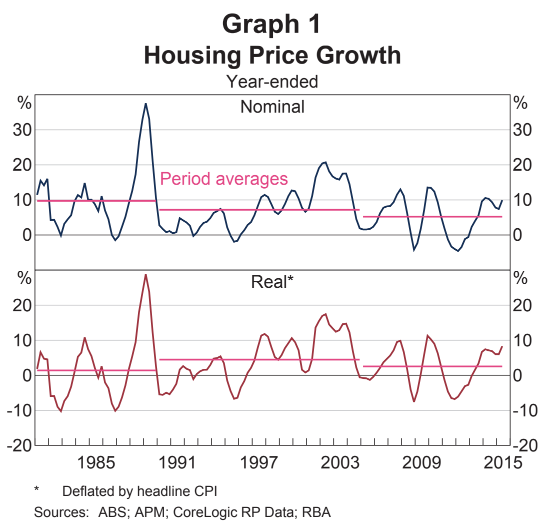
Introduction

Housing is the most important asset owned by the majority of Australian households. It is a large component of household wealth and serves a unique, dual role as an investment vehicle and a durable good from which consumption services are derived. With most mortgages and many small business loans secured against residential dwellings in Australia, housing also forms an important part of the collateral backing the financial sector's balance sheet.

Changes in housing prices can affect the behaviour of a number of economic variables. For example, household consumption can be affected via the housing wealth channel; dwelling investment via a Tobin's Q relationship (whereby investment occurs as long as the expected return is above the cost of the investment); and small business investment can be affected by owners of small businesses facing collateral constraints in accessing credit.[1] Changes in dwelling prices also influence financial stability via their influence on the values of both household balance sheets and the assets backing bank balance sheets.

Over the past 30 years, Australian housing prices have increased on average by 7¼ per cent per year, and over the inflation-targeting period by around 7 per cent per year (Graph 1).[2] However, these averages mask three distinct phases:

- During the 1980s, annual housing price inflation was high, at nearly 10 per cent on average, but so too was general price inflation. In real terms, housing price inflation during the 1980s was relatively low, at 1.4 per cent per annum compared with 4.5 per cent during the period from 1990 to the mid 2000s, and 2.5 per cent over the past decade.



* Marion Kohler is from International Department but completed this work in Economic Analysis Department, and Michelle van der Merwe is from Economic Analysis Department. The authors would like to thank Luci Ellis, Tony Richards, Peter Tulip and, in particular, James Hansen for valuable comments and discussions.

1 More detail can be found in Dvornak and Kohler (2003) and Windsor, Jääskelä and Finlay (2013) on the wealth channel; Corder and Roberts (2008) on dwelling investment and Tobin's Q; and Connolly, La Cava and Read (2015) on the housing collateral channel.

2 For a discussion of very long-term developments in housing prices over the past century, see Stapledon (2012).

- The 1990s until the mid 2000s were marked by quite high housing price inflation, of 7.2 per cent per annum, on average, in nominal terms.
- Annual nominal housing price inflation over the past decade was lower than either of these periods, at a little over 5 per cent on average.

The remainder of this article analyses to what extent the differences in long-run trends can be explained by differences in fundamental drivers of housing price growth.

Drivers of Long-run Housing Price Growth

Framework

A variety of models have been used in the literature to understand what determines housing prices. Much of the literature focuses on whether the observed *level* of prices is in line with fundamental determinants. In contrast, this article examines the extent to which changes or trends in such fundamental drivers correlate with observed changes in longer-run housing price growth.

The price of any good or asset is determined jointly by demand and supply. In this sense many of the frameworks in the existing literature are only partial because they often focus on either demand- or supply-side factors. One framework that nests a number of approaches and allows joint consideration of the supply and demand side is the stock-flow model of the housing market; it captures the dynamic interaction between housing demand, supply and prices over the time (DiPasquale and Wheaton 1994).

In the stock-flow model, demand for housing assets (from both owner-occupiers and investors) is negatively related to the price and user cost (the cost of owning), and positively related to rent. A number of other variables also play a role, including demographic factors, the permanent income of households, and the cost of and access to credit. This encompasses different models of demand. One is the user cost of housing, which relates the price of owning a home to the cost of renting and has been estimated for Australia by Fox and Tulip (2014). The user cost is dependent on the real interest rate, running costs, depreciation of the asset and the expected real rate of housing price appreciation. Similarly, an investor would consider whether the rental return covers the user cost of owning the property, although the point of 'no arbitrage' will be different to that of an owner-occupier, given the different tax treatment of owner-occupied and investor property in Australia. Another, complementary view is that housing is like any other asset, where the price today reflects the sum of expected future discounted cash flows. However, property assets are likely to behave differently to other asset classes because, in comparison with most financial assets, they involve relatively large transaction costs, are traded in relatively thin markets and consist of heterogeneous products (Case and Shiller 1989; Bodman and Crosby 2004).

In the short run, the demand for housing can change more quickly than the supply of housing, and so housing prices will need to adjust temporarily to equilibrate housing demand and supply (unless vacant housing can absorb the change in demand). Supply adjustments in response to demand shocks usually take some time, reflecting both the timing lags associated with the construction of new supply and – in the case of supply reductions – that the existing stock is large relative to the flow of new dwellings (Ellis 2006). A developer will decide to construct a new dwelling if the cost of construction (including the cost of purchasing and readying the land) is less than the expected sale price of the new dwelling, including the land. (This framework is often referred to as the Tobin's Q model.) As new dwellings are built, all other things equal, downward pressure is placed on prices until supply and demand are equilibrated in the long run. The (new) long-run equilibrium price will depend on the relative price elasticities of supply and demand for housing.

Inflation

Measured in nominal terms, growth in housing prices will be affected by the general level of inflation. As already noted, during the 1980s, nominal housing price inflation was relatively high and volatile, but so too was general price inflation. Indeed, until the late 1980s, housing prices grew broadly in line with general price inflation.

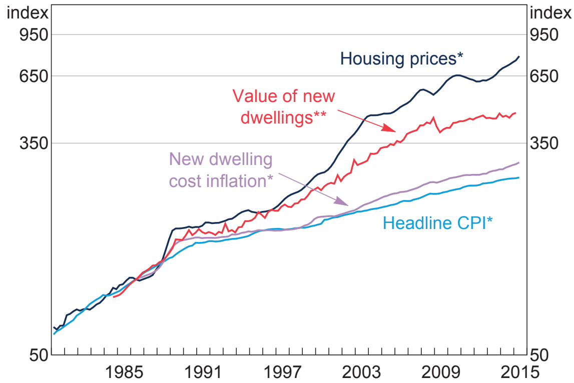
Over the past 20 years, general price inflation was low and stable, consistent with the inflation target of 2 to 3 per cent per annum, which was introduced in the early 1990s. Housing price growth, however, has outstripped the rate of inflation in other prices in the economy including inflation in the cost of new dwellings (Graph 2).[3] In real terms, housing price growth since the 1990s was above that of the 1980s. One possible explanation is that this reflects improvements in the quality of housing over time that have not been adequately measured. The housing price measure used in Graph 2 (which is a hedonically adjusted housing price index) already abstracts from the higher costs of a number of quality improvements, such as the increase in floor space and the addition of modern conveniences such as air conditioning, but it may not fully capture all improvements.[4] An alternative benchmark is the value of new dwellings, where changes in quality are explicitly accounted for; this has also increased noticeably over the past few decades. However, housing prices have increased by a considerably faster pace than even the value of new dwellings, which include the costs of quality improvements of housing over time.

This gap between housing prices and different measures of the cost of new housing suggest that, over the past 25 years, factors have been at work that have increased the demand for housing relative to additions in housing supply (including in well-located and more desirable locations) and by more than had been the case during the 1980s.

3 This is true for both the CPI measure for new dwelling cost inflation in Graph 2 and the building cost index published by Rawlinsons (2014), which follows the CPI closely over that period.

4 Most notably, the hedonic measure of housing prices used in Graph 2 may not abstract fully from a premium that is being placed on living close to the city centre (or other desirable locations) as cities increase in size over time (Ellis and Andrews 2001; Kulish, Richards and Gillitzer 2012) or the shift to higher-quality building materials used in construction (Kearns 2012).

Graph 2
Inflation, Housing Prices and Quality
June quarter 1986 = 100, log scale



* Abstracts from quality improvements
** Includes changes associated with quality improvements; RBA estimates
Sources: ABS; APM; CoreLogic RP Data; RBA

The remainder of this section reviews some of the drivers that may help to explain relatively stronger demand growth for housing in the past two decades or so: one-off factors such as financial deregulation and the shift in the early 1990s to an environment of low and stable inflation; long-term determinants such as population growth; and cyclical factors that have contributed to housing price growth.

Disinflation, deregulation and housing demand

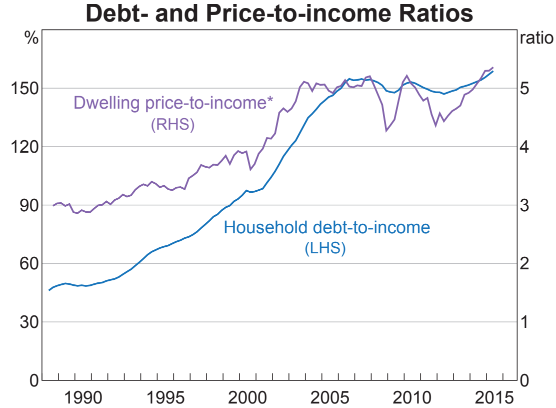
The deregulation of the financial sector during the 1980s and the shift to a low inflation and low interest rate environment in the early 1990s greatly increased household access to finance in Australia. These developments have been discussed in detail elsewhere (e.g. RBA 2003, 2014; Ellis 2006), so they are only summarised briefly here.

Many important changes to the financial landscape in Australia were made in the mid 1980s up until the early 1990s. Over time, financial deregulation, together with increased competition, increased borrowers' access to credit and reduced its cost. At the same time, the shift from a high- to a low-inflation environment in the 1990s saw nominal interest rates decline in line with the lower inflation compensation required.

Low inflation together with increased competition in the mortgage market reduced housing loan interest rates, thereby easing serviceability constraints. Previously credit constrained households were increasingly able to borrow more for a given level of income and pay higher prices. Without a corresponding increase in supply in the most desirable locations, this was likely to have led to a pick-up in housing price growth, and household debt, for a protracted period (Kulish *et al* 2012).

The increased access to credit by Australian households over this period can be seen in the steady increase of the ratio of household debt to income (Graph 3). A similar trend is observed in the dwelling price-to-income ratio.[5] While deregulation and disinflation were largely complete by the mid 1990s, the adjustment of the economy to the new steady state took well over a decade (Ellis 2005; Kent, Ossolinski and Willard 2007). These adjustments appear to have largely run their course, with the household debt-to-income ratio fluctuating around 150 per cent over the past decade.

Graph 3
Debt- and Price-to-income Ratios



* Mean dwelling price
Sources: ABS; CoreLogic RP Data; RBA

Underlying demand and supply of new housing

Underlying demand for new housing

Underlying demand for new dwellings can be thought of as representing what demand for newly built housing might have been, given the observed rate of population growth and an estimate of underlying average household size (Richards 2009a, 2009b). In other words, this is the longer-run level of demand, abstracting from shorter-term influences on housing demand related to the business cycle. Underlying demand, though unobservable, consists of three components: demand from newly formed households; demand for new dwellings to replace demolished ones; and demand for second or vacant homes (Graph 4). The latter two components have been relatively stable contributors to underlying demand compared with changes in the household formation rate, which have driven most of the variation in estimates of underlying demand. The rate of household formation in turn reflects the interaction between population growth and average household size.[6]

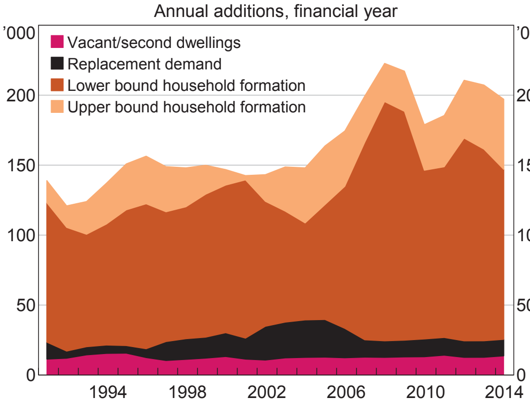
From 1990 to the mid 2000s, population growth in Australia was relatively low compared with that of the previous two decades, owing to a declining natural rate of population growth and lower net immigration. Since the mid 2000s, Australia has seen much higher net immigration and so population growth has stepped up to a significantly higher rate (Graph 5). A slightly higher natural increase in population has also contributed to the shift.

Average household size – the other component of the household formation rate – has declined markedly since the 1960s and, all else equal, has

5 The reduction in the rate of inflation also contributed to the trend increase in the debt-to-income ratio; the rate at which nominal income growth will erode debt occurs less rapidly than in a high inflation environment (RBA 2003). Also, it is possible that households are willing to spend relatively more on housing as their real incomes rise, and this could also contribute to a rising debt-to-income ratio. However, the flattening out of the debt-to-income ratio over the past decade (when real incomes have continued to increase) suggests that this may have been a less important factor over the time period considered here.

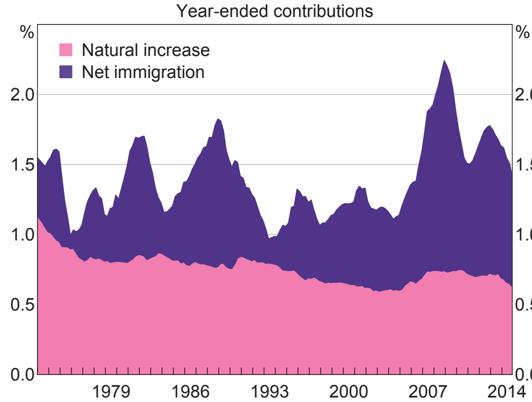
6 Data on average household size are only available in Census years and average household size measured at any point consists of a longer-run underlying trend (determined by demographics, income etc.), and shorter-term adjustments in response to changes in housing prices (see below). In order to extract the longer-run, underlying trend of average household size, three alternative trend measures are fitted to generate annual estimates. The result is a range of scenarios for underlying demand, helping to account for some of the uncertainty around its estimation.

Graph 4
Components of Underlying Demand
Annual additions, financial year



Sources: ABS; RBA

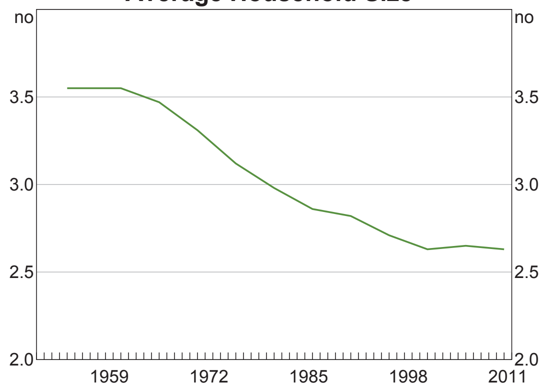
Graph 5
Population Growth*
Year-ended contributions



* Total population growth is the sum of the components
Sources: ABS; RBA

generated an increase in demand for housing for a given level of population (Graph 6). Unlike the earlier trend, average household size has been little changed since the 2000s. Changes in average household size reflect a combination of demographic changes, household preferences and endogenous responses to housing prices (Richards 2009a, Richards 2009b). Much of the downward trend over the past five decades has been attributed to demographic changes resulting from falling fertility rates, an ageing population and rising household

Graph 6
Average Household Size*



* Average household size in 2011 is calculated using ABS projections of the number of households
Sources: ABS; RBA

incomes (Kearns 2012).[7] These forces have resulted in smaller-sized households, on average, that have demanded more housing for a given level of population (Ellis 2010). Average household size may also adjust in response to changes in housing prices. To the extent that pressures arising from higher demand for new housing outstrip supply increases over a short period, some of the excess demand is likely to be accommodated by short-term increases in average household size.

Combining the range of estimates of average household size, population growth and demand for second homes and replacement dwellings, suggests that annual demand for new housing was relatively stable prior to the mid 2000s, fluctuating between 120 000 and 145 000 new dwellings every year (Graph 4). Since then, annual demand for new housing increased by around 40 per cent (or by around 50 000 new dwellings), largely owing to strong population growth.

Will underlying demand remain elevated? Forecasts from the Department of Immigration and Border Protection suggest that population growth has declined noticeably over the past year or so, but

7 Migration flows can also be a source of demographic change in average household size in countries with significant immigration such as Australia, if migrant household sizes are different to those of the existing population.

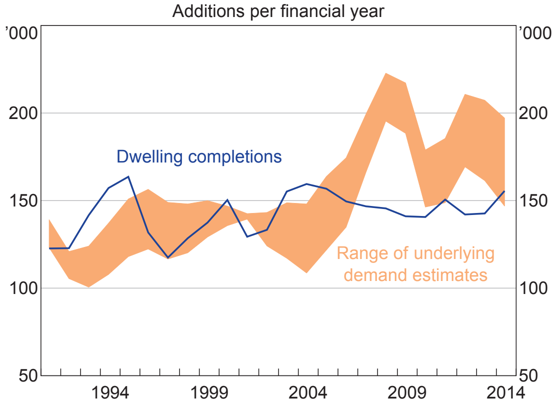
population is still expected to expand at a pace above that recorded from 1990 to the mid 2000s. Underlying demand for new dwellings will also depend on developments in average household size. To the extent that the levelling off in household size since the early 2000s has partly reflected a response to rising housing prices, average household size could rise, thereby offsetting any increase in demand from population growth.

