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SELECTED ISSUES

January 23, 2018

Approved By
Asia and Pacific Department

Prepared by Thomas Helbling, Philippe Karam, Kyungsuk Lee, Dirk Muir (all APD), Grace Bin Li (RES), and Mikhail Pranovich (ICD), with additional inputs by Ioana Hussiada (APD) and Siegfried Steinlein (OAP) and assistance from Nadine Dubost (APD).

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AUSTRALIA'S LINKAGES WITH CHINA: PROSPECTS AND RAMIFICATIONS OF CHINA'S ECONOMIC TRANSITION[1]

- **China and Australia have increasingly strong linkages, especially through trade and commodity channels.** These are driven by China's demand for commodities such as coal and iron ore, and services such as tourism and education, of which Australia is a major supplier. These links are important for China's transition to a services-driven, consumer-led economy from a manufacturing-driven, export-led one. The work below considers risks to China during this transition, focusing on spillovers to Australia.

- **The analysis uses ANZIMF (Australia-New Zealand Integrated Monetary and Fiscal model), a version of the IMF's GIMF (Global Integrated Monetary and Fiscal model).** ANZIMF is a micro-founded, overlapping generations dynamic stochastic general equilibrium (DSGE) model with a detailed bilateral trade flows structure. Two sectors for services (tourism and education) and for metals and coal are added to better track the evolving structure of the Chinese economy and changing economic relationship with Australia.

- **Three macro scenarios are constructed to illustrate the specific and complex nature of those linkages.** A simple and general takeaway is reinforced throughout – while real GDP in Australia experiences only small changes, these movements mask much broader movements in the composition of GDP, between domestic and external demand, or sectors in the economy. More specifically, analyzing two scenarios on the upside for Australia and one on the downside, three further takeaways stand out.

    - ***Increased services demand in China.*** The government enacts reforms that encourage households to substitute away more from saving to consumption while boosting productivity. Australia's service sector benefits, but other sectors can be disadvantaged from a more productive China through other channels. *Takeaway*: Understanding the structure of the shock that occurs in China is as important as the outcome of the shock when interpreting the spillovers to Australia.

    - ***Increased foreign commodities demand from China.*** China restricts its production of iron ore, coal and associated goods such as steel, although there is still strong Chinese demand for these goods. Australia exports more commodities, but a mild slowdown in growth in China causes a contraction elsewhere in the Australian economy, driven mainly by an appreciation of the Australian dollar. *Takeaway*: Australia is a diversified economy in which its flexible exchange rate moderates outcomes from any particular shock.

    - ***Disorderly rebalancing in China.*** The transition process is derailed, accompanied by a broad-based slowdown in growth with lower productivity, weaker-than-expected activity

[1] Prepared by Philippe Karam and Dirk Muir (both APD). The chapter benefited from valuable comments by seminar participants at the Treasury of Australia.

in the steel industry (with a fall in demand for iron ore and coal), lower housing prices, and increased corporate risk. Although Australia's net commodity exports fall, there is a rebalancing between domestic and external demand, and a rebalancing between China and Australia's other trading partners that stimulates Australia's exports and services sector, on net. *Takeaway*: Although Australia is a diversified economy, it depends on the interaction of its commodities sector with its multiple trading partners, beyond China alone.

A. Introduction

1. China and Australia have increasingly strong linkages, especially through trade and commodity channels. There are also some financial linkages, but they will not be a focus of the following analysis. The trade links are driven by demand from China for commodities and services. Key commodities are coal and iron ore used in its intermediate good industries, like steel. Services imports have a strong consumer component, primarily tourism and education services, of which Australia is also a major supplier. Australian capacity for iron ore and coal production has expanded in the wake of the now-concluded mining investment boom, while services continue to expand in Australia buoyed by a strong tertiary education system, and growing opportunities for tourism.

2. This paper examines the risks to China during its transition and focuses on their spillovers to Australia. While it is acknowledged that China's ongoing transition to a services-driven, consumer-led economy from a manufacturing-driven, export-led one has been largely successful to date, there are still possibilities for upside and downside risks. This paper considers three illustrative risk scenarios, closely focusing on the sectors of China's economy with salient linkages to Australia.[2] The first two are upside risks for Australia, and the third a downside risk.