Supply of new housing

Whether or not an increase in demand leads to increased housing price growth depends on the response of supply to changes in demand. There is considerable evidence that, in the short run, there are lags in the ability of the supply of housing to respond to changes in demand. This is not surprising given the length and complexity of the planning process, the time taken to construct new dwellings, the difficulty in the provision and funding of required infrastructure, as well as the cost of readying undeveloped land for construction and availability of suitable sites (Hsieh, Norman and Orsmond 2012). Previous Australian and international literature has pointed out that local zoning and planning policies have played a prominent role in explaining some of the protracted supply-side rigidities observed in many housing markets (Glaeser, Gyourko and Saks 2005; Kulish *et al* 2012). If supply additions fall short of underlying demand for new housing for a time, prices can be expected to increase, at least until additional supply is available. Moreover, given the lags associated with construction, expected price changes play an important role in developers' decision-making processes.

Over the past three decades, dwelling completions have been relatively stable, at around 130 000 to 145 000 completions per annum (Graph 7). However, completions alone hide the noticeable increase in size and improvement in the quality of new dwellings that have occurred over time, along with the increased cost associated with their construction (Kearns 2012). For example, the average number of spare bedrooms has increased over the past 20 years

Graph 7
Underlying Demand and Supply
Additions per financial year



Sources: ABS; RBA

for households across all age groups and most household types.[8]

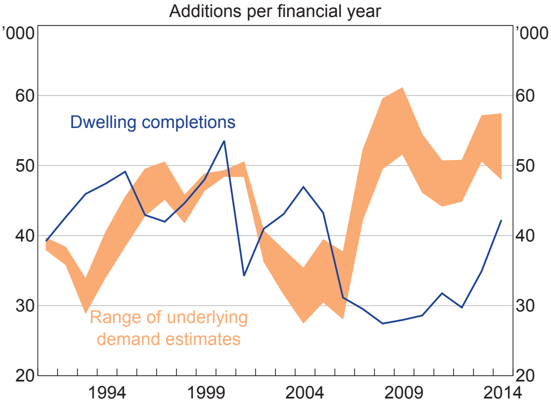
Annual supply and demand gap

When compared with the range of underlying demand estimates, completions suggest that, over much of the past decade, the supply side has been slow, or unable, to respond to the significant increases in underlying demand (based on estimates of underlying average household size, rather than actual household size).[9] More recently, the gap between underlying demand for and supply of new dwellings in Australia looks to have become smaller (Graph 7). Graph 8 suggests that much of the aggregate gap was accounted for by developments in New South Wales. Underlying demand-supply gaps in Queensland and Western Australia also look to have contributed to the aggregate gap, although the estimates of underlying demand on a state level are subject to even larger uncertainty than those at the national level (since some of the assumptions made on household formation are less likely to hold at a disaggregated level). More recently, new supply in New South Wales has increased sharply, consistent with the earlier period of strong underlying demand

8 Thanks to Mark Caputo and Stephen Knop for providing this analysis.

9 See footnote 6 for details on the estimates of underlying average household size.

Graph 8
NSW – Underlying Demand and Supply
Additions per financial year

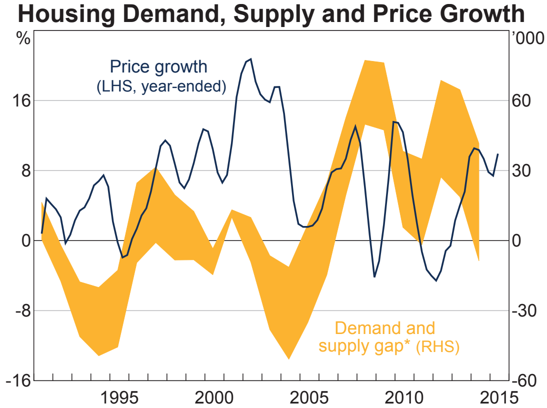


Sources: ABS; RBA

growth and the significant time lags in building construction, as well as very low interest rates currently that could be expected to underpin developers’ expectations for housing price growth to continue for some time. It could also be that an increased policy focus in recent years on alleviating supply-side rigidities has played some role in facilitating this pick-up (see also Hsieh *et al* (2012)).

To summarise, since the mid 2000s, the Australian housing market looks to have been subject to a series of persistent increases in demand stemming from high population growth, while supply has continued to increase by around 145 000 dwellings. Graph 9 suggests that the excess demand for new

Graph 9
Housing Demand, Supply and Price Growth



* A positive number indicates excess demand; shading indicates range
Sources: ABS; CoreLogic RP Data; RBA

dwellings (measured as underlying additional demand less additional dwellings) may have played a role in generating price growth since the mid 2000s, while it looks to have played a less prominent role in the decade before that.

Cyclical factors

While this article focuses on longer-run drivers of housing price growth, cyclical factors are likely to play a role in driving price growth over shorter periods. Most notably, monetary policy is thought to have an especially strong effect on the housing market, both in the established market through higher activity and prices and in the new dwelling market by encouraging dwelling investment. In fact, Otto (2007) finds that the level of the mortgage interest rate was a significant explanator of Australian capital city dwelling price growth over a period of around 20 years. While a lower mortgage rate encourages consumption of housing to be brought forward, in the long run, even if mortgage rates were to remain low for an extended period of time, there should be a supply response to help move the market back into its longer-run equilibrium. Indeed, the reduction in real mortgage rates since 2011 – following reductions in the cash rate – has been closely associated with both stronger housing price growth and strong dwelling construction more recently.

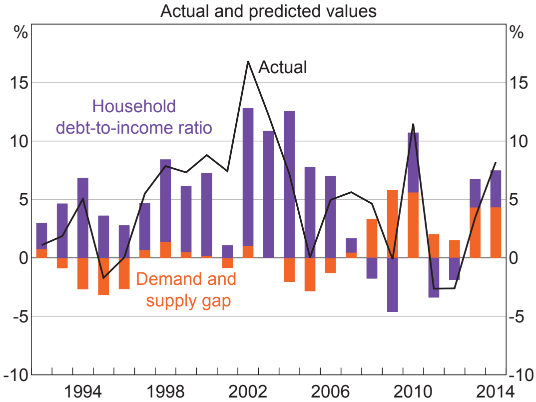
An Illustrative Example

The analysis in the previous section suggests a number of factors that are likely to have been associated with the longer-term trends in housing price growth over the inflation targeting period: the move to an environment of low inflation and easier access to credit following financial deregulation, as well as differences between the underlying demand for new dwellings and their supply. In order to illustrate the importance of these factors both over time and relative to each other, the exercise in this section is based on a very simple estimated model of housing price growth since 1991, motivated by Otto (2007).

The model, discussed in more detail in Appendix A, considers the relationship between annual housing price growth and changes in the debt-to-income ratio as well as changes in the gap between the underlying demand and the supply in the preceding year. While this simple model cannot account for all the factors affecting housing price growth over the past 25 years, the model is able to account for more than half of the variation. As it is difficult to disentangle the causality between housing price growth and changes in the debt-to-income ratio, the results are only indicative and do not necessarily imply causation.[10] However, if households' ability or willingness to borrow (relative to their income) is a binding constraint in their housing purchase decision, then an increase in the debt-to-income ratio should lead to higher house prices, all else equal.

Graph 10 (based on this illustrative model) suggests that housing price growth was closely associated with changes in the debt-to-income ratio over most of the 1990s until the mid 2000s (the exception is the period around 2000/01, where housing market activity was affected by the introduction of the GST (Kearns and Lowe 2011)). The underlying demand gap has played a more prominent role over the past decade, and changes in the debt-to-income ratio played a less prominent role over this period.

Graph 10
Housing Price Growth*
Actual and predicted values



* Financial year growth, adjusted for the constant; bars are contributions to the model prediction of housing price growth

Source: RBA

10 For more details, see Appendix A.

Other empirical studies suggest that real income growth is one of the main drivers of housing price growth over very long periods. If we include changes in real income per capita or real income in our econometric model, the coefficient is insignificant, suggesting that over the sample period considered here higher income per capita has had no role to play above its effect on underlying average household size.

Interest rate cycles do not appear to have had a particular correlation with housing price growth over and above what is already captured by the debt-to-income ratio and the demand-supply gap. While this contrasts with Otto (2007), that model does not include changes in the debt-to-income ratio. Intuitively, as most property purchase involves borrowing, it seems plausible that changes in the debt-to-income ratio would capture a large share of the impact of changes in interest rates on housing price growth.

Conclusion

This article analyses the factors influencing long-run housing price growth in Australia. During the 1980s, housing price inflation broadly followed general price inflation in the economy, which was relatively high and volatile. Following the financial deregulation of the mid 1980s and disinflation of the early 1990s, cheaper and easier access to finance underpinned a secular increase in households' debt-to-income ratio that was closely associated with high housing price inflation from the early 1990s until the mid 2000s. The past decade saw a stabilisation of debt-to-income levels, but also a prolonged period of strong population growth – underpinned by high immigration – and smaller household sizes that led to increases in underlying demand exceeding the supply of new dwellings.

Looking ahead, it seems unlikely that there will be a return to the rather extreme conditions of the earlier episode when significant increases in household debt supported high housing price growth. Nonetheless, protracted periods of changes in population growth that are not met by adjustments in dwelling supply could lead to periods of sizeable changes in housing price growth. One important factor for housing price growth is the ability of the supply of new dwellings to respond to changes in demand. The significance of this is made clear by the recent increases in higher-density housing and lower growth of those prices relative to prices of detached houses, whose supply has been less responsive.

Appendix A

The econometric model of housing price growth discussed here was chosen to evaluate the validity and relative importance of the key factors identified. The purpose is not, however, to identify the best empirical model for housing price growth and a different model might be preferable for that purpose.

Equation (1) shows the specification underlying the illustrative example used in the text (Graph 10) for annual growth in Australian capital city housing prices, estimated over 1991 to 2014 (standard errors are shown in parentheses).[11]

$$\begin{aligned} \Delta \ln P_t = & \underset{(1.40)}{1.52} + \underset{(0.19)}{0.92}\Delta Debt\_Income_t \\ & + \underset{(0.03)}{0.09}Gap_{t-1} + \varepsilon_t \end{aligned} \quad \text{(A1)}$$

$\Delta \ln P_t$ is the annual rate of growth in nominal housing prices (in per cent), $\Delta Debt\_Income_t$ is the change in the household debt-to-income ratio from $t - 1$ to t, and Gap_{t-1} is the difference between underlying supply and demand (using the middle of the estimated data range) from the previous year, divided by 1 000. Nominal inflation, which has been relatively stable over the estimation period, is captured as part of the constant. The model has quite high explanatory power, with an adjusted R^2 of 0.55, and has no serial correlation of note. Note that the introduction of the GST in 2000/01 is not well captured in the model.[12]

11 The lag specification was determined through general-to-specific modelling, starting with a model with a sufficiently long lag structure of all exogenous variables and removing insignificant variables step by step.

12 If a dummy variable is included in 2000/01 for the introduction of the GST the adjusted R^2 becomes 0.70 and the coefficient estimates are broadly similar.

In the model, the contemporaneous change in the debt-to-income ratio is significant, which could have a number of explanations. First, the time structure of dwelling purchases is such that, even though households often have pre-approval of finance when they purchase a dwelling, they usually take out a loan only after they purchase; the measured relationship is therefore close to contemporaneous, even though the decision might be causal from debt-to-income ratio to housing price. Second, there is a feedback between housing debt and house prices: an increase in the availability of finance allows households to pay higher housing prices, but higher housing prices in turn also require higher borrowing. The possible reverse causality means that the relationship between housing price growth and changes in debt-to-income ratios is not necessarily a causal relationship (in a temporal sense), but rather represents a correlation.

An instrumental variable (IV) estimate could, in principle, account for a possible endogeneity bias in the coefficient of the change in the debt-to-income ratio. However, this approach proved not to be possible in the model presented here for two reasons. First, our data covers only 23 years, which would make any IV estimates vulnerable to small sample bias. Using a longer time series (that is, including data prior to the 1990s) poses the problem of a number of structural changes in the economic relationships discussed in this article. Second, it is difficult to find a suitable instrument for the effect of financial deregulation and disinflation on households' indebtedness. The real mortgage rate facing household borrowers is one potential instrument. However, the measured changes in the real mortgage rate happened relatively quickly compared with the time it took for households to change their debt and house purchase decisions in response. As Bayoumi (1993) and Kent *et al* (2007) emphasise, the change to household behaviour can easily take more than a decade, including because of the relatively low frequency with which an individual household purchases a new home. As a result, it is difficult to find a good instrument for these changes in households' debt relative to their income, which would allow to better control for the possible endogeneity between house prices and the debt-to-income ratio. However, if households' ability or willingness to borrow (relative to their income) is a binding constraint in their housing purchase decision, then an increase in the debt-to-income ratio should lead to higher house prices. In this case, the endogeneity bias (of higher house prices in turn leading to a higher debt-to-income ratio in the same time period) is likely to be relatively minor. ✠

References

Bayoumi T (1993), 'Financial Deregulation and Household Saving', *Economic Journal,* 103(421), pp 1432–1443.

Bodman P and M Crosby (2004), 'Can Macroeconomic Factors Explain High House Prices in Australia', *Australian Property Journal*, 38(3), pp 175–179.

Case K and R Shiller (1989), 'The Efficiency of the Market for Single-Family Homes', *The American Economic Review*, 79(1), pp 125–137.

Connolly E, G La Cava and M Read (2015), 'Housing Prices and Entrepreneurship: Evidence for the Housing Collateral Channel in Australia (Draft paper)', RBA *Small Business Conditions and Finance Conference*, March.

Corder M and N Roberts (2008), 'Understanding Dwellings Investment', Bank of England *Quarterly Bulletin*, December, pp 393–403.

DiPasquale D and W Wheaton (1994), 'Housing Market Dynamics and the Future of Housing Prices', *Journal of Urban Economics*, 35(1), pp 1–27.

Dvornak N and M Kohler (2003), 'Housing Wealth, Stock Market Wealth and Consumption: A Panel Analysis for Australia', RBA Research Discussion Paper No 2003–07.

Ellis L (2005), ' Disinflation and the Dynamics of Mortgage Debt', in *Investigating the Relationships between the Financial and Real Economy*, BIS Papers No 22, BIS, Basel, pp5–20.

Ellis L (2006), 'Housing and Housing Finance: The View from Australia and Beyond', RBA Research Discussion Paper No 2006–12.

Ellis L (2010), 'Recent Developments in the Housing Market and its Financing', Address to Financial Review Residential Property Conference 2010, Sydney, 18 May.

Ellis L and D Andrews (2001), 'City Sizes, Housing Costs, and Wealth', RBA Research Discussion Paper No 2001-08.

Fox R and P Tulip (2014), 'Is Housing Overvalued?', RBA Research Discussion Paper No 2014–06.

Glaeser EL, J Gyourko and R Saks (2005), 'Why Have Housing Prices Gone Up?', *American Economic Review*, 95(2), pp 329–333.

Hsieh W, D Norman and D Orsmond (2012), 'Supply-Side Issues in the Housing Sector', RBA *Bulletin*, September, pp 11–19.

Kearns J (2012), 'The Outlook for Dwelling Investment', Address to the Australian Business Economists' Lunchtime Briefing, Sydney, 13 November.

Kearns J and P Lowe (2011), 'Australia's Prosperous 2000s: Housing and the Mining Boom', in H Gerard and J Kearns (eds), *The Australian Economy in the 2000s*, Proceedings of a Conference, Reserve Bank of Australia, Sydney pp 73–100.

Kent C, C Ossolinski and L Willard (2007), 'The Rise of Household Indebtedness', in C Kent and J Lawson (eds), *The Structure and Resilience of the Financial System*, Proceedings of a Conference, Reserve Bank of Australia, Sydney pp 123–163.

Kulish M, A Richards and C Gillitzer (2012), 'Urban Structure and Housing Prices: Some Evidence From Australian Cities', *Economic Record*, 88(282), pp 303–322.

Otto G (2007), 'The Growth of House Prices in Australian Capital Cities: What Do Economic Fundamentals Explain?', *The Australian Economic Review*, 40(3), pp 225–238.

Rawlinsons (2014), *Australian Construction Handbook*, 32nd edn, Rawlinsons Publishing, Perth.

RBA (2014), *Submission to the Financial System Inquiry*, Reserve Bank of Australia, Sydney, April.

RBA (2003), 'Household Debt: What the Data Show', RBA *Bulletin*, March, pp 1–11.

Richards T (2009a), 'Conditions and Prospects in the Housing Sector', Address to the 4th Annual Housing Congress, Sydney, 26 March.

Richards T (2009b), 'Housing Market Developments', Talk to CEDA Housing Forum: A National Round-up, Sydney, 29 September.

Stapledon N (2012), 'Trends and Cycles in Sydney and Melbourne House Prices from 1880 to 2011', *Australian Economic History Review*, 52(3), pp 293–317.

Windsor C, J Jääskelä and R Finlay (2013), 'Home Prices and Household Spending', RBA Research Discussion Paper No 2013–04.

Lower Bulk Commodity Prices and Their Effect on Economic Activity

Adam Gorajek and Daniel Rees*

Recent declines in bulk commodity prices have reduced the growth of household income, company profits and government revenues. The declines have been associated with a contraction in mining investment and, by lowering the growth of aggregate demand, have restrained non-mining business investment. At the same time, a number of factors are helping to offset the effects of declining commodity prices. These include accommodative monetary policy and the depreciation of the exchange rate. Also, after saving some of the mining boom proceeds, households appear to be reducing their rates of saving to maintain consumption.

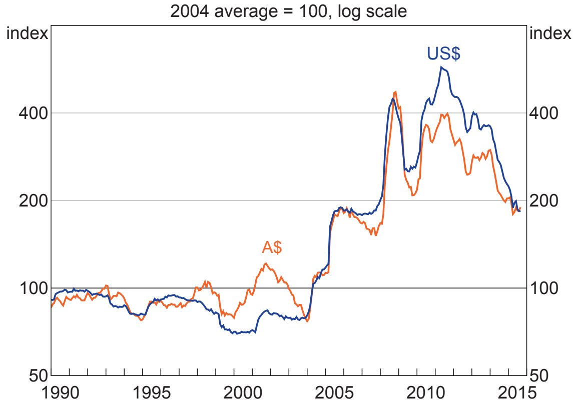
Introduction

Since 2011, there have been large declines in global prices for so-called 'bulk' commodities, which are iron ore and coking coal (both used in steel production), and thermal coal (used in energy production) (Graph 1). The declines follow large price increases over the 2000s, when growth in global demand for steel and energy, particularly from China, exceeded growth of bulk commodity supply. In time, these higher prices led to a marked expansion of capacity and production, including in Australia. Prices were expected to decline as production increased, but the sizes of the declines have been larger than most forecasters had anticipated.

Graph 1

RBA Index of Bulk Commodity Prices

2004 average = 100, log scale



Source: RBA

The combination of higher prices and increased domestic production has at times seen bulk commodities account for over a third of Australia's export revenue in recent years. This large share means that the recent price declines have significantly reduced growth of Australia's export revenues and, through various channels discussed in this article, have slowed the growth of economic activity. The Australian dollar has depreciated, partly in response to the bulk commodity price declines, and monetary policy has become more accommodative, both of which have dampened the effect of lower commodity prices on economic activity.

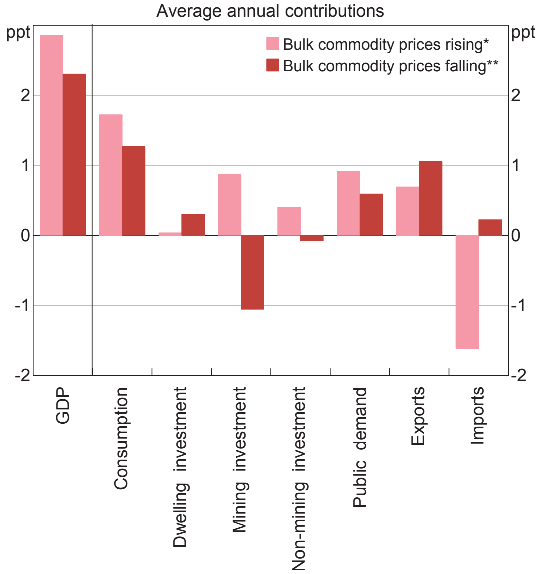
The first section of this article describes the main channels through which lower bulk commodity prices affect the Australian economy, including the offsetting effects of the exchange rate depreciation. It organises the channels into those affecting business investment, net exports, public demand and household consumption – the main expenditure components of GDP. To simplify the discussion it

* The authors are from Economic Group.

does not include the impacts of the monetary policy response.[1]

Accurately estimating the importance of the channels is challenging, partly because the expenditure components interact with each other and with other economic developments. Rees, Smith and Hall (2015) estimate a model of the Australian economy that is useful for this task and can incorporate the effects of monetary policy. The key results are summarised in the second section of this article. A similar exercise has been conducted by Tulip (2014), using a different model, with a focus on the effects of rising commodity prices during the 2000s. Although our focus is on the period of falling commodity prices, our estimates for the period of rising prices are quantitatively similar to those in Tulip (2014).[2]

Graph 2
GDP Growth
Average annual contributions



* March quarter 2005 to December quarter 2011
** December quarter 2012 to June quarter 2015
Sources: ABS; RBA

Describing the Main Transmission Channels

Business investment

The cycles in bulk commodity prices and mining investment since the mid 2000s have been closely linked. The initial expansion of mining capacity in response to the rise in commodity prices required large increases in spending on construction, machinery and equipment. As global production expanded to a level commensurate with the increase in demand, prices eventually declined and incentives for further investment diminished. After making an important contribution to Australian GDP growth as commodity prices rose, mining investment has subtracted from growth since the latter part of 2012 (Graph 2).

The companies mining bulk commodities in Australia had anticipated that prices would decline and they had already limited commitments for new investment spending before most of the recent price declines occurred. However, as the declines in commodity prices and mining company profits have been larger than was anticipated, mining investment may have declined by more than would otherwise have been the case. Information from the Bank's liaison program suggests that many producers have responded by reducing spending targeted at maintaining their mines and have embarked on other cost-cutting measures.

For non-mining business investment, the effect of the declines in bulk commodity prices operate partly through the associated exchange rate depreciation. Working in one direction, the lower exchange rate has made investment spending relatively more expensive because Australia imports many of its capital goods from overseas. Working in the other direction, the depreciation has improved demand conditions for businesses that produce tradable goods and services via an improvement in international competitiveness. Domestic demand and labour market conditions also matter for business investment, so the aggregate impact of the decline

1 The effects of monetary policy on the economy are discussed by Kent (2015).

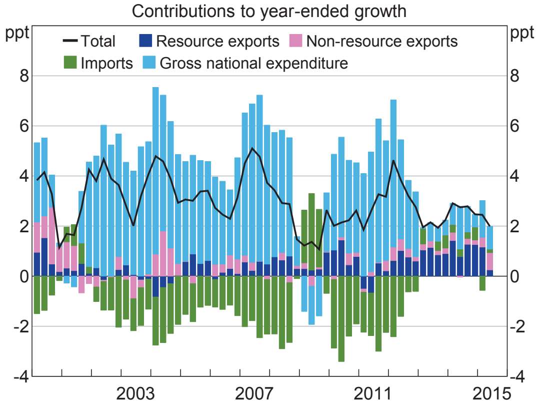
2 Implications of the mining boom, including its impact on the labour market, are also discussed in detail in Connolly and Orsmond (2011).

in commodity prices depends partly on the channels involving the other expenditure components. On the whole, even if the net effect of the depreciation is to stimulate an expansion of non-mining business investment, this effect is partly offset by the contractionary effects of lower commodity prices on other components of domestic demand.

Net exports

The increase in mining capacity triggered by the initial rise in commodity prices has led to strong growth in the volume of resource exports, particularly in recent years (Graph 3). The subsequent price declines have so far had little impact on export volumes because most Australian production has remained profitable. There have been some reports of smaller, less profitable mines closing down over the past year, particularly in the coal sector. Further closures are possible if prices remain at current levels for an extended period or decline further. While exports of bulk commodities are expected to continue to grow over the next couple of years as additional capacity comes on line, the pace of growth is expected to moderate.

Graph 3
Gross Domestic Product
Contributions to year-ended growth



Source: RBA

Non-resource export volumes are being supported by the lower exchange rate, through the associated improvement to competitiveness. Service exports have clearly responded, including in the sectors of tourism, education and business services. The overall pick-up of total non-resource exports has been limited in the current episode though, as manufactured exports have remained subdued and have not responded to the exchange rate depreciation by as much as historical relationships would suggest.

On the import side, volumes initially rose as commodity prices increased, in line with the pick-up in demand for mining capital goods and the appreciation of the exchange rate. As commodity prices have unwound, the reverse has occurred. In particular, imports of capital goods and services have declined of late.

Public demand

The Australian Government and some state governments collect significant revenues from the production and sale of bulk commodities. For the state governments – particularly Queensland and Western Australia, which have large endowments of bulk commodities – the revenues take the form of royalties, tied directly to the market value of production. For the Australian Government, the revenues mostly take the form of company taxes, tied indirectly to the market value of production via mining company profits. Movements in commodity prices may also influence capital gains and personal income tax receipts through their effect on the share prices of mining firms and employee wages.

The links to the value of resource production mean that government revenues were boosted as bulk commodity prices were high and rising, while more recently falling prices have been weighing on government revenues. For instance, the latest Australian Government budget estimated that recent declines in the actual and projected iron ore price reduced expected tax receipts by $20 billion over the four years to 2017/18. This compares with a total projected cash deficit of $116 billion over that time.

In principle, governments can respond to the revenue declines in several ways. One option is to reduce public demand, which captures components of government expenditure that contribute directly to economic activity. Alternatively, governments can reduce net transfer payments to households and business, in which case the economic impact would occur through those sectors. Governments can also absorb the lower revenues by borrowing more (or saving less), deferring some of the economic impact to a later date.

Although it is difficult to identify separately the governments' responses to the cycle in bulk commodity prices in the current episode, they appear to have chosen a mix of the options. For the Australian Government, for instance, recent budgets have downgraded projected growth of public demand and new policies have reduced net transfers to households. The Australian Government has also increased projected borrowing.[3]

Household expenditure

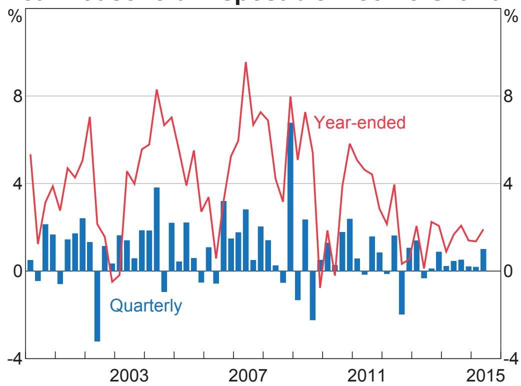
The bulk commodity prices cycle has also had important implications for household expenditure, primarily through its effect on real household disposable income. For instance, Tulip (2014) estimates that the mining boom boosted real household disposable income by around 13 per cent at its peak. Lately some of that has been unwinding, contributing to relatively low income growth by historical standards (Graph 4). While the unwinding has occurred partly through the reductions in net government transfer payments, other channels have also been important.

One of the key channels is labour income. The pressure for firms in the mining industry to improve efficiency has caused them to rein in labour costs. In addition to that effect, the transition from the investment to the production phase of the mining boom has been reducing the amount of labour required for resource and resource-related activity. The direct effects of a reduction in employment in the resource sector are likely to be small because mining accounts for just 2 per cent of total employment. However, it could have broader effects

3 Further details are available in Australian Government (2015).

Graph 4

Real Household Disposable Income Growth*



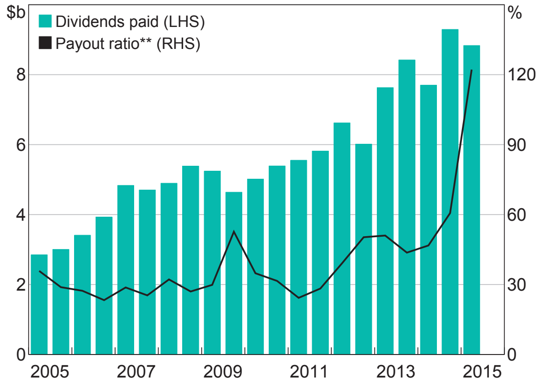
* Income level smoothed with a two-quarter moving average between March quarter 2000 and March quarter 2002

Sources: ABS; RBA

due to spillovers to other industries. The Bank's liaison suggests that broader cost-cutting initiatives in the mining industry have placed pressure on the margins of businesses that supply goods and services to the mining industry, which have sought to reduce their own labour and supplier costs as a result. According to estimates by Rayner and Bishop (2013), in 2011/12 these businesses accounted for more than twice as much employment as the mining industry. Recent work by Jacobs and Rush (2015) has also shown that even across industries that have little relation to mining, growth of labour costs has slowed noticeably from the time that bulk commodity prices started to fall, suggesting that low wage growth has had a more general role in the economy's adjustment process.

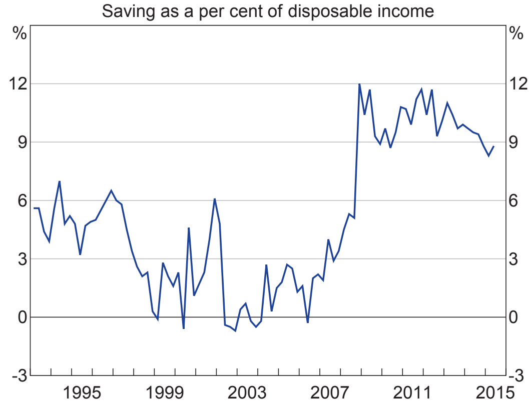
Another channel is mining company dividends, which are paid out of company profits. The effect on domestically distributed dividends is smaller than the decline in company profits because foreign ownership of mining companies is high. Mining companies also tend to commit to maintaining or increasing dividend payments over time, which smooths dividend payments through changes in commodity prices, particularly anticipated ones. While some mining companies have reduced their dividends recently, aggregate industry dividend payments have increased in recent years (Graph 5).

Graph 5
Mining Company Dividends*
ASX 200, semi-annual



* Energy and mining-related materials companies
** Ratio of dividends to underlying profit
Sources: Bloomberg; Morningstar; RBA

Graph 6
Household Saving Ratio
Saving as a per cent of disposable income



Source: ABS

Ultimately, how changes to household income affect consumption depends on whether the changes are perceived to be persistent or temporary. Households typically prefer to smooth their consumption over time, so income changes that are perceived to be temporary often result in larger changes to saving than to consumption. Recent research has found that Australian households, like the mining companies, have, in aggregate, behaved as if they perceived the initial boost to real incomes from the bulk commodity price increases as largely temporary.[4] This behaviour can account for some of the gradual decline in the household saving ratio that has been observed over recent years, which has dampened the effect of slower income growth on consumption growth (Graph 6).

Modelling the Impacts

To gauge the relative importance of the channels described above, we simulate the effect of lower bulk commodity prices using the multi-sector model of the Australian economy described in Rees *et al* (2015). Using a model allows us to explore the effects of commodity price changes while controlling for other economic developments and to account for simultaneous interactions between different households and businesses. It also allows us to explore how the effects play out across industries (the so-called 'production side' of the economy), using the three broad industry classifications: the mining sector; the non-mining tradable sector; and the nontradable sector. The model makes a number of simplifying assumptions, including that public demand does not react to changes in commodity prices. The model is calibrated to fit Australian data and generates results with strong qualitative parallels to the channels described above.

To generate our results we impose a path of commodity prices that roughly matches the changes in the RBA's Index of Commodity Prices (ICP) since

4 The research includes Rees (2013) and Kulish and Rees (2015).

2003 (Graph 7)[5]. At each point during the commodity price boom, households and firms in the model expected commodity prices to decrease in the future. In this sense, the boom was unanticipated.[6] However, the fall in commodity prices was anticipated. For the purposes of the scenario, the model assumes that commodity prices continue to decline until the end of 2018, although they remain considerably above their pre-2003 levels. The extension to 2018 illustrates the transition of the economy to an environment of lower commodity prices, which plays out gradually over several years. This extension should not be interpreted as a forecast. We show our results relative to what the model would have predicted if commodity prices had remained stable since 2003.

The commodity price boom is estimated to have raised the level of GDP, relative to the no-boom baseline, by around 4 per cent at the peak of the boom in 2011 (Graph 8).[7] As commodity prices fall, the model indicates that output grows at a below-average pace and eventually reverts to its no-boom baseline.

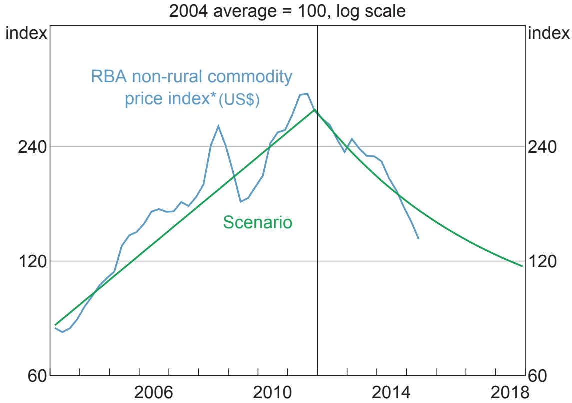
Graph 8 also shows the contributions of the expenditure components of GDP to changes in the level of output. Consistent with the actual pattern of investment in recent years, mining-related investment falls sharply after the peak in commodity prices (Graph 9). This is only partially offset by increased investment in the other sectors of the economy.

5 The ICP is an indicator of the average prices received by Australian commodity exporters, with commodities weighted by their relative importance in total commodity export earnings. The weight of bulk commodities in the index is currently around 58 per cent, although the ICP also includes rural commodities, base metals and other resources exported by Australia. The broader index is used here because it corresponds to the concept of commodity prices in the model.

6 This is consistent with the pattern of forecast errors during the commodity price boom documented in Plumb, Kent and Bishop (2013).

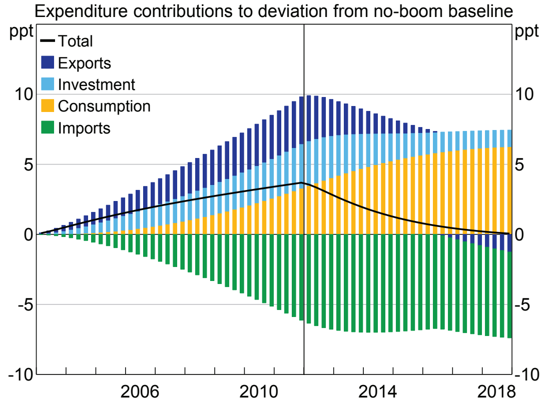
7 In all graphs, the vertical line denotes the peak in commodity prices. This is somewhat smaller than the estimate of 6 per cent reported in Downes *et al* (2014). It is not unusual for different macroeconomic models to provide slightly different estimates. Although there are several reasons for the difference, one factor may be that Downes *et al* define the mining boom to also include a large increase in investment, over and above that explained by high commodity prices.