- ***Increased services demand in China*.** Households substitute away more from saving to consumption while the government enacts reforms to facilitate the process and boost productivity. Australia's service sector benefits, but other sectors face competitive pressures from a more productive China.

- ***Increased foreign commodities demand from China.*** China restricts its production of iron ore, coal and associated goods such as steel, although there is still strong Chinese demand for these goods. Australia exports more commodities, but China's resulting mild slowdown in growth triggers a mild contraction elsewhere in the Australian economy driven mainly by an Australian dollar appreciation.

- ***Disorderly rebalancing in China*.** The rebalancing process is derailed, leading to a broad-based slowdown in growth with lower productivity, weaker-than-expected performance of the steel industry, lower housing prices, and increased corporate risk. Although Australia's net commodity exports fall, there is a rebalancing between domestic and external demand, and between China

[2] For similar scenario analysis that is centered more on China rather than its spillovers using one of the IMF's global models, see Dizioli and others (2016).

and Australia's other trading partners, that stimulates Australia's exports and services sector, on net.

3. There are four takeaways from these scenarios. The most generally applicable takeaway from all three scenarios is that while real GDP in Australia experiences only small changes, these mask much broader movements in the composition of GDP, whether it be between domestic and external demand, or between sectors in the economy (commodities, services, other tradables, nontradables). The first upside scenario related to China's services demand demonstrates that understanding the components of the shock that occurs in China is as important as its outcomes on the Chinese economy when interpreting the spillovers to Australia. The second upside scenario that focuses on the commodities sector illustrates that Australia is a diversified economy that takes advantage of its flexible exchange rate regime, and its open economy more generally. This takeaway carries over to the downside scenario, which draws out a subtler point – although Australia is a diversified economy, it depends on the interaction of its commodities sector with its multiple trading partners, beyond China alone, and these can have unexpected feedback effects into other sectors of Australia's economy.

4. The paper explores these scenarios, first by setting up the relevant stylized facts, and then using the Australia-New Zealand Integrated Monetary and Fiscal model (ANZIMF) as its analytical tool. Section B outlines key stylized facts about China and its ongoing transition, the current state of Australia, and both countries' commodity and consumer services sectors, along with their interlinkages. Sections C, D and E present the three scenarios, reflecting shocks to China's transition path as currently articulated by the IMF's 2017 Article IV consultation with China (IMF 2017a) and the *World Economic Outlook* (IMF 2017b). The analysis in these sections uses ANZIMF, a version of the IMF's Global Integrated Monetary and Fiscal model (GIMF), presented in some detail in Box 1. Section F concludes the paper.

B. Stylized Facts on Linkages Between Australia and China[3]

5. Australia and China have strong linkages, resulting from both differences and similarities economic structures. One key similarity is that both are dynamic, growing economies while noting that Australia is a high-income, advanced economy, while China is a middle-income, emerging economy in transition. Moreover, Australia is shaped by its role as a commodity exporter (albeit with a diversified economy) while China has become the prime global commodity importer (also a diversified economy, but still less dependent on services, and more on industry). Both countries have vibrant service sectors, but China's services sector is still expanding rapidly, particularly in segments dominated by households – tourism and education. Australia is in a strong position as a supplier of these services.

[3] Sources for data in this section include: ABS; CEIC; China National Bureau of Statistics; Haver Analytics; OECD.stat; and publications by Department of Foreign Affairs and Trade (2015, 2017); East Asian Bureau of Economic Research and China Center for International Economic Exchanges (2016); International Energy Administration (2017); International Trade Administration (2017); and Tourism Research Australia (2017).

Box 1. ANZIMF – The Australia-New Zealand Integrated Monetary and Fiscal Model

ANZIMF is an annual, multi-region, micro-founded general equilibrium model of the global economy. It comprises seven regions – Australia, New Zealand, China, Advanced Asia, Emerging Asia, the United States, and a bloc of the remaining countries; it is an annual, micro-founded DSGE model that includes commodity and services sectors focused on coal/iron ore/metals, and tourism/education services, respectively.[1] It is based on the IMF's Global Integrated Monetary and Fiscal model (GIMF), with supporting documentation that is applicable to ANZIMF (Kumhof and others, 2010 and Anderson and others, 2013). Structurally, each country/regional block is close to identical, but with different key steady-state ratios and behavioral parameters, based on a stylized data set consistent with 2015 and 2016, and some long-term trends, primarily related to asset holdings (Table 1).