Graph 7
Real Commodity Prices
2004 average = 100, log scale



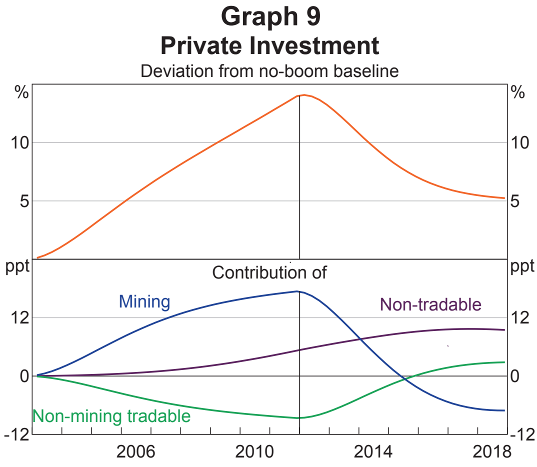
* Deflated by US GDP Chain Price Index
Source: RBA

Graph 8
Gross Domestic Product
Expenditure contributions to deviation from no-boom baseline

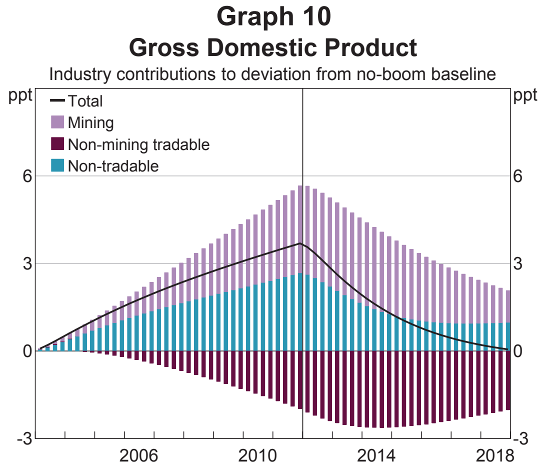


Source: RBA

Export volumes decline, because when commodity prices fall the model predicts that some marginal mining projects become unprofitable. The associated resource export declines are partly offset by a pick-up in non-resource exports, which benefit from a depreciation of the exchange rate (see below). As so few mining projects have to date become unprofitable, the model seems to overstate the response of resource exports. Indeed, resource exports have increased strongly in recent times, because of lags from investment to production. In the model, imports are expected to decline slightly in response to the lower commodity prices,



Source: RBA



Source: RBA

reflecting developments in the other expenditure components and the exchange rate depreciation.

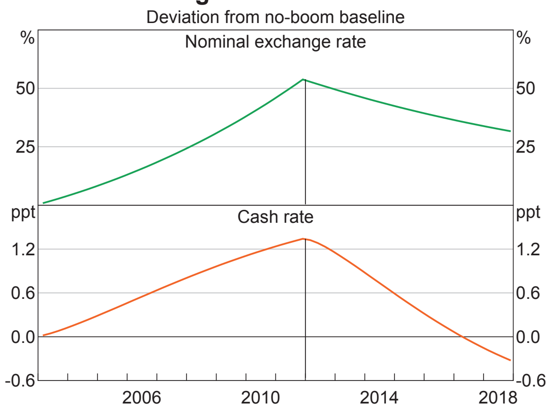
The model suggests that consumption continues to expand at an above-average pace even as commodity prices fall, because households draw down on the savings that they accumulated during the period of rising commodity prices. This prediction accords with the rise in the household saving ratio from 2006 and the decline in the household saving ratio observed in recent years, although aggregate consumption growth has been more subdued than the model results would imply. This discrepancy could reflect the fact that household consumption, like the other expenditure components is, in practice, affected by many factors besides falling commodity prices that are not modelled in this scenario. For example, as illustrated in Jacobs and Rush (2015), wages growth has been particularly slow over the past few years, even after accounting for changes in the terms of trade.

Consistent with recent patterns, the aggregate industry breakdown in the model suggests that mining sector output remains at an elevated level relative to baseline even after commodity prices start to fall (Graph 10). This reflects the substantial increase in mining investment that occurs during the boom in commodity prices, which expands the productive capacity of the mining industry. The model suggests that output in the non-tradable sector gradually moves back towards its baseline level, largely due to a fall in demand for non-traded goods and services by mining firms as they start to wind back on investment in new projects.

During the commodity price boom, the expansion of the mining and non-traded sectors is partly accommodated by slower growth in the non-mining tradable sector. This accommodation allows labour and capital to move to the expanding parts of the economy and helps to contain the inflationary consequences of the boom. After commodity prices start to fall, the model suggests that it takes several years for the non-mining tradable sector to start to recover, much as has been observed over recent years. This protracted nature of the recovery may reflect the fact that the commodity price boom coincided with a sustained period of relatively low investment in this sector, which lowers its productive capacity. Moreover, even though the exchange rate depreciates after the boom, it is estimated to remain above pre-boom levels in line with the assumption about commodity prices.

The model suggests that falling commodity prices will typically lead to a period of below-average economic growth, but, consistent with recent data, it does not predict a sharp contraction in activity. A number of factors help to mitigate the adverse economic consequences of lower commodity prices. One of these is the depreciation of the exchange rate, which, in time, helps to support a recovery in the non-mining tradable sector (Graph 11). Monetary policy also helps to support the economy through the commodity price cycle. During a commodity price boom, monetary policy is tighter than otherwise, in order to mitigate the inflationary consequences of rapidly rising domestic income. Once commodity prices start to fall, monetary policy helps to support economic activity, especially in the non-mining sectors, which include the most interest-sensitive parts of the economy. As with the exchange rate, it takes time for accommodative monetary policy to translate into a pick-up in the pace of economic activity.

Graph 11
Exchange and Interest Rates



Source: RBA

Conclusion

Bulk commodity prices have declined substantially in recent years, along with a range of other commodity prices. The declines have reduced the pace of growth in household income, company profits and government revenue, have been accompanied by a contraction in mining investment expenditure and, by lowering the growth of aggregate demand, have restrained non-mining business investment.

At the same time, a number of factors are helping to offset the effects of falling commodity prices. These include the depreciation of the exchange rate, which is helping to stimulate growth of net exports. Accommodative monetary policy is also assisting the transition, through a number of channels. And, having apparently saved some of the proceeds of the mining boom, households seem to be lowering their rates of saving to maintain consumption as commodity prices fall. ✠

References

Australian Government (2015), 'Budget Strategy and Outlook 2015-16', in Budget Paper No. 1, *2015/16 Australian Government Budget*, Commonwealth of Australia, Canberra.

Connolly E and D Orsmond (2011), 'The Mining Industry: From bust to boom', RBA Research Discussion Paper No 2011-08.

Downes P, K Hanslow and P Tulip (2014), 'The Effect of the Mining Boom on the Australian Economy', RBA Research Discussion Paper No 2014-08.

Jacobs D and A Rush (2015), 'Why Is Wage Growth So Low?', RBA *Bulletin*, June, pp 9–18.

Kent C (2015), 'Monetary Policy Transmission: What's Known and What's Changed', Public Lecture at the Australian National University, Canberra, 15 June.

Kulish M and D Rees (2015), 'Unprecedented Changes in the Terms of Trade', RBA Research Discussion Paper No 2015-11.

Plumb M, C Kent and J Bishop (2013), 'Implications for the Australian Economy of Strong Growth in Asia', RBA Research Discussion Paper No 2013-03.

Rayner V and J Bishop (2013), 'Industry Dimensions of the Resource Boom: An Input-Output Analysis', RBA Research Discussion Paper No 2013-02.

Rees D, P Smith and J Hall (2015), 'A Multi-Sector Model of the Australian Economy', RBA Research Discussion Paper No 2015-07.

Rees D (2013), 'Terms of Trade Shocks and Incomplete Information', RBA Research Discussion Paper No 2013-09.

Tulip P (2014), 'The Effect of the Mining Boom on the Australian Economy', RBA *Bulletin*, December, pp 17–22.

Explaining the Slowdown in Global Trade

Jarkko Jääskelä and Thomas Mathews*

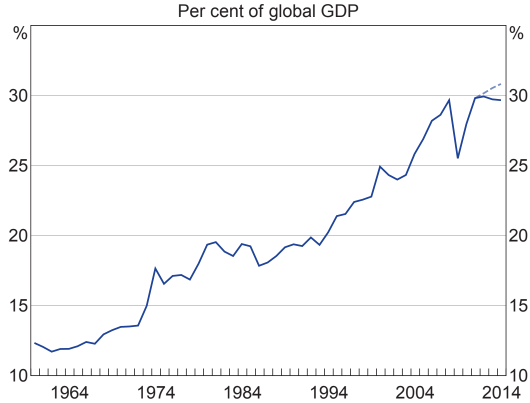
Following the global financial crisis, global trade contracted sharply and, after an initial recovery, grew at an unusually slow pace relative to global GDP. This article reviews cyclical and structural explanations for this phenomenon, and finds econometric evidence that cyclical factors – namely shifts in the composition of aggregate demand toward less import-intensive components and heightened economic uncertainty – can explain most of the slowdown in trade in a panel of advanced economies. Although the slowdown in aggregate global trade is well explained by the model used, the results vary by country. For Australia, the model performed well until 2012, after which it over-predicted import growth, most likely because it did not adequately capture the import intensity of mining investment and resource exports.

Introduction

Before the global financial crisis, international trade had been growing at about 1½ times the rate of global GDP for around four decades, resulting in a substantial increase in the global trade-to-GDP ratio (Graph 1). The increase in trade over this period is widely attributed to structural factors, including substantial declines in the cost of trade, expansions of global supply chains and the increased importance of emerging economies in international trade (WTO 2013). Trade as a share of GDP increased dramatically over this period for emerging economies, like those in east Asia. In contrast, trade as a share of GDP in the United States and other advanced economies increased at a slower pace and their share of global merchandise exports has declined since the early 1990s (Graph 2).

Since the financial crisis, however, growth in global trade has not resumed its earlier pace. Growth rebounded strongly in 2010, following widespread recession, but real global trade has subsequently grown at an average annual rate of around 2 per cent, well below the pre-crisis average of 6½ per cent. Sustained weakness in economic growth, especially in advanced economies, can help to explain the

Graph 1
Global Trade*
Per cent of global GDP



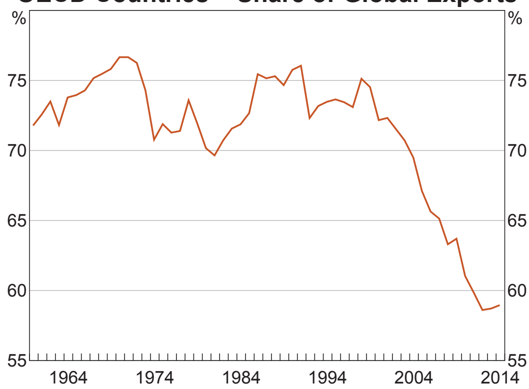
* Average of imports and exports; dashed line shows increase at pre-crisis average rate
Sources: OECD; RBA; World Bank

slowdown in trade. But over the past four years trade has grown at an even slower rate than GDP, resulting in the ratio of trade to GDP falling a little over this period. This has led to some suggestions that the slowdown in trade might be of a more permanent, or structural, nature.

This article reviews possible structural and cyclical factors behind the recent slowdown in global trade and finds evidence that a large part of the slowdown in trade can be explained by cyclical factors. This suggests that if growth in global business

* The authors are from Economic Group and International Department.

Graph 2
OECD Countries – Share of Global Exports



Source: World Bank

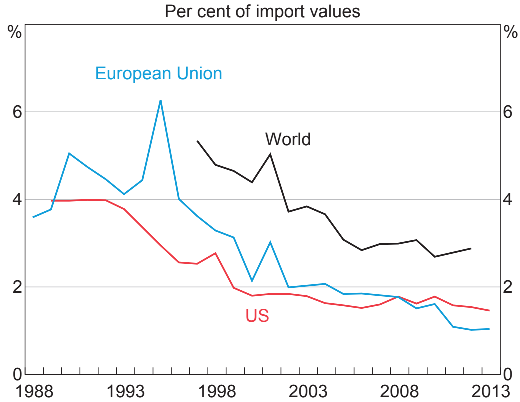
investment, which is the most import-intensive component of demand, were to pick up to pre-crisis levels and the general economic uncertainty were to dissipate, growth in trade would also be likely to increase again.

Structural Explanations for the Slowdown

One possible explanation for the recent slowdown in global trade is that structural policies and factors that had boosted trade, such as trade liberalisation and supply-chain expansion, have largely run their course. In support of this explanation, Ferrantino and Taglioni (2014) note that trade in complex goods typically associated with supply chains has grown particularly slowly after the financial crisis. Constantinescu, Mattoo and Ruta (2015) argue that trade has become less responsive to changes in income since the early 2000s, perhaps because of a slowing in the pace at which supply chains are internationalising.

Nevertheless, it may be too early to conclude that structural expansion in trade is over. Global supply chains are still a relatively recent phenomenon and increasing demand for consumer durables from emerging economies is likely to boost the importance of the large-scale, efficient production that they afford. There is also potential for further trade liberalisation. According to the World Trade Organization, the average good imported into the United States or the euro area still faces around a 1½ per cent tariff and the average global import faces a tariff of around 3 per cent (Graph 3). Furthermore, other economically significant non-tariff barriers, such as anti-dumping and 'buy local' legislation on government purchases, remain in place in many countries (Evenett 2014).

Graph 3
Import Tariffs*
Per cent of import values



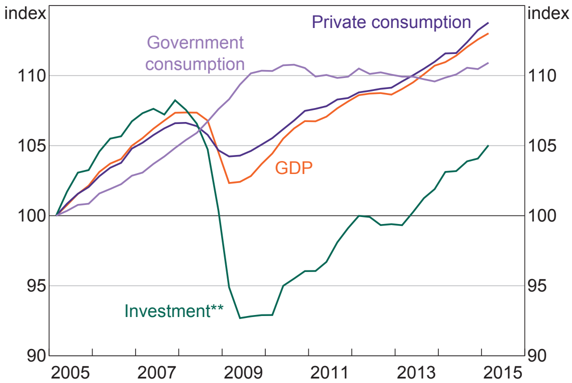
* Weighted mean applied rate
Source: World Bank

Cyclical Explanations for the Slowdown

Cyclical factors, such as the composition of the recovery in global GDP growth and lingering economic uncertainty following the crisis, could also help to explain the slowdown in trade growth relative to GDP growth.

Domestic demand is an important driver of imports in most economies. Business investment is usually the most trade-intensive component of domestic demand because firms often require specialised capital goods not available locally and typically have more direct international access to purchase goods from overseas than do households (see, for example, Bems, Johnson and Yi (2013); Bussière *et al* (2013)). As a result, the continuing weakness in business investment, relative to other components of demand, is likely to have slowed growth in global trade in the post-crisis period (Graph 4).

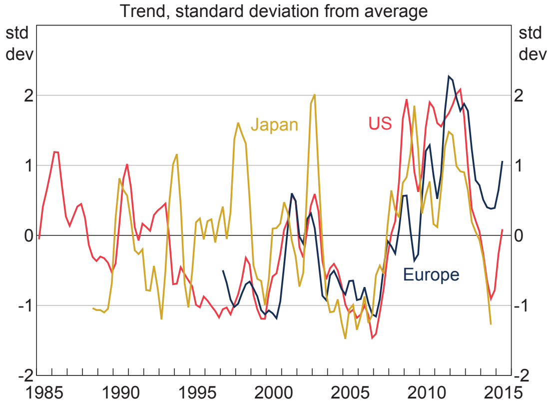
Graph 4
Advanced Economies – GDP components*
March 2005 = 100



* Aggregated at fixed 2011 PPP exchange rates
** Aggregate private and public gross fixed capital formation
Sources: OECD; RBA

Measures of economic uncertainty have been elevated since the financial crisis, reflecting, in part, difficulties in forecasting the timing and pace of economic recovery, and this may also have weighed on trade (Graph 5). Novy and Taylor (2014) argue that a large part of the collapse in trade during the financial crisis can be attributed to uncertainty. They showed that an increase in uncertainty altered firms' inventory policies, and if firms reduced foreign orders by more than domestic orders, this could lead to a bigger contraction in international trade flows than in domestic economic activity. Uncertainty can also affect trade by restricting credit growth, to which trade appears to be particularly sensitive (Chor and Manova 2012).

Graph 5
Economic Uncertainty
Trend, standard deviation from average



Sources: Economic Policy Uncertainty; RBA

Estimating the Contribution of Cyclical Factors to the Slowdown

An econometric model can be used to quantify the contribution of both the weak recovery in the post-crisis period in the components of aggregate demand that have high import intensity and the lingering economic uncertainty during this period. The import demand model of Bussière *et al* (2013) is augmented with a measure of economic uncertainty from Baker *et al* (2015) for this purpose.[1]

Bussière *et al*'s model relates imports to relative prices and a measure of aggregate demand that weights the expenditure components according to their import intensities. This import-adjusted demand measure (*IAD*), has the form:

$$IAD_{j,t} = c_{j,t}^{\omega_{c,t}} g_{j,t}^{\omega_{g,t}} i_{j,t}^{\omega_{i,t}} x_{j,t}^{\omega_{x,t}} \qquad (1)$$

where *c*, *g*, *i* and *x* represent the expenditure components of GDP (private consumption, government consumption, investment and exports, respectively) of country *j* while ω represents the import intensity of each component.[2] For example, in 2005, the import content of Australian investment was 26 per cent, a bit higher than that of private consumption at 18 per cent and exports

1 Where available, the uncertainty measures constructed by Baker *et al* (2015) (available at <www.policyuncertainty.com>) are used. For European economies without a direct uncertainty measure, the aggregate European measure constructed by Baker *et al* is used. For non-European countries without uncertainty indices, uncertainty is proxied by a GDP-weighted average of the available uncertainty measures, except for Australia where the measure constructed in Moore (forthcoming, closely following Baker *et al* (2015)) is used. The country-specific uncertainty measures are relatively highly correlated, so the weighted average is likely to be a reasonable approximation for the countries that have no individual measure available. However, the results are robust to including only those countries for which a direct uncertainty measure is available.

2 Derived from the OECD input-output (I/O) tables; the weights are time-varying and scaled to sum to one in each period. The I/O tables have three vintages for most countries: 1995, 2000 and 2005. The weights are interpolated linearly between these points.

at 14 per cent. The import content of government consumption was relatively low at 10 per cent. Bussière *et al* find that the import-adjusted demand measure explains the fall in trade volumes during the crisis better than other, more traditional, demand measures, such as domestic demand or GDP.

This article re-estimates Bussière *et al*'s model, updating the sample period to the first quarter of 2015 and adding economic uncertainty as an explanatory variable, and examines its performance during the post-crisis slowdown. Specifically, the following equations for imports are estimated for a panel of 18 advanced economies, using data from the OECD's harmonised national accounts database.[3] In the models, the quarterly growth of real imports ($\Delta \ln m_{j,t}$) depends on the quarterly growth rates of aggregate demand ($\Delta \ln D_{j,t}$); relative import prices ($\Delta \ln RPM_{j,t}$); uncertainty ($\Delta \ln UNC_{j,t}$); and time-invariant country-specific factors (FE_j). IAD, domestic demand and GDP are alternatively used as the measure of aggregate demand ($D_{j,t}$).

$$\begin{aligned}\Delta \ln m_{j,t} &= \beta_1 + \beta_2 \Delta \ln D_{j,t} \\ &+ \beta_3 \Delta \ln RPM_{j,t} + \beta_4 \Delta \ln UNC_{j,t} \\ &+ FE_j + \varepsilon_{j,t}.\end{aligned} \qquad (2)$$

The econometric results suggest that the relative slowdown in aggregate global trade growth can be largely explained by cyclical factors. The parameters are statistically significant (with one exception) and take their expected signs: higher demand has a positive effect on import growth, while higher import prices and an increase in uncertainty tend to have a negative effect on imports (see Table A1).[4]

The models using the IAD measure of domestic demand perform noticeably better over the full sample (1985:Q2 – 2015:Q1) than the models using the conventional demand variables. The IAD model that includes a measure of economic uncertainty has the most explanatory power.[5]

To analyse the performance of these models over the recent period, they are re-estimated using data up to the end of 2010, so that the models 'observe' the trade collapse during the financial crisis and the subsequent rebound, but not the recent slowdown in global trade growth relative to GDP growth. The estimated model coefficients are then used to project what the models would have forecast growth to be over the past four years, given the actual movements in the various demand and uncertainty indicators. The resulting projections for the level of import volumes from the IAD model, with and without uncertainty, are shown in Graph 6, along with the actual import volumes. The fitted values from the models prior to 2011 are also shown. Notably, the extent of the decline in trade in 2009 is not entirely explained by the models (although they do much better than the models with traditional domestic demand measures, which are not shown). This is hardly surprising, given the extraordinary circumstances of the financial crisis.

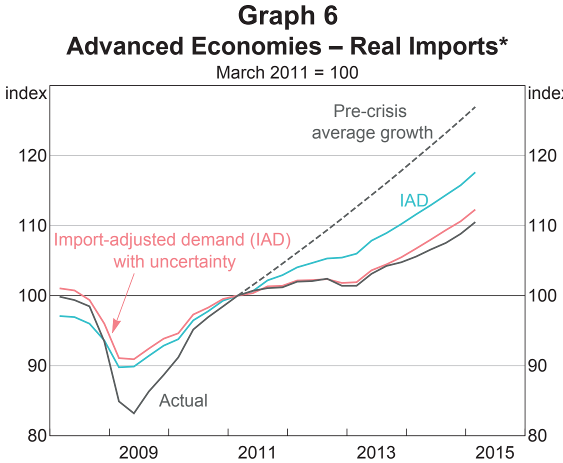
The difference between the dashed line and the blue line on Graph 6 shows that around half of the slowdown in trade growth from its average pre-crisis rate can be explained by the import-adjusted demand model on its own; this result is consistent with other work looking at demand-side factors such as Boz, Bussière and Marsilli (2014) and Morel (2015). Almost all of the remaining slowdown, particularly over the earlier stages of the post-crisis period slowdown, is explained when measures of uncertainty are included in the model.

The IAD model with uncertainty suggests that uncertainty was associated with a reduction in

3 Only OECD countries are included in the sample, thereby excluding several trade-intensive emerging economies, most notably China. Quarterly national accounts data by component are unavailable for China. Including other emerging Asian economies in the sample was not found to materially affect the results.

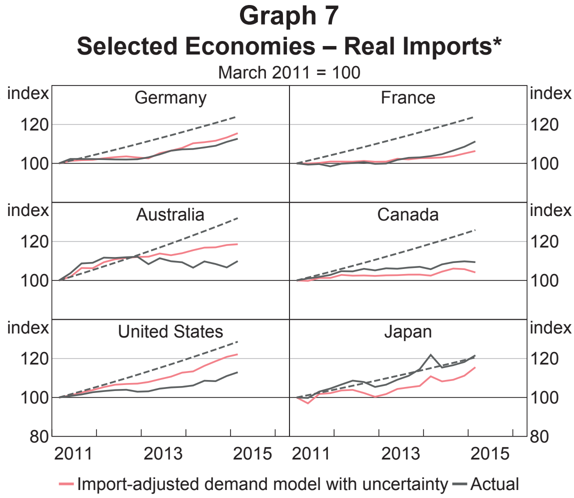
4 Model specifications with lags were also estimated; these were found to improve the fit marginally but did not significantly change the point estimates of the coefficients of interest. Including time-varying fixed effects (assumed to average zero over the sample period) is another way to estimate how cyclical factors affect trade. These parameters are estimated to be negative over most of the post-crisis period, consistent with the results presented below that the trade slowdown is largely cyclical.

5 Using the post-crisis sample period only, the relative performance of different specifications does not change, and the point estimates for the coefficients are similar. However, the parameter estimates are less precise owing to the shorter sample period.



* Aggregated at fixed 2011 PPP exchange rates

Sources: OECD; RBA



* Dashed lines represent growth at pre-crisis average rate

Sources: OECD; RBA

aggregate import growth in both 2011 and 2012 of around 1½ percentage points, and a slightly smaller reduction in the past couple of years. During 2011 and 2012, the uncertainty measures were particularly high, with concerns about a Greek exit from the euro area, debt-ceiling debates in the United States and the upcoming election of the Abe Government in Japan all contributing. Over this period, business investment was particularly weak but, as the blue IAD model line in Graph 6 shows, this alone would not have been enough to cause trade growth to slow as much as it did. As the uncertainty eased and business investment growth picked up in 2013, both models correctly predicted the pick-up in trade. More recently however, through 2014 and early 2015, import growth was slightly slower than the models' prediction.

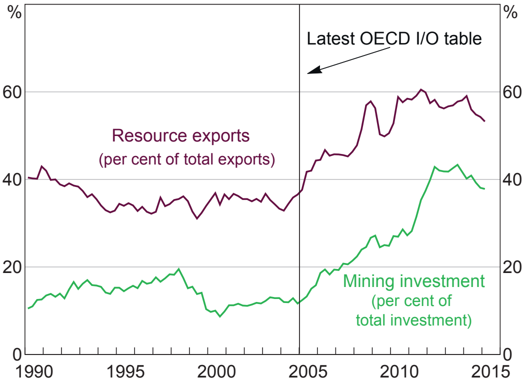
Although the aggregate slowdown in trade is well explained by the model, the results vary by country. Graph 7 shows the predictions for real imports for selected economies from the IAD model with uncertainty, compared with the actual growth (the solid grey line) and the pre-crisis trend growth (the dashed line) in real imports. The results for the entire sample of countries can be found in Table A2.

For the large euro area economies, such as France and Germany, the model performs fairly well. For Canada, the model under-predicts imports growth slightly, although most of the error occurs in early 2011 and the model-implied growth rates over the rest of the period are broadly in line with the observed data. For the United States, import growth has been below what the model would predict, but demand composition and uncertainty help explain some of the weakness. In Japan, the model under-predicts import growth, which was quite close to its long-run average despite pressure from slowing GDP growth and a substantially lower exchange rate.

In Australia, the model over-predicts import growth from 2012 onwards. Given Australia's recent resource boom, the 2005 input-output tables by the OECD used to weight domestic demand by import intensity are likely to understate the import content of investment and overstate the import content of exports. This results from mining investment being more import-intensive than other types of investment, and resource exports being significantly less import-intensive than other exports.[6] Subsequent to the estimation of the 2005 input-output tables, mining investment and resource exports increased substantially (Graph 8). Mining investment peaked in 2012 and has fallen substantially since then, while

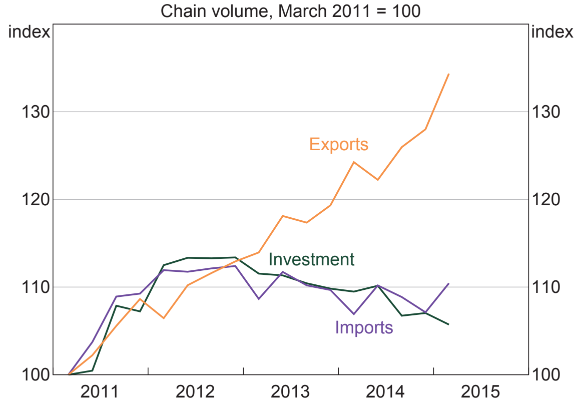
6 ABS input-output tables – although not necessarily harmonised to the OECD ones – are available up to the 2009/10 period, which could provide an avenue for future research to test this explanation for the residual.

Graph 8
Australia – Measures of Mining Activity
Nominal



Sources: ABS; RBA

Graph 9
Australia – Selected GDP Components
Chain volume, March 2011 = 100



Source: ABS

the volume of resources exports has continued to increase. The model's over-prediction of growth in import volumes since 2012 could therefore be explained by the implicit understatement of the import intensity of resources investment, which is in decline, and overstatement of the import intensity of resources exports, which are increasing (Graph 9).

One potentially important reason for the model fitting the aggregate data better than data on a country level is that the relative import price variables – which measure the national accounts import price deflator relative to the GDP deflator – may not be fully capturing the effects of real exchange rate movements and associated changes in competitiveness. The GDP deflator is a broad measure of domestic prices, which is not necessarily the relevant cost comparison in making decisions about whether to buy domestically or import. These measurement errors are, however, likely to net out in aggregate, but could materially affect country-level results; Morel (2015) finds some tentative evidence for this by comparing the European core to the periphery in a similar model.

Conclusion

Growth in global trade has not recovered to the same extent as global growth in GDP in the period since the financial crisis, perhaps because of a lesser role for structural factors in supporting increased trade of late. However, the relative weakness in global trade growth is well explained by the composition of the recovery in global growth, with investment remaining subdued, and lingering economic uncertainty. This suggests that, should investment recover to pre-crisis growth and the general economic uncertainty dissipate, growth of global trade is likely to strengthen more in line with global GDP growth. Of course, if the slowdown in GDP growth, and investment in particular, are longer-term phenomena, then trade growth is likely to be subdued for an extended period. It should also be noted that this work does not conclusively rule out a moderation in the structural expansion of trade associated with globalisation and industrialisation, but there remain reasons to expect that the structural expansion in trade has further to run. ✠

Appendix A

The baseline regression takes the form:

$$\Delta \ln m_{j,t} = \beta_1 + \beta_2 \Delta \ln D_{j,t} + \beta_3 \Delta \ln RPM_{j,t} + \beta_4 \Delta \ln UNC_{j,t} + FE_j + \varepsilon_{j,t} \quad \text{(A1)}$$

where $\Delta \ln m_{j,t}$ is the log change in national accounts imports for country *j* at time *t*, $\Delta \ln D_{j,t}$ is the log change in the demand measure, UNC_t uses the Baker *et al* (2013) and Moore (forthcoming) policy uncertainty measures (standard deviations from average level) and $\Delta \ln RPM_{j,t}$ is the log change in the relative price of imports to domestic goods, measured as the ratio of the import deflator to the GDP deflator. Uncertainty measures are available for the G7 economies and Australia; for others a GDP-weighted average is used as a proxy. The uncertainty measures are not entirely harmonised; for instance, for the United States the measure includes a wider range of factors. Country fixed effects are also included in all specifications (denoted by FE_j).

GDP data are obtained from the OECD harmonised databases; where the harmonised time series are too short, particularly for the relative deflators, the longer series available in the OECD's Economic Outlook database are used. The results are robust to the exclusion of these longer time series in favour of the harmonised data. Data for all countries cover the period 1985:Q2–2015:Q1, except for Germany, which is estimated from 1991:Q1 onwards. For the uncertainty model, the sample period is shorter due to the availability of the uncertainty measures.

Table A1: Estimation Results[(a)]
Dependent variable: quarterly growth of real imports, 1985:Q2–2015:Q1

	GDP model	Domestic Demand model	Import-adjusted demand model	Import-adjusted demand with uncertainty
β_1	0.48***	0.45***	0.30**	0.21*
Y	1.20***	–	–	–
DD	–	1.38***	–	–
IAD	–	–	1.14***	1.26***
UNC	–	–	–	–0.19***
RPM	–0.15**	–0.04	–0.16**	–0.15*
Observations	2 136	2 136	2 136	1 426
R^2(within)	0.16	0.23	0.37	0.47

(a) ***,** and * denote estimates that are significant at 99, 95 and 90 per cent level, respectively. Standard errors are estimated using a clustered sandwich estimator

Table A2: Actual and Predicted Annual Average Real Import Growth
Per cent

	Actual Values		Model Fitted Values in Post-crisis Period[a]	
	Pre-crisis (1985–2007)	Post-crisis (2011–2015:Q1)	Import-adjusted demand model	Import-adjusted demand model with uncertainty
Australia	7.2	1.7	4.8	4.7
Belgium	4.9	2.1	2.6	2.7
Canada	5.9	2.5	3.5	1.1
Denmark	4.9	2.5	2.5	1.9
Finland	5.3	0.4	0.1	–2.4
France	5.5	2.2	2.4	1.7
Germany	5.5	2.8	4.6	3.9
Italy	4.7	–2.9	–0.2	–1.0
Japan	4.8	4.6	3.2	3.9
Korea	10.6	2.3	4.7	2.7
Netherlands	5.6	2.3	1.1	0.9
Norway	4.2	1.2	3.2	0.6
New Zealand	5.4	5.9	7.2	5.8
Portugal	7.5	0.8	0.7	–1.4
Spain	9.5	–0.3	2.3	–0.7
Sweden	4.7	2.9	3.6	1.9
United Kingdom	5.5	2.2	3.9	2.1
United States	6.5	2.8	6.3	5.5
Advanced Economies Total[b]	**6.1**	**2.1**	**3.7**	**2.4**

(a) Using coefficients estimated over the period 1985–2010, fitted to the period 2011:Q1–2015:Q1
(b) Aggregated at fixed 2011 PPP exchange rates

References

Baker SR, N Bloom and SJ Davis (2015), 'Measuring Economic Policy Uncertainty', Economic Policy Uncertainty site. Available at <http://www.policyuncertainty.com/media/BakerBloomDavis.pdf>.

Bems R, RC Johnson and K-M Yi (2013), 'The Great Trade Collapse', *Annual Review of Economics*, 5(1), pp 375–400.

Boz E, M Bussière and C Marsilli (2014), 'Recent Slowdown in Global Trade: Cyclical or Structural', VoxEU site. Available at <http://www.voxeu.org/article/recent-slowdown-global-trade>.

Bussière M, G Callegari, F Ghironi, G Sestieri and N Yamano (2013), 'Estimating Trade Elasticities: Demand Composition and the Trade Collapse of 2008-2009', *American Economic Journal: Macroeconomics*, 5(3), pp 118–151.

Chor D and K Manova (2012), 'Off the Cliff and Back? Credit Conditions and International Trade during the Global Financial Crisis', *Journal of International Economics*, 87(1), pp 117–133.

Constantinescu C, A Mattoo and M Ruta (2015), 'The Global Trade Slowdown: Cyclical or Structural?', IMF Working Papers 15/6.

Evenett SJ (2014), 'The Global Trade Disorder: The 16th GTA Report', Centre for Economic Policy Research, London.

Ferrantino M and D Taglioni (2014), 'Global Value Chains in the Current Trade Slowdown', *World Bank - Economic Premise*, pp 1–6.

Moore A (forthcoming), 'Measuring Economic Uncertainty and its Effects', RBA Research Discussion Paper.

Morel L (2015), 'Sluggish Exports in Advanced Economies: How Much is Due to Demand?', Bank of Canada Discussion Paper 2015-3.

Novy D and A Taylor (2014), 'Trade and Uncertainty', NBER Working Paper 19941.

WTO (2013), 'World Trade Report 2013: Factors Shaping the Future of World Trade', WTO, Geneva.