Consumption dynamics are driven by saving households and liquidity-constrained (LIQ) households. Saving households face a consumption-leisure choice, based on the overlapping generations (OLG) model of Blanchard (1985), Weil (1989) and Yaari (1962) where households treat government bonds as wealth since there is a chance that the associated tax liabilities will fall due beyond their expected lifetimes, making the model non-Ricardian and endogenizing the long-term determination of the real global interest rate to equilibrate global savings and investment. The real exchange rate serves to adjust each country's saving position (its current account and associated stock of net foreign assets) relative to the global pool. LIQ households cannot save, consuming all their income each period, amplifying the model's non-Ricardian properties in the short term.

Private investment relies on the Bernanke-Gertler-Gilchrist (1999) financial accelerator. Investment cumulates to the private capital stock for tradable and nontradable firms, which is chosen by firms to maximize their profits, with a standard inverse relationship between the capital-output ratio and the cost of capital. Firms are costly for investors to monitor, and are perceived as riskier as financial conditions (or the economy, more generally) worsen, leading to endogenously determined corporate risk premia.

Table 1. Key Ratios in ANZIMF

(Percent of GDP, unless otherwise stated)

	Australia	China	Other Asia 1/
Share of Global GDP (%)	2.1	10.3	16.0
Domestic Demand (% of GDP)			
Household Consumption	57.2	53.5	59.0
Private Investment	20.0	25.0	20.1
Government Absorption	22.8	24.0	21.0
Trade (% of GDP)			
Non-Commodity Exports	13.2	25.7	29.6
Partner 2/	1.7	0.9	0.8
Final Goods	5.0	18.4	16.3
Partner 2/	0.8	0.8	0.5
Consumption Services	3.5	2.0	2.6
Partner 2/	0.9	>0	0.2
Intermediate Goods	4.8	5.2	10.8
Partner 2/	0.9	0.1	0.3
Non-Commodity Imports	22.2	23.3	28.6
Partner 2/	4.4	0.3	0.6
Final Goods	13.9	9.2	12.7
Partner 2/	3.9	0.2	0.4
Consumption Services	2.6	2.6	1.9
Partner 2/	0.1	0.2	0.2
Intermediate Goods	5.7	11.5	14.0
Partner 2/	0.6	0.2	0.1
Net Commodities	9.0	-2.4	-1.0
Partner 2/	5.3	-1.1	-0.5

1/ Includes HKG, IND, IDN, JPN, KOR, MYS, SGP, THA, PHL, VNM and other small Asian and Pacific island states.
2/ China in case of Australia; Australia in the case of China and Other Asia.
Sources: IMF staff calculations; IMF's World Economic Outlook and Direction of Trade Statistics; U.N. Comtrade; OECD.stat National Accounts Database.

[1] Advanced Asia includes Hong Kong SAR of China, Japan, the Republic of Korea, Singapore and Taiwan Province of China. Emerging Asia includes Bangladesh, Cambodia, India, Indonesia, Lao PDR, Malaysia, Mongolia, the Philippines, Sri Lanka, Thailand, Vietnam and other smaller Asian and Pacific island states. The remaining countries bloc includes the rest of the world, but will be dominated by the European Union and the G-20 countries not mentioned in other regions of the model.

Box 1. ANZIMF – The Australia-New Zealand Integrated Monetary and Fiscal Model (concluded)

Government absorption consists of exogenously determined spending on consumption goods and infrastructure investment. Both affect the level of aggregate demand. In addition, spending on infrastructure cumulates into an infrastructure capital stock (subject to constant but low rate of depreciation). A permanent increase in the infrastructure capital stock permanently raises the economy-wide level of productivity.

The nominal side of the economy depends on implicit Phillips' curves and monetary policy. The core price is the consumer price index, CPI, while relative prices mimic the structure of the national expenditure accounts. There is also wage inflation, which is implicitly a key driver for CPI inflation. In the short term, the nominal side of the economy is linked to the real side through monetary policy, which is usually an inflation forecast targeting regime that uses an interest rate reaction function reliant on expected inflation. As interest rate effects work their way through the transmission mechanism, inflation moves back to its target level within several years.