Default Risk Among Australian Listed Corporations

Michael Robson*

Market-based information can help detect deteriorating corporate health because it incorporates more forward-looking information than other data sources such as financial statements. With this in mind, the Reserve Bank has developed an indicator of financial health based on a contingent claims framework developed by Merton (1974), which is sometimes called a distance-to-default model. The Bank will primarily use the model to assess trends in financial health for the corporate sector as a whole and, in aggregate, the model is able to broadly match the dynamics of the corporate failures data, suggesting that it will be a useful addition to the Bank's existing suite of monitoring tools. The results from the model suggest that corporate financial conditions remain robust, despite some deterioration more recently, which partly reflects the headwinds faced by listed resource companies.

Introduction

Historically, businesses have accounted for a disproportionate share of the non-performing loans, and ultimately the losses of banks both in Australia and overseas (Rodgers 2015). There are a number of reasons why business lending is inherently riskier than household lending: limited liability structure, competitive pressures and their more direct exposure to cyclical fluctuations in activity. These heighten the risk of default for individual businesses and lead to common vulnerabilities at both the industry level and for the business sector as a whole. The resulting correlation in business sector defaults, in combination with the fact that business loans are less likely than housing loans to be backed by high-quality collateral, means that, on average, deterioration in the financial health of businesses is more likely to transmute into a threat to financial stability.

The Bank's regular monitoring currently focuses on the listed corporate sector, primarily because of data limitations but also because listed corporations are on average larger and more likely to contribute directly to a systemic shock. Financial statements are the main source of information about corporate health used in the Bank's monitoring, supplemented with market-based information, such as equity prices. However, a strand of the existing literature on corporate credit risk suggests that combining the two types of information detects deteriorating corporate health more effectively than either source alone (see, for example, Hillegeist *et al* (2004)).

With this in mind, the Bank has developed an indicator of financial health based on a contingent claims framework developed by Merton (1974), sometimes called a distance-to-default (D2D) model. The indicator uses information on liabilities from financial statements together with a company's market capitalisation to assess credit risk. Individual companies' probabilities of default can be aggregated to assess risk for particular industries or for the business sector as a whole. The key simplifying assumption underpinning the model is that a company will default if the market value of its assets falls below the book value of its liabilities. The

* The author is from Financial Stability Department and acknowledges the earlier work in this area by David Rodgers.

difference between the value of assets and liabilities determines the company's probability of default (PD).

Variants of the Merton model are widely used in commercial and policy-making settings; the level of focus – such as on sectoral trends versus individual corporations – varies widely in application. The most prominent commercial application of the D2D model is by Moody's KMV in its Expected Default Frequency (EDF™) product (see Crosbie and Bohn (2003) for a description of the model). This is a more complex model using an option pricing framework that can accommodate multiple classes of liabilities. It uses a proprietary database of corporate defaults, which allows for an empirical mapping from the D2D to the PD (rather than mapping via a normal distribution that has some limitations).

In the regulatory sphere, the International Monetary Fund and the Bank of England have used the Merton approach to assess the vulnerability of non-financial companies, with some success in determining which companies are most likely to default (Tudela and Young 2003; IMF 2009). Similar models have also been applied to the banking sector: Gizycki and Goldsworthy (1999) present an earlier application at the Bank, while the Danmarks Nationalbank (2009) uses a Merton model to examine the risk of financial institutions breaching regulatory capital ratios. More recently, D2D models have been used in efforts to uncover ongoing vulnerabilities in euro area banks (Saldias 2012) and to assess the effectiveness of the Basel II framework (Blundell-Wignall and Roulet 2012).

The Merton Model

The basic Merton model produces an estimate of the PD for a listed company based on its market valuation and its outstanding liabilities by making an assumption about the evolution of the value of its assets. The model assumes a simple financial structure, comprising a single senior debt claim and a junior equity claim. Under these assumptions, a firm defaults when the market value of its assets falls below the value of its liabilities. As information on liabilities is limited to semi-annual financial statements, the model assumes that liabilities are constant over the horizon of interest, in this case one year. To determine the probability of default, only the value of assets needs to be determined. Asset values are assumed to drift higher at the risk-free rate over time, with random shocks driving variation around this assumed path. As a result, the range of possible asset values in the future may be sufficiently wide to include asset values that are lower than the fixed value of liabilities, in which case the company will be in default. The range of potential asset values at the 12-month horizon is represented by a probability distribution function; in this case returns are assumed to be log-normally distributed.[1] The PD can be thought of as the area under the portion of the distribution function that is below the value of liabilities (sometimes called the default point or the debt barrier). Alternatively, the expected gap between asset and liability values can be standardised and expressed in terms of the asset return volatility, which is the D2D.

If the market value of assets was observable, the model would be simple to implement. However, the market value of assets cannot be observed directly. Merton's insight was that, in the framework described above, the position of the holders of the equity claim on the corporation is equivalent to their possessing a call option on the company, where the strike price is the value of its liabilities. If the value of assets exceeds the value of liabilities when debts mature, the debts are paid and the equity holders keep any excess value. However, if the market value of assets falls below the value of liabilities, there is no incentive to pay back the debt; on the contrary, it makes sense to forfeit the equity value and default. Accordingly, option pricing theory can be used to derive the market value and volatility of assets from

1 This assumption is common in constructing Merton-type models. A variation of the model based on a heavy-tailed return distribution would likely be better able to match observed equity dynamics, but this would require a more complex option pricing framework and is consequently reserved for future work.

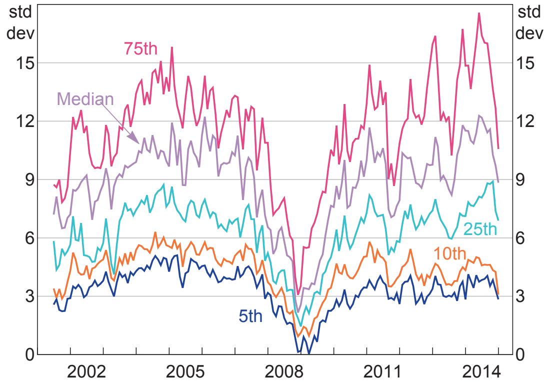
the value and volatility of equity and the value of liabilities. The key expressions that define the model are outlined in Appendix A.[2]

Results

While commercial variants of the Merton model are designed to maximise the accuracy of assessments of the financial health of individual companies, the Bank will primarily use the model to assess trends in financial health for the corporate sector as a whole. Tracking developments in the distribution of the D2D or PD, as shown in Graphs 1 and 2, is one way to monitor aggregate developments.[3] Looking at the historical trends in the D2D, the period around the 2008 crisis stands out (as expected), with the combination of falling equity prices and heightened volatility driving the median D2D to a trough of around 2½ standard deviations. Across the distribution there is a common pattern of the D2D rising to a relatively high level in the early 2000s, before peaking around the middle of the decade and then falling sharply over 2007–08. The subsequent recovery reflected a combination of rebounding equity prices, diminished volatility and declining leverage, with the median D2D peaking in mid 2014 at around its pre-crisis high.[4] The recent sharp fall in the D2D partly reflects weakness in the resource sector, consistent with falling commodity prices.

While the D2D is easy to interpret in a qualitative sense – a lower D2D equates to a deterioration in financial health – the fact that it is expressed

Graph 1
D2D Distribution*
Listed non-financial corporations, by percentile



* Asset-weighted
Sources: Bloomberg; Morningstar; RBA

Graph 2
PD Distribution*
Listed non-financial corporations, by percentile

* Asset-weighted
Sources: Bloomberg; Morningstar; RBA

in standard deviations of asset values makes quantitative interpretation more difficult. One way to get around this is to look at the PD distribution instead (see Graph 2). As the basic Merton model uses the standard pricing model for an option with a fixed exercise date (a European option), the PD is the probability that the market value of a corporation's assets will be below the debt barrier in one year. Looking at the historical trends over the sample period, the 95th percentile, which contains the most vulnerable corporations, peaks at almost 50 per cent in early 2009. Graph 2 also illustrates the limitations of using a normal distribution to map from the D2D

2 As this version of the model assumes a fixed date (European) call option equity retains value even if asset values are projected to fall below the default point within the 12-month horizon because there is a chance that future shocks will push asset values back above the default point. To the extent that some debts actually fall due beyond the 12-month horizon, the same issue might explain the higher number of defaults predicted by this model than actually observed in the Australian data.

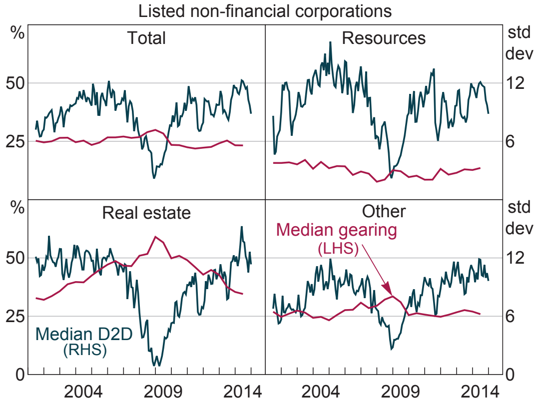
3 As the D2D and PD are inversely related – vulnerability is associated with a low D2D and a high PD – the most vulnerable companies are found at the opposite ends of the respective distributions. Asset-weighted distributions are presented to avoid overstating the importance of fluctuations in the D2D and PD of smaller companies.

4 Some of the recovery following the crisis is also likely to reflect the exit of weaker companies from the sample via failure.

to the PD; only extreme events like the financial crisis are able to drive a discernible shift in the PD distribution even at the 95th percentile. Moving down the distribution, the peak PDs drop sharply: the 70th percentile peaked at around 5 per cent.

In monitoring corporate health, the Bank often analyses the information from financial statements at the broad sectoral level. This is because demand and supply shocks and business models can differ across sectors. Graph 3 shows that real estate companies have tended to be more leveraged than other companies. Higher leverage is likely to have contributed to the sharper deterioration in the median D2D for this sector during the financial crisis, although it may also have reflected the small number of real estate companies in the sample. By contrast, resource companies tend to be less leveraged. The financial health of resource companies, as measured by the D2D, has deteriorated recently, as falling commodity prices have weighed on their equity prices and made them more volatile.

Graph 3
D2D by Sector*
Listed non-financial corporations



* Asset-weighted
Sources: Bloomberg; Morningstar; RBA

Model Performance

The performance of the model in predicting corporate default can be assessed in a number of ways. At the most basic level, predicted defaults can be compared with actual defaults. Assuming that default probabilities are independent, the number of predicted defaults in a given period can be found by summing the PD of each firm. In other words, if the average PD in a period across 1 000 firms is 5 per cent, the expected number of defaults would be 50. To assess the (one-year ahead) PD, it is most appropriate to compare the aggregate PD in any month with the actual number of listed companies that default 12 months later.

However, given the simple definition of default in this model and the fact that corporate default is more likely to be a drawn-out process (for example, in practice there is the potential for outstanding debts to be restructured), a more relaxed definition of successful default prediction can be justified, with predicted defaults compared with cumulative defaults over the next 12 months. Table 1 presents the number of failures in each calendar year of the sample in absolute terms and as a proportion of the total number of non-financial corporations reporting.[5] By both number and share, failures were relatively high in the early 2000s, although they peaked around the time of the financial crisis in 2008–09. While actual failure, proxied here by entry into external administration, is an imperfect measure of default, the two are likely to be highly correlated.

A comparison of predicted and actual failures is presented in Graph 4.[6] The simplified definition of default in the model suggests caution in drawing strong conclusions from the level of predicted defaults. But the pattern of the predicted defaults series is broadly similar to that of actual failures, which is encouraging. The 2008 crisis is the dominant feature of the series, with the average level of predicted defaults a little higher in the post-crisis period than in the years prior. Given the intention is to use this tool primarily to assess aggregate or sectoral corporate health, matching the patterns of total corporate failures is more important than accurately

5 As indicated in Graph 4, the fall in the failures series in 2013 and 2014 reflects the lag between a company entering external administration ('failing') and recognition of this event in the data. It is likely that the series will be revised higher in coming years.

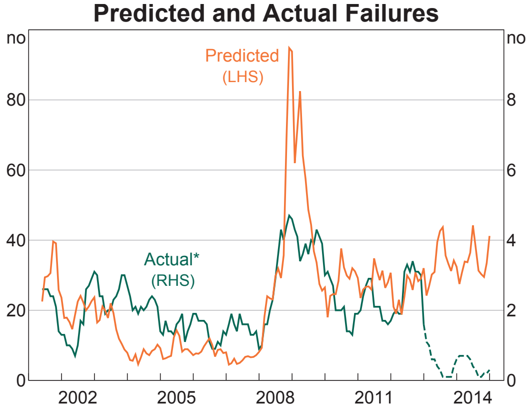
6 In the context of the Merton model, predicted default and predicted failure are equivalent and will be used interchangeably.

Table 1: Listed Non-financial Corporate Failures

Year	Number of firms reporting[(a)]	Number failed	Per cent failed
2001	1 214	29	2.4
2002	1 243	18	1.4
2003	1 345	28	2.1
2004	1 418	28	2.0
2005	1 515	12	0.8
2006	1 635	17	1.1
2007	1 748	19	1.1
2008	1 740	40	2.3
2009	1 715	43	2.5
2010	1 775	18	1.0
2011	1 787	23	1.3
2012	1 744	30	1.7
2013[(b)]	1 727	1	0.1
2014[(b)]	1 613	1	0.1
Average	**1 587**	**22**	**1.4**

(a) Firms reporting return on assets at the end of the calendar year
(b) Failures are preliminary figures and are subject to revision
Sources: Bloomberg; delisted Australia; Morningstar; RBA

Graph 4
Predicted and Actual Failures



* Dashed line indicates preliminary failures series and is subject to revision; 7-month centered moving average
Sources: Bloomberg; deListed Australia; Morningstar; RBA

predicting the absolute level of total failures or the failure of individual companies. Also important is the model's ability to distinguish between failing and non-failing companies.

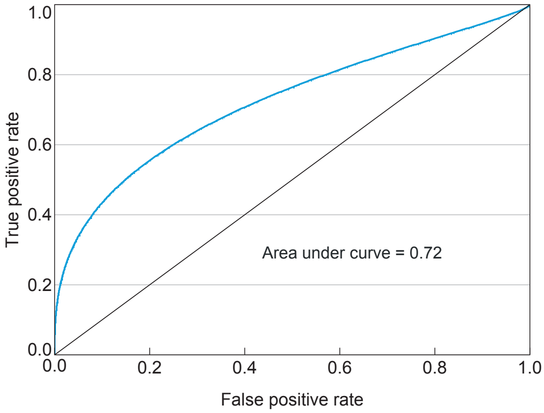
The simple comparison of predicted failures and actual failures gives a good indication of whether or not the Merton model is a useful indicator of corporate health. Another test of the usefulness of the model is whether it can adequately discriminate between corporations that are close to failure and healthier corporations. One way to do this is to compare the average PD over the 12 months leading up to failure (for the corporations that ended up failing) with the average PD for corporations that did not fail, over the same period. For this model the average PD for failing corporations is around 12 percent, while the average PD for other corporations is 1½ per cent. Statistical tests suggest that the difference between these values is significant.

A more sophisticated way of assessing the discriminatory power of the Merton model is to use receiver operating characteristic (ROC) analysis. This approach compares the true positive rate (the number of failures that are predicted and observed, as a share of total observed failures) and the false positive rate (failures that are predicted but not observed, as a share of total observed non-failures). Observed failures are based on the data in Table 1, while predicted failures are defined by choosing a threshold and classifying all companies with reported PDs above that threshold as failed.[7] A true positive occurs when a predicted failure occurs in the 12 months prior to an observed failure. A false positive occurs when a predicted failure is not followed by an observed failure in the following year. This is an intuitive approach based on the idea that, for a given failure threshold, if two models of failure have the same number of correct failure predictions, the one that has a smaller number of incorrect predictions should be preferred.

By varying the chosen failure threshold (across the range of PD values from 0 to 1) and assessing the ratio of true positives to false positives, a ROC curve can be constructed (Graph 5). The ROC curve

7 For example, when the PD threshold is set at 10 per cent, all of the companies with PDs above 10 per cent are assumed to have failed and those with PDs below 10 per cent are assumed to continue trading.

Graph 5
ROC Curve



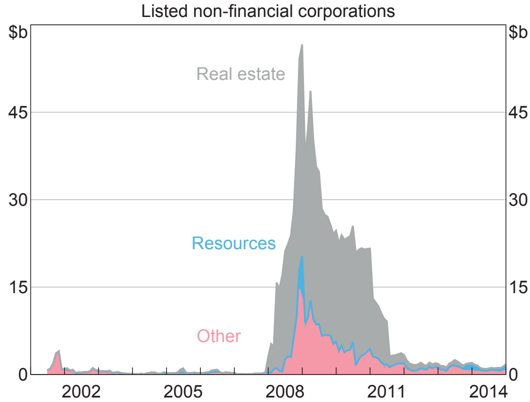
Source: RBA

illustrates the trade-off between correctly identifying companies that go on to fail as 'failing', and incorrectly categorising companies that will survive. For low PD thresholds, the true positive and false positive rates will both be high. But as the PD threshold is increased (tightening the criteria for failure prediction) the true positive rate falls, and, if the model is informative, the false positive rate will fall faster. The area under the ROC curve (AUC) is a useful summary statistic for comparing different models. A model is considered to be an improvement over a random guess if the AUC is greater than 0.5; that is, if the ROC curve lies above a 45 degree line. The smoothed ROC curve for our baseline model, shown in Graph 5, is well above the 45 degree line and has an AUC of 0.72, which indicates that it is substantially more informative than a random guess.