Fiscal policy is driven by a sufficiently detailed government sector that can reproduce simplified fiscal accounts for each country. Fiscal policy aims to maintain a debt target (expressed as a deficit target, in flow space) using at least one of seven policy instruments. On the spending side, these are government consumption, spending on infrastructure spending, general lumpsum transfers to all households (such as pensions, aged care provisions, unemployment insurance) and lumpsum transfers targeted to LIQ households (such as welfare, certain pensions). On the revenue side, there are taxes on consumption (the goods and services tax, GST), personal income (PIT) and corporate income (CIT).

Trade is tracked bilaterally between all regions. The flows react to demand, supply and pricing (i.e. the terms of trade and bilateral real exchange rates) conditions. There are flows for non-commodity goods and services, and commodities. Commodities trade, and its related demand and supply equations, are based on coal and metals (especially iron ore). Non-commodities trade is further broken into final goods (consumption and investment), consumption services, and intermediate goods.

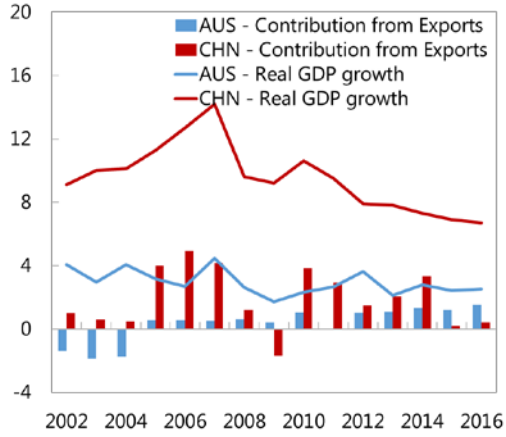
Relative to standard versions of GIMF, this model contains sectors for commodities and for services. The data definition for commodities in this application are relatively narrow, covering only coal, iron ore, and other minerals. Similarly, the definition of services is restricted to tourism (mostly travel, accommodation, and food services) and education (mostly travel and correspondence courses).

The commodities sector. The U.S. dollar global commodities price is determined when producing countries sell in a global market, from which all countries then compete for their demands on the basis of price. Countries produce commodities from their endowment. Supply moves in tandem in the short term with the gap between the current and medium-term average global price, and reacts (optionally) to demand-driven long-term changes in the global price. Both the short- and long-term price elasticities of supply are 0.05. Net export flows are explicitly tracked, although it is possible from the model structure of the model to deduce the bilateral flows. Commodities are inputs to both tradable and non-tradable intermediate goods production, although the majority flows to tradables.

The services sector. Services are produced from tradable and nontradable goods. They are priced as an input for consumption in Australia, or exported to be consumed by foreigners. Services are exclusively part of consumption, and their demand vis-à-vis consumption goods is relatively inelastic. Consumption of services is a combination of services provided domestically or abroad. This allows for a final price of services that will enter the CPI, much as consumption services combines with the consumption of goods to define final household consumption.

6. Real GDP growth has been strong since the late 1990s in both countries. China has led the world, while Australia is usually a leader among the advanced economies. Both economies have had strong contributions to growth from aggregate exports.

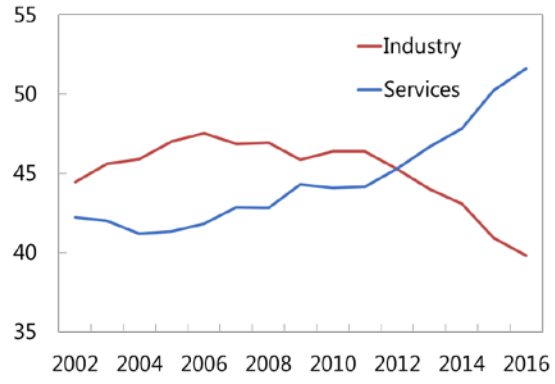
Real GDP Growth
(In percent, year-on-year)



Sources: Haver; CEIC; IMF staff calculations

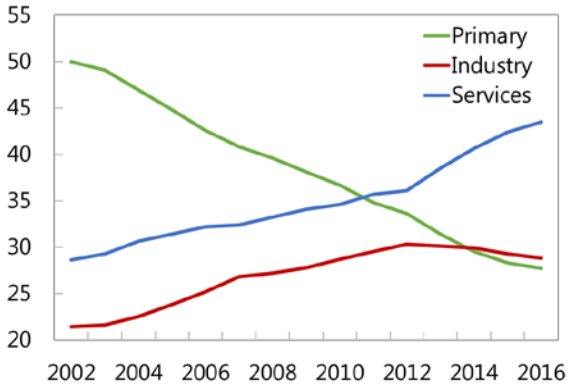
7. China has been transitioning towards a services-driven economy since the Global Financial Crisis. The share of services in the economy has now reached almost 52 percent of GDP (although still lagging most advanced economies), while that of industry has declined by around 8 percentage points to 40 percent since 2006. Employment restructuring is another factor of the ongoing transition where employment in the primary sector (includes agriculture and mining) having declined since 2002 from 50 percent to about 28 percent, while services increased from 29 percent to 44 percent. Industrial employment has peaked to reach over 30 percent in 2012, but has slowly declined since.

China's GDP by Production
(In percent of nominal GDP)



Sources: CEIC; IMF staff calculations

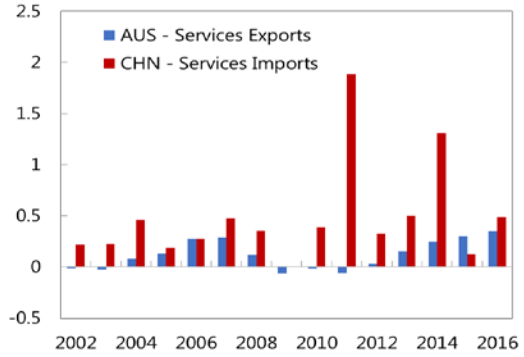
China's Employment by Sectors
(In percent of total employment)



Sources: CEIC; IMF staff calculations

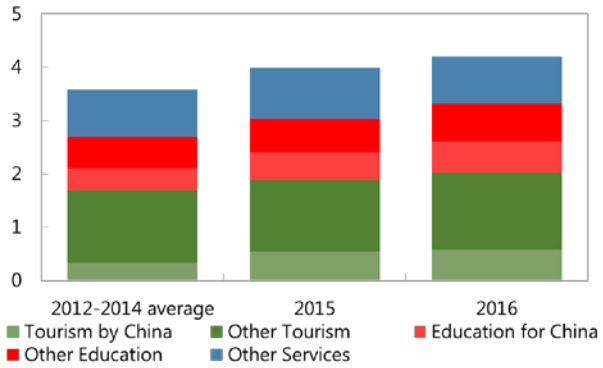
8. The shift to services has also been reflected in increasing trade in services. China has seen its imports of services rise steadily as a share of GDP, under rapidly growing real GDP. This has been a major driver for Australia's strengthening growth in services exports. In Australia, its services exports have been dominated by tourism and education, with China demanding an increasing portion of those services.

Contributions to GDP Growth
(In percentage points)



Sources: Haver; CEIC; IMF staff calculations

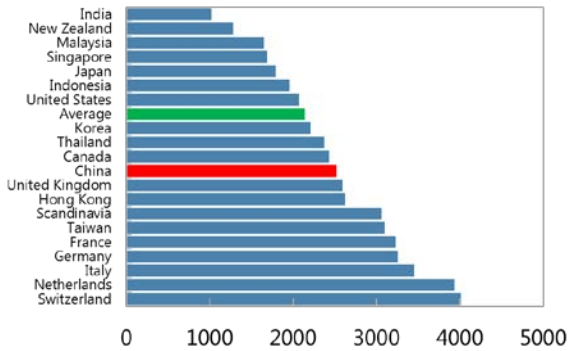
Australia's Exports of Services
(In percent of GDP)



Sources: Department of Foreign Affairs and Trade, *Trade in Services, Australia,* 2014 and 2016 editions; IMF staff calculations