Implications for Financial Stability

One reason that tracking the potential for corporate default is important is that it can have implications for the performance and solvency of financial institutions, which in turn can trigger episodes of systemic instability. In this context, defaults on intermediated debt are the most direct transmission channel. To assess the financial stability implications of the PDs derived from the Merton model, individual firm probabilities need to be weighted by their debt outstanding to create a measure of debt-at-risk (DAR) (Graph 6). Intermediated debt is most relevant in this case, but in the absence of reliable estimates for most corporations, total book value of debt sourced from financial statements is used.[8] The resulting series is dominated by the 2008 crisis period and its aftermath, with DAR very low in most other periods. At the sectoral level, much of the increase in the DAR reflected heavily indebted real estate companies – Centro Properties Group in particular – that were seriously affected by the crisis, although infrastructure companies (included in the 'Other' category) that carried a lot of debt into the crisis – such as Babcock & Brown – also contributed.[9]

Graph 6
Debt-at-Risk
Listed non-financial corporations



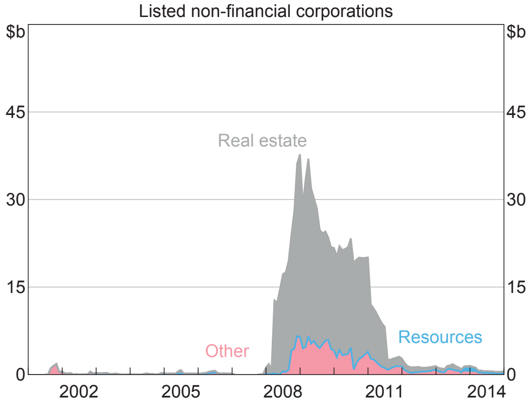
Sources: Bloomberg; Morningstar; RBA

The DAR, while more relevant to financial stability than the unweighted PD, is far from a perfect measure of the impact of corporate failure. It overstates likely losses because it fails to account for potential asset recovery following failure. Another alternative – expected losses – attempts to take into account recoverable assets. The expected loss is calculated as debt-at-risk less the estimated value of assets at the 12-month horizon. The sectoral breakdown of this estimate is shown in Graph 7. It is qualitatively similar to the DAR, but it peaks at a

8 Trade credit accounts for the bulk of the gap between total debt and total liabilities.

9 The sharp fall in DAR in the first half of 2011 almost entirely reflects the run-off of debt by Centro Properties Group.

Graph 7
Expected Losses
Listed non-financial corporations



Sources: Bloomberg; Morningstar; RBA

lower level. Although they are by no means perfect analogues, and sectoral comparisons are clouded by classification issues, the broad industry trends in major banks' non-performing loans (NPLs) and specific provisions are consistent with the patterns in the industry breakdowns of DAR and expected losses. For example, loans to real estate companies accounted for a disproportionate share of the increase in banks' NPLs in the crisis period.

Conclusion

Information from financial statements is useful to analyse corporate health, but it is backward looking, available infrequently and only with a substantial lag. The systematic incorporation of more timely, forward-looking information from financial markets can enhance our ability to identify and track pockets of corporate vulnerability. The Merton model is a natural way to do this that fits comfortably within the current monitoring framework. The model's ability to identify the risks stemming from the real estate sector in 2008, and the deterioration in financial health in the resource sector more recently, indicates the value it adds as part of a suite of risk metrics.

However, the model is not without limitations. The assumption that returns are log-normally distributed is a simplification that makes the model easy to work with, but the literature suggests that stock returns are better matched by alternative, often heavy-tailed, distributions. Historical default distributions such as the one used in Moody's KMV's commercial variant of the model might improve its ability to match the observed failure series, but these data are not generally available and in any case embed an assumption that future default experience will match that seen in the past. Using such data would also come at the cost of a significantly more complex model. Another approach would be to include the distance-to-default or probability of default in a hybrid model of corporate default alongside a range of other explanatory variables from financial statements and other sources. Both approaches are currently being investigated as the Bank seeks to further enhance its ability to track corporate health. ✠

Appendix A – The Merton model

Asset values are assumed to follow geometric Brownian-motion so that returns are log-normally distributed:

$$\ln A_T \sim N\left[\ln A_t + \left(\mu - \frac{\sigma_A^2}{2}\right)\tau, \sigma_A^2\tau\right], \tag{A1}$$

where A is the market value of assets, μ is the expected annual (risk-free) rate of return, σ_A is the standard deviation of asset values and $\tau = T - t$ is the horizon of interest. The probability of default is then given by:

$$P(\text{default}) = \Phi\left[\frac{\ln L - \ln A_t - \left(\mu - \frac{\sigma_A^2}{2}\right)\tau}{\sigma_A\sqrt{\tau}}\right], \tag{A2}$$

where L is equal to the sum of total current liabilities and half of non-current liabilities and Φ is the standard normal cumulative distribution function. The market value of assets and their volatility are unobservable, but the Black-Scholes option pricing model can be used in conjunction with a relationship between asset and equity volatility (which also relies on the assumption about the process characterising asset value movements) to solve for them numerically, using equity value, E, and volatility, σ_E, as key inputs:

$$E = A\Phi[d_1] - Le^{-\mu\tau}\Phi[d_2],$$

$$d_1 = \frac{\ln\left[\frac{A}{L}\right] + \left(\mu + \frac{\sigma_A^2}{2}\right)\tau}{\sigma_A\sqrt{\tau}},$$

$$d_2 = d_1 - \sigma_A\sqrt{\tau},$$

$$\sigma_A = \frac{E\sigma_E}{A\Phi(d_1)} \tag{A3}$$

where, d_2 is the distance-to-default, and the probability of default is:

$$PD = \Phi[-d_2]. \tag{A4}$$

Expected losses in the event of default are calculated as:

$$E(\text{Loss}) = Le^{-\mu\tau}PD - A\Phi[-d_1], \tag{A5}$$

this can be thought of as a put option written by the debt holders of the company for the equity holders. If the company defaults, the debt holders bear a loss equal to the difference between the liabilities outstanding and the expected value of assets. This is equivalent to paying the equity holders that amount, since under limited liability, equity holders can only lose their equity investment.

References

Blundell-Wignall A and C Roulet (2012), 'Business Models of Banks, Leverage and the Distance-To-Default', *OECD Journal: Financial Market Trends*, 2012/2, No 103.

Crosbie P and J Bohn (2003), 'Modelling Default Risk', Moody's KMV Company.

Danmarks Nationalbank (2009), Financial Stability, 1st Half 2009.

Gizycki M and B Goldsworthy (1999), 'Australian Banking Risk: The stock market's assessment and the relationship between capital and asset volatility', RBA Research Discussion Paper No 1999–09.

Hillegeist SA, EK Keating, DP Cram and KG Lundstedt (2004), 'Assessing the Probability of Bankruptcy', *Review of Accounting Studies*, 9(1), pp5–34.

IMF (International Monetary Fund) (2009), 'How Vulnerable Are Non-financial Firms?', *World Economic Outlook: Crisis and Recovery*, World Economic and Financial Surveys, IMF, Washington DC, pp 20–22.

Merton R (1974), 'On the Pricing of Corporate Debt: The risk structure of interest rates', *The Journal of Finance*, Vol (2), pp 449–470.

Rodgers D (2015), 'Credit Losses at Australian Banks: 1980–2013', RBA Research Discussion Paper *2015– 06.*

Saldias M (2012), 'Systemic Risk Analysis Using Forward-Looking Distance-To-Default Series', Federal Reserve Bank of Cleveland Working Paper, No 10–05.

Tudela M and G Young (2003), 'A Merton-Model Approach to Assessing Default Risk in UK Public Companies', Bank of England Working Paper, No 194.

The Life of Australian Banknotes

Alexandra Rush*

An assessment of the likely life of a banknote is an important input to a currency issuer's planning. Without accurate predictions of banknote life, there is the potential to incur the economic costs of producing and storing excess banknotes or, conversely, in an extreme case, of not being able to meet the public's demand. The life of a banknote, however, is not directly observed and must be estimated. This article discusses some traditional measures of banknote life and provides some alternative estimates using 'survival' modelling.

Introduction

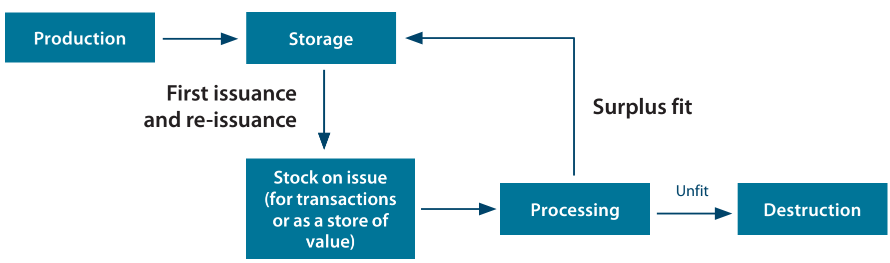
To make decisions on banknote production, processing, distribution and storage requirements, it is important for currency issuers to understand how long banknotes typically remain in circulation before they need to be replaced with new banknotes.

This article examines three ways of estimating the life of banknotes using data commonly available to currency issuers on the number of banknotes circulating, destroyed and issued for the first time. Two of the methods are based on turnover, and are often used due to their ease of calculation and simple data requirements. The third method is based on more complex statistical models that predict the probability of banknotes surviving over time. The results from these methods can also be compared with samples of banknotes collected from circulation. More detailed analysis and further technical information on the construction of the three estimation methods are available in a more extensive research paper (see Rush (2015)).

The Life Cycle of Banknotes

To examine the life of a banknote, it is important to understand the manner in which banknotes are issued and circulated. Banknotes are produced and then stored until required to meet public demand (Figure 1). Once issued, they may spend time being held as a store of value or in active circulation (being used in transactions). In Australia, banknote demand generally grows in line with nominal GDP and shows seasonal peaks each year, particularly during Easter and December. Following these seasonal peaks, banknotes in excess of the public's requirements

Figure 1: Life Cycle of a Banknote



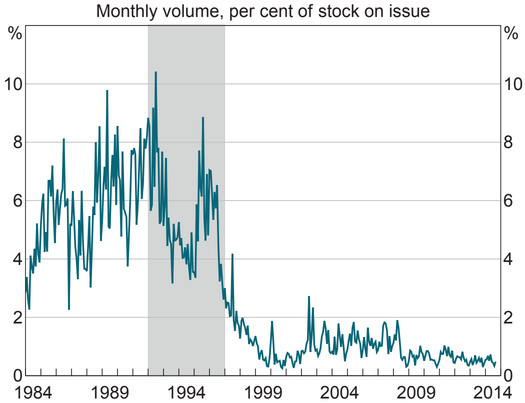
* The author is from Economic Analysis Department but the majority of this work was completed in Note Issue Department.

('surplus fit' banknotes) are returned to the Reserve Bank via the commercial cash industry to be reissued at a later date.

As a result of being used in circulation, banknotes deteriorate in quality and eventually become unfit. Banknotes may become unfit due to randomly occurring mechanical defects (including staple holes and tears) or gradually through the process of ink wearing off as the banknote is handled. The length of time before becoming unfit can differ considerably from banknote to banknote – one used repeatedly in transactions will become unfit sooner than one stored in a protected location.

Banknotes returned to the Bank via the commercial cash system are assessed and validated. Fit banknotes are eventually reissued into circulation and unfit banknotes are destroyed.[1] Banknote destructions fluctuate considerably from month to month, but the average rate of destruction of banknotes in circulation fell from 5.7 per cent per month prior to 1992 to 1.0 per cent per month after the introduction of the more durable polymer New Note Series (NNS) banknotes (Graph 1).

Graph 1
Banknote Destructions*
Monthly volume, per cent of stock on issue



* The grey shaded area shows the years in which NNS polymer banknotes were first introduced

Source: RBA

1 For more information on the Bank's damaged banknote policy and sorting standards see <http://banknotes.rba.gov.au/damaged-banknotes/damaged-banknotes-policy/>.

Estimating the Life of Banknotes

Ideally, the life of every banknote could be studied by recording the dates when they were first issued into circulation and when returned for destruction. While this option is becoming increasingly available to currency issuers, it cannot be applied to the large stock of banknotes already in circulation. Instead, banknote life can be estimated using a number of different methods that make use of aggregate data on the number of banknotes circulating, destroyed and issued for the first time.

Traditional steady-state or turnover method

Currency issuers commonly use a simple steady-state[2] or turnover formula to estimate the average life of a banknote (over any given 12-month period), calculated as:

$$\textit{Average life} = \frac{\textit{Average stock of banknotes on issue}}{\textit{Total number of banknotes destroyed}} \qquad (1)$$

The median banknote life can be calculated by finding the point at which 50 per cent of banknotes survive, using the assumption that the probability that a banknote becomes unfit at a given point in time is given by the inverse of the estimated average life. This assumes that the probability of a banknote becoming unfit is invariant to the time it spends in circulation.[3] However, since some banknotes last a very long time (e.g. those kept in safe locations as a store of value), the estimate of average banknote life will be larger than the median estimate.

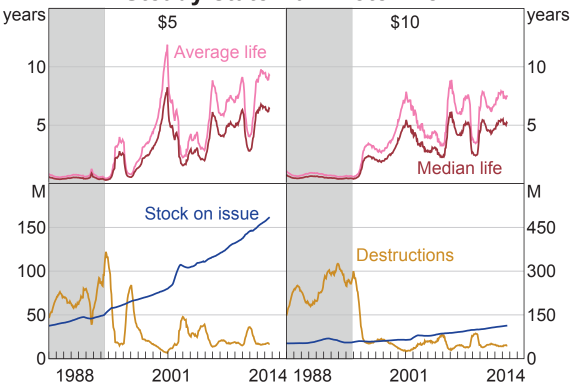
Using this method for Australia's $5 to $50 denominations, a number of observations can be made:

- As expected, the median life is lower than the average life for all denominations and time periods (Graphs 2 and 3).

2 It is often known as the 'steady-state' method since it was thought that after a banknote series had been circulating for a number of years, the growth in banknote destructions and circulation would stabilise and the estimate of banknote life would become relatively constant.

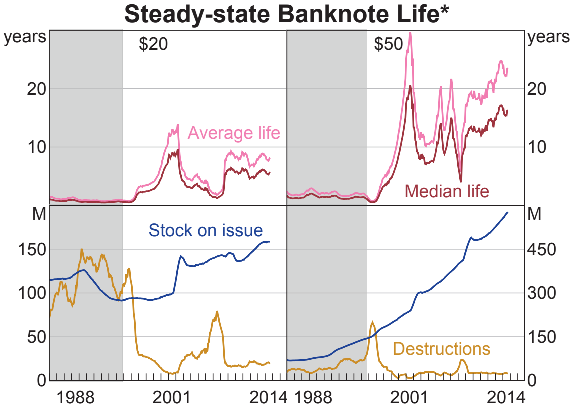
3 See Rush (2015) for more details.

Graph 2
Steady-state Banknote Life*



* The grey shaded areas show the periods of paper banknote issuance
Sources: RBA; Rush (2015)

Graph 3
Steady-state Banknote Life*



* The grey shaded areas show the periods of paper banknote issuance
Sources: RBA; Rush (2015)

- Since the issuance of NNS polymer banknotes, the median life has ranged widely across denominations – from 3.5 years for $5 banknotes up to 10 years for $50 banknotes – even though all Australian banknote denominations are produced with the same technology and have identical security features.[4] This result is expected since lower-value denominations are more likely to be used in transactions, whereas higher-value denominations are more likely to be used as a store of value.
- For all denominations, the life of polymer banknotes is longer than the equivalent paper banknotes (which had median life spans ranging from around six months to 1.5 years for the $5 and $50 denominations respectively). The volatility of the estimates also increased after the introduction of polymer banknotes as their life became progressively greater than the 12-month period included in the formula.[5]

'Feige' steady-state method

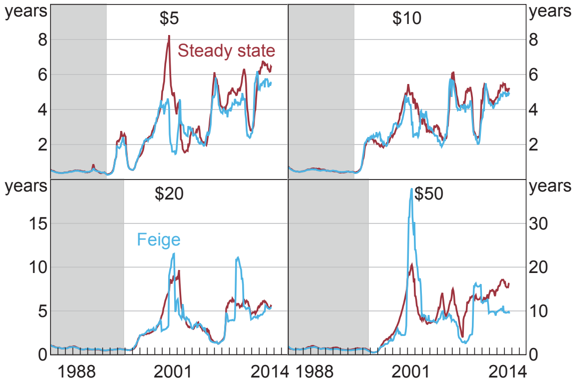
A limitation of the steady-state formula discussed above is that it is biased by growth in the number of circulating banknotes. This bias arises because destructions (the denominator) tend to reflect banknotes that were issued some time ago, whereas the number of banknotes in circulation (the numerator) includes banknotes that have only recently been issued. In other words, the average age of banknotes on issue falls if the population of banknotes is growing due to the addition of new banknotes. Feige (1989) derives an alternative formula for average banknote life that aims to reduce this bias by adjusting the denominator by the number of banknotes issued into circulation for the first time.

As expected, using the Feige method results in banknote life estimates that are generally a little lower than the traditional steady-state results (Graph 4). The results of the Feige equation appear to be less volatile over time for the paper series and the low-value $5 and $10 polymer banknotes, whereas

4 Since $100 banknotes are generally held by the public as a store of value, they do not tend to actively circulate and with such little handling do not deteriorate significantly over time. Indeed, less than 10 per cent of $100 polymer banknotes ever issued have been returned to the RBA as unfit banknotes, making estimates of $100 banknote life uninformative.