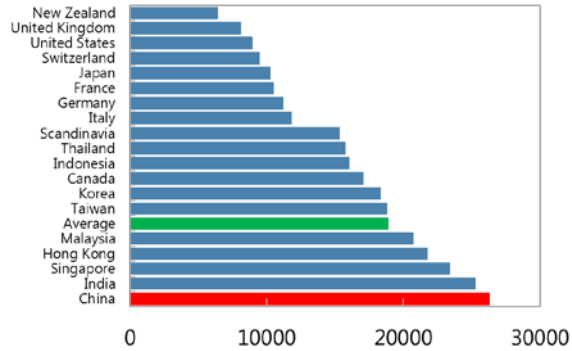
9. Tourism to Australia from China has been increasing over time, both in value per tourist, and number of tourists. Generally, education and tourism services make up between 11 and 17 percent of GDP in OECD countries. A large portion of tourism spending comes from abroad, and counts as services exports. Tourism is not necessarily the largest component of services exports in many countries – it is often financial services, which is not the case in the China- Australia relationship. China has increased its share of total tourism spending in Australia from 3.5 percent in 2000 to 22 percent in 2015. The strong pace continued in 2015, with strong growth real spending by China (29.8 percent), and tourist visits (18.8 percent). The level of spending per Chinese tourist in Australia is above average, at A$2,523 per tourist. Moreover, where the level of average spending has stayed within A$150 of its current value of A$2,140 since 2006/07 for other countries' tourists to Australia, China's spending per tourist has increased by 57 percent from A$1,610.[4] Similarly, the number of visits by Chinese tourists has increased by 350 percent between 2006/07 and 2016/17, accounting for almost 30 percent of the increase in total visitors over that same decade.

Tourism Spending
(Average A$ per visitor in 2016/17)



Sources: Tourism Research Australia, *International Visitors Survey Results, August, 2017*; IMF staff calculations

Education Spending
(Average A$ per student in 2016/17)

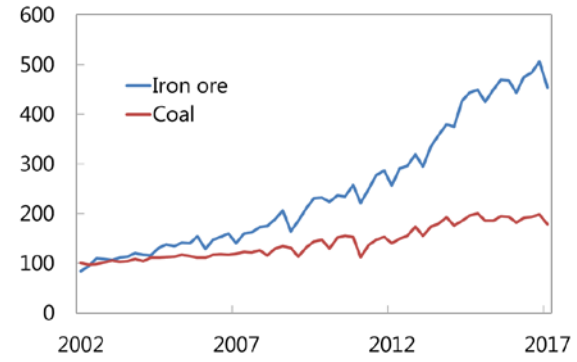


Sources: Tourism Research Australia, *International Visitors Survey Results, August, 2017*; IMF staff calculations

[4] For tourism and education data, the year 2006/07, for example, indicates the 12-month period ending June 30, 2007.

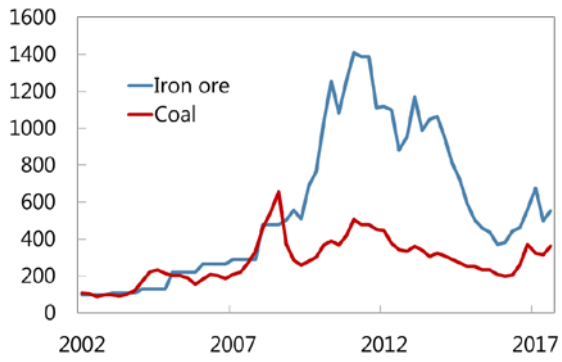
10. The linkages between China and Australia in education spending tells a similar story. Average education spending from 2006/07 to 2016/17 rose from A$16,225 to A$26,350 by Chinese students (just behind India in percentage increase), although average spending across all countries in Australia has also increased, unlike for tourism, by about 58 percent (versus China's 62 percent). The number of students from China has risen by 340 percent since 2006/07, accounting for over 53 percent of the increase in foreign students, now totaling over 182,000 for 2016/17.