5 When the life of banknotes had been less than a year, comparing the number of unfit banknotes observed in a year relative to the stock on issue over the same year would have given a reasonable estimate of the average or median life span. As the life increases beyond a year, however, the formula may not always give an accurate estimate, particularly around periods when a lot of banknotes are issued or old banknotes are destroyed. (For example, if many old banknotes happened to be destroyed in a particular year, the life span estimates for that year are likely to be underestimated. The remaining stock of banknotes on issue would be much younger and, therefore, unlikely to become unfit for a time and so subsequent life estimates are likely to be overestimated for some time.)

Graph 4
Median Estimates of Banknote Life*



* The grey shaded areas show the periods of paper banknote issuance
Sources: RBA; Rush (2015)

for the $20 and $50 polymer banknotes there are still some significant fluctuations. This is most likely due to the fact that the Feige equation only adjusts for new banknotes when they are first issued into circulation, but does not satisfactorily control for situations where banknotes are issued and then temporarily withdrawn from circulation. For example, in the lead-up to January 2000, large volumes of new banknotes were issued to meet precautionary demand (owing to concerns about Y2K problems). These extra banknotes were withdrawn when no longer required and reissued later. As a result, there was a sharp decline in the estimated banknote life in 1999 and a sharp increase a year later.

Limitations of the steady-state methods

While easy to understand and simple to calculate, the traditional and Feige steady-state methods have a number of limitations:

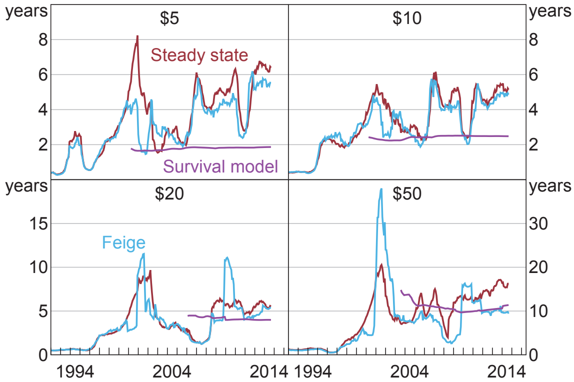
- The steady-state measures do not provide much information about how the probability of becoming unfit varies over a banknote's lifetime or how life spans vary within a banknote denomination. It is possible that the probability of a banknote becoming unfit could increase over time due to inkwear. The life span of banknotes is also likely to vary, even within a denomination, since not all banknotes are treated in the same way by the public. For example, banknotes used as a store of value are likely to stay in good condition (and thus, should have a longer life) compared with banknotes used repeatedly in transactions.
- The steady-state methods cannot control for changes to currency issuer policies, including the issuance of a new banknote series or measures taken to improve the quality of banknotes in circulation. For example, from time to time the Bank conducts targeted quality programs (known as cleansing programs), which involve accelerating the withdrawal of a specific denomination in circulation and replacing any unfit banknotes with new banknotes. During these cleansing programs, banknote life (as estimated by the steady-state measures) initially declines since destructions are high compared with the stock of banknotes on issue. Their typical life subsequently becomes longer since the remaining stock of banknotes on issue is of a higher quality and fewer banknotes become unfit for a time.
- Fluctuations in banknote demand can also cause volatility in the two steady-state measures. For example, in late 2008, the demand for $50 banknotes increased sharply in response to concerns associated with the global financial crisis (GFC). Although those concerns quickly abated, it took more than two years to unwind the excess supply of $50 banknotes in circulation. The sharp increase in circulating $50 banknotes was not mirrored by large increases in destructions (since $50 banknotes tend to last many years) and thus, the banknote life estimated by the turnover formulas increased and remained at higher levels for several years.

Survival modelling

More complex models of the survival of banknotes can be estimated to address some of the limitations of the two steady-state methods. These models estimate banknotes' probability of survival, and the number of banknotes from each issuance date that survive over time, in order to reconcile the total number of fit banknotes observed each month.[6] Unlike the simple turnover formulas, these survival models do not assume a constant probability of a banknote becoming unfit and can also take into account the fact that some banknotes are used as a store of value, or for numismatic purposes (i.e. study or collection), and are unlikely to become unfit. The survival models suggest that these stored or numismatic banknotes represent around 30 per cent of $50 banknotes and 10–15 per cent of the lower-value $5, $10 and $20 banknotes. In addition, the survival models include other variables to take into account factors that affect the supply of and demand for banknotes. For example, they can take into account the greater demand for $50 banknotes around the onset of the GFC and indicate that the probability of survival declined a little over the period, which suggests that banknotes were handled more frequently during the crisis.

The median estimates of banknote life resulting from the survival models are far more stable over time than the results of the steady-state methods (Graph 5). This makes the estimates of the survival models more useful for long-term decision-making, where the currency issuer needs to abstract from the fluctuations in banknote life estimates caused by one-off events. The disadvantage of the survival models relative to the steady-state methods is that they require longer time series of data before estimates can be produced.

Graph 5
Median Estimates of Banknote Life



Sources: RBA; Rush (2015)

Reassuringly, averaged over long spans of time, the median banknote life spans are quite similar across all three methods and are most similar for the $50 denomination (Table 1). All three methods predict longer life spans as the denomination value increases, though the difference between the median life of the lowest- and highest-value denominations is largest under the survival models' estimates.

Back-testing the Models

The article has so far focused on the expected average or median life span of a newly issued banknote predicted by three estimation methods. The methods can also be used to estimate the median age of banknotes in circulation or destroyed

Table 1: Median Banknote Life Estimates
From issuance of NNS, years

Denomination	Steady state	Feige	Survival models
$5	3.5	3.0	1.9
$10	3.5	3.2	2.5
$20	4.1	3.9	4.0
$50	10.0	8.9	10.7

Sources: RBA; Rush (2015)

6 Further technical information and details on these non-linear regression models are available in the research paper on the life of Australian banknotes, see Rush (2015).

at a point in time, which can be validated against the age of banknotes observed in two sampling programs conducted by the Bank.

In Australia, unfit banknotes are returned to the National Note Processing and Distribution Centre (NNPDC) where they are validated, assessed and destroyed. A sample of around 800 000 unfit banknotes was extracted in 2011 and sorted into production vintages based on the unique serial number printed on each banknote.[7] The median age estimates derived from the steady-state method are higher than those in the sample of unfit banknotes, particularly for $10 banknotes (Table 2). The results are most similar between the steady-state method and the sample for $5 banknotes; however, the 2011 period coincided with a cleansing program for the $5 which, as discussed previously, caused the steady-state method to have lower life predictions than would otherwise have been the case. The median estimates for the age of unfit banknotes generated by the survival models are lower than the steady-state estimates and, on average, are closer to the results of the sample.

The Bank also conducts a Commercial Cash Sampling (CCS) program, which collects unsorted banknotes from cash-in-transit companies across Australia. The purpose of this program is to assess the quality of circulating banknotes, but it can also be used to examine the distribution of ages of banknotes that actively circulate. For three sample periods (February in each of 2011, 2012 and 2013), the traditional steady-state method generally implies higher median ages for banknotes on issue than predicted by the survival models and the CCS sample methodology (Table 3). The median ages of banknotes in circulation from the CCS samples tend to be closer to those predicted by the survival models.

Table 2: Age of Unfit Banknotes in 2011

Median years

Denomination	Traditional steady state	Survival models	Unfit sample
$5	5.3	4.3	5.2
$10	7.3	4.4	4.9
$20	5.3	4.4	4.6
$50	6.6	5.4	6.1

Sources: RBA; Rush (2015)

Table 3: Age of Banknotes in Circulation

Median years

Denomination	Traditional steady state			Survival models			Unfit sample		
	2011	2012	2013	2011	2012	2013	2011	2012	2013
$5	5.7	5.9	6.8	5.5	6.0	6.7	4.8	5.2	5.9
$10	4.8	5.9	7.2	4.6	5.3	6.6	4.4	5.0	6.6
$20	5.4	5.9	6.4	5.3	5.9	6.3	4.3	5.0	5.7
$50	6.7	7.2	7.8	5.5	6.1	6.5	5.1	5.6	6.1

Sources: RBA; Rush (2015)

7 The first two numbers of a banknote's serial number identify the year a banknote was manufactured; for more information, see <http://banknotes.rba.gov.au/production-and-distribution/production/>.

Conclusions

The median life of Australian banknotes spans a wide range across denominations – from around 2–3 years for the $5 up to around 10 years for the $50 – with little variation across the methods of calculation over the long run. The two steady-state methods are easy to calculate, and indicate that polymer banknotes last considerably longer than the equivalent paper denominations. These methods are, however, unable to account for supply and demand shocks and the estimates have considerable volatility from month to month. The survival models correct for some of the limitations of the steady-state methods and produce more stable and intuitive estimates of banknote life. They are able to provide other useful information, such as the proportion of banknotes for each denomination that actively circulate (as opposed to being used for store of value or numismatic purposes). The survival models' predictions for banknote survival are also, on average, more consistent with samples of circulating and unfit banknotes. Given the advantages of the new survival models, they will be a useful complement to the traditional estimation methods and can help the Bank's long-term decision-making. ✠

References

Feige EL (1989), 'Currency Velocity and Cash Payments in the U.S. Economy: The Currency Enigma', *MPRA* Paper No 13807.

Rush A (2015), 'The Life of Australian Banknotes', RBA Research Discussion Paper No 2015-10.

Reserve Bank Publications

Most of the publications listed below are available free of charge on the Bank's website (www.rba.gov.au). Printed copies of these publications, as well as a wide range of earlier publications, are also available on request; for details refer to the enquiries information at the front of the *Bulletin*.

Statement on Monetary Policy

These statements, issued in February, May, August and November, assess current economic conditions and the prospects for inflation and output.

Financial Stability Review

These reviews, published semiannually, assess the current condition of the financial system and potential risks to financial stability, and survey policy developments designed to improve financial stability.

Annual Reports

- *Reserve Bank of Australia Annual Report*
- *Payments System Board Annual Report*
- *Equity & Diversity Annual Report*

Research Discussion Papers (RDPs)

This series of papers is intended to make the results of current economic research within the Bank available for discussion and comment. The views expressed in these papers are those of the authors and not necessarily those of the Bank.

Abstracts or introductions of all RDPs, and the full text of RDPs published since 1988, are available on the Bank's website.

Conference Volumes

Conference volumes have been published on the Bank's website since 1993. The most recent titles are:

- *Financial Flows and Infrastructure Financing*, July 2014
- *Liquidity and Funding Markets*, December 2013
- *Property Markets and Financial Stability,* December 2012
- *The Australian Economy in the 2000s,* December 2011
- *Reserve Bank of Australia 50th Anniversary Symposium,* July 2010
- *Inflation in an Era of Relative Price Shocks,* May 2010
- *Lessons from the Financial Turmoil of 2007 and 2008,* October 2008

Other Publications

The Bank periodically produces other publications that may take the form of submissions to inquiries, surveys or consultation documents. Some recent examples include:

- *Submission to the Senate Inquiry into Matters Relating to Credit Card Interest Rates*, August 2015
- *Central Clearing of Repos in Australia: A Consultation Paper,* March 2015
- *Review of Card Payments Regulation – Issues Paper,* March 2015
- *Submission to the Inquiry into Digital Currency,* November 2014
- *Supplementary Submission to the Financial System Inquiry*, August 2014
- *Submission to the Inquiry into Financial Related Crime*, July 2014
- *Submission to the Inquiry into Foreign Investment in Residential Real Estate,* May 2014
- *Submission to the Financial System Inquiry,* April 2014

Recent Bulletin Articles

June Quarter 2015

Firms' Investment Decisions and Interest Rates

Why Is Wage Growth So Low?

Developments in Thermal Coal Markets

Potential Growth and Rebalancing in China

Banking Fees in Australia

Structural Features of Australian Residential Mortgage-backed Securities

Wealth Management Products in China

Recent Developments in Asset Management

Skin in the Game – Central Counterparty Risk Controls and Incentives

March Quarter 2015

Australian Banknotes: Assisting People with Vision Impairment

The Economic Performance of the States

Insights from the Australian Tourism Industry

Australia and the Global LNG Market

China's Property Sector

Developments in Banks' Funding Costs and Lending Rates

Market Making in Bond Markets

Shadow Banking – International and Domestic Developments

The IMF's 'Surveillance': How Has It Changed since the Global Financial Crisis?

December Quarter 2014

Cycles in Non-mining Business Investment

Labour Movements during the Resources Boom

The Effect of the Mining Boom on the Australian Economy

Chinese Rebalancing and Australian Exports

The Equity Securities Lending Market

Fast Retail Payment Systems

The Offshore Renminbi Market and Australia

Identifying Global Systemically Important Financial Institutions

Sovereign Debt Restructuring: Recent Issues and Reforms

Recent Speeches

Committee for Economic Development of Australia (CEDA) event, Philip Lowe, Deputy Governor, September 2015

Property Markets and Financial Stability: What We Know So Far, Luci Ellis, Head of Financial Stability Department, September 2015

Opening Statement to the Senate Economics References Committee Inquiry into Matters Relating to Credit Card Interest Rates, Malcolm Edey, Assistant Governor (Financial System), August 2015

'Reform' and Economic Growth, Glenn Stevens, Governor, August 2015

Panel participation at the Risk Australia 2015 Conference, Mark Manning, Deputy Head of Payments Policy (Financial System), August 2015

Adjustments in the Labour Market, Christopher Kent, Assistant Governor (Economic), August 2015

National Wealth, Land Values and Monetary Policy, Philip Lowe, Deputy Governor, August 2015

Opening Statement to House of Representatives Standing Committee on Economics Inquiry into Home Ownership, Luci Ellis, Head of Financial Stability Department, August 2015

Address to the Boao Forum for Asia Financial Cooperation Conference, Glenn Stevens, Governor, July 2015

Issues In Economic Policy, Glenn Stevens, Governor, July 2015

Panel participation at the Global Investor/ISF Australia Securities Finance Masterclass, Mark Manning, Deputy Head of Payments Policy (Financial System), July 2015

The Changing Landscape of Central Banking, Glenn Stevens, Governor, June 2015

Remarks on Financial Integration in the Asia Pacific, Guy Debelle, Assistant Governor (Financial Markets), June 2015

Copyright and Disclaimer Notices

Australian Property Monitors

The following Copyright and Disclaimer Notices apply to data on dwelling prices obtained from Australian Property Monitors (APM) and reported in the article 'Long-run Trends in Housing Price Growth' in this issue of the *Bulletin*.

In compiling this data, APM relies upon information supplied by a number of external sources. The information is supplied on the basis that while APM believes all the information in it will be correct at the time of publication, it does not warrant its accuracy or completeness and to the full extent allowed by law excludes liability in contract, tort or otherwise, for any loss or damage sustained by subscribers, or by any other person or body corporate arising from or in connection with the supply or use of the whole or any part of the information in this publication through any cause whatsoever and limits any liability it may have to the amount paid to the Publisher for the supply of such information.

New South Wales Land and Property Information

Contains property sales information provided under licence from the Land and Property Information. Australian Property Monitors Pty Ltd is authorised as a Sales Information Provider by the Land and Property Information.

State of Victoria

The State of Victoria owns the copyright in the Property Sales Data and reproduction of that data in any way without the consent of the State of Victoria will constitute a breach of the *Copyright Act 1968* (Cth). The State of Victoria does not warrant the accuracy or completeness of the Property Sales Data and any person using or relying upon such information does so on the basis that the State of Victoria accepts no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information supplied.

State of Queensland

© State of Queensland (Department of Natural Resources and Mines) 2015. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.

Government of the State of South Australia

Warning

The information contained in this dataset is extracted from records of land status and cadastral boundary definition held by the Government of South Australia (the 'State'). The information is not represented to be accurate, current, complete, or suitable for any purpose, at the time of its supply by the State, and may have changed since the date of supply by the State. The software by which the information is provided is not represented to be error free. No responsibility is accepted by the State for any reliance placed by any person upon the information, or the software by which it is provided. Persons acquiring or using the information and its associated software must exercise their independent judgement in doing so.

Copyright

Copyright in the information remains with the Crown in right of the State of South Australia. The information is reproduced under licence from the Crown.

Privacy

The information contained in this dataset must not be used for the purposes of compiling contact lists, whether personalised or not.

Crown in Right of Tasmania

This product incorporates data that is copyright owned by the Crown in Right of Tasmania. The data has been used in the product with the permission of the Crown in Right of Tasmania. The Crown in Right of Tasmania and its employee and agents:

a. give no warranty regarding the data's accuracy, completeness, currency, or suitability for any particular purpose

b. do not accept liability howsoever arising including but not limited to negligence for any loss resulting from the use of or reliance upon the data.

Australian Capital Territory

The Territory Data is the property of the Australian Capital Territory. No part of it may in any form or by any means (electronic, microcopying, photocopying, recording or otherwise) be reproduced, stored in a retrieval system or transmitted without prior permission. Enquiries should be directed to: The Executive Director, ACT Planning and Land Management, GPO Box 1908, Canberra, ACT 2601.

Northern Territory

Copyright in the underlying data for the Northern Territory is owned by the Northern Territory of Australia represented by the Department of Infrastructure, Planning and Environment for which no responsibility is accepted.

Western Australian Land Information Authority (Landgate)

Western Australian Land Information Authority (2013) trading as Landgate. Based on information provided by and with the permission of the Western Australian Land Information Authority (2013) trading as Landgate.