Australia's Commodity Export Volumes
(2002=100)



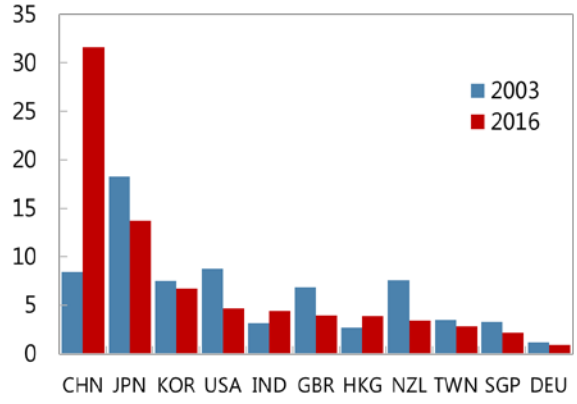
Sources: Haver Analytics; IMF staff calculations

Australia's Commodity Export Prices
(2002=100)



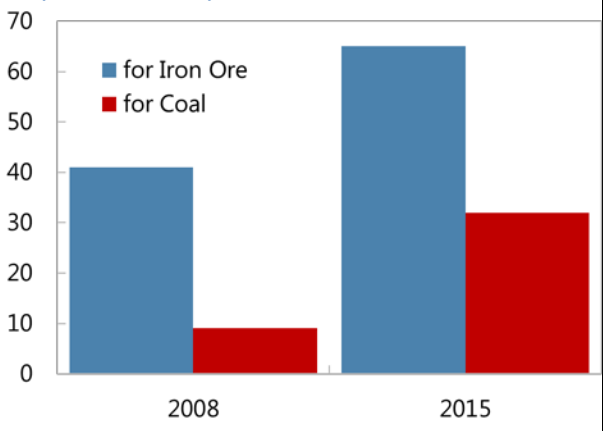
Sources: Haver Analytics; IMF staff calculations

Australia's Exports by Destination
(In percent of merchandise exports)



Sources: ABS; IMF staff calculations

Australia's Share of China's Imports
(In percent of imports)



Source: China National Bureau of Statistics

11. Australia has become a major supplier of China's commodity imports, especially for the steel industry. China's export-led growth in the past has made it the world's largest consumer of commodities, and has spawned key intermediate goods industries, such as steel. China consumes most of its own steel, as it continues to rapidly expand its infrastructure and builds its cities to accommodate its ever-growing consumer base. The steel industry is dependent on imports of iron ore and coking coal, even though China is the world's largest coal producer, at 46 percent of the market. Australia supplies a large share of the remaining demand for coal and iron ore, increasing

their share over time in volume terms and even value, despite large fluctuations in global coal and iron ore prices. Because Australia is geographically distant, but has a stable supply chain with China, it has also increased its trading relationships in all goods with other Asian countries along the route to, or close to, China. Roughly 75 percent of all Australian exports now go to Asia, versus 55 percent in 2003.

12. Three conclusions are deduced from the observed trends in the stylized facts that further motivate the scenario analysis below. First, China has grown strongly as it transforms itself structurally towards a typical advanced economy, led by its services sector. Second, Australia has capitalized on China's strong growth; it has integrated its commodity supplies into China's steel industry, and is increasingly providing more services to China's household sector as well. Third, neither process is concluded, and the linkages between Australia and China are expected to expand in the future, meaning that Australia is also increasingly exposed to the risks China faces during its transition process. The scenario analysis below will attempt to explore in more detail the increased importance of the Australia-China linkages, and provide the policymaker with key results highlighting the likely effects of increasing ties and possible risks on the Australian economy.

C. Upside Scenario 1 – Higher Chinese Household Spending on Tourism and Education

Takeaway: *Understanding the structure of the shock to China is as important as the outcome of the shock in China when interpreting the spillovers to Australia and other countries.*

13. In China, the restructuring process is accelerated, which includes permanently higher services demand (Figure 1). There are two components to this process – first, a household preference shift away from saving; second, accelerated restructuring to bring forward productivity growth. The preference shift leads to a decline in private saving by 1 percent of GDP, and a lower current account balance, accommodated by an immediate 1.5 percent appreciation of China's real effective exchange rate (REER). Higher productivity lowers factor costs, encouraging firms' labor and capital demand, adding to labor income and financial wealth. Consequently, consumption is 1 percent higher relative to baseline, driven by private saving in the short term, and higher productivity in the longer term.

14. Higher Chinese consumption continues the trend of higher demand for services, but with no substantive effects on commodities. It is also assumed that the increase in China's household wealth continues the preference shift towards services that often occurs as a country transitions to a high-income economy. Imports of services increase about 7 percent in the medium term and settle at 4 percent in the long term, accounting for about half of the increase in consumption. Commodities play a small role, since the shift in demand is toward less-commodity intensive services, with no notable spillovers to Australia's commodities sector.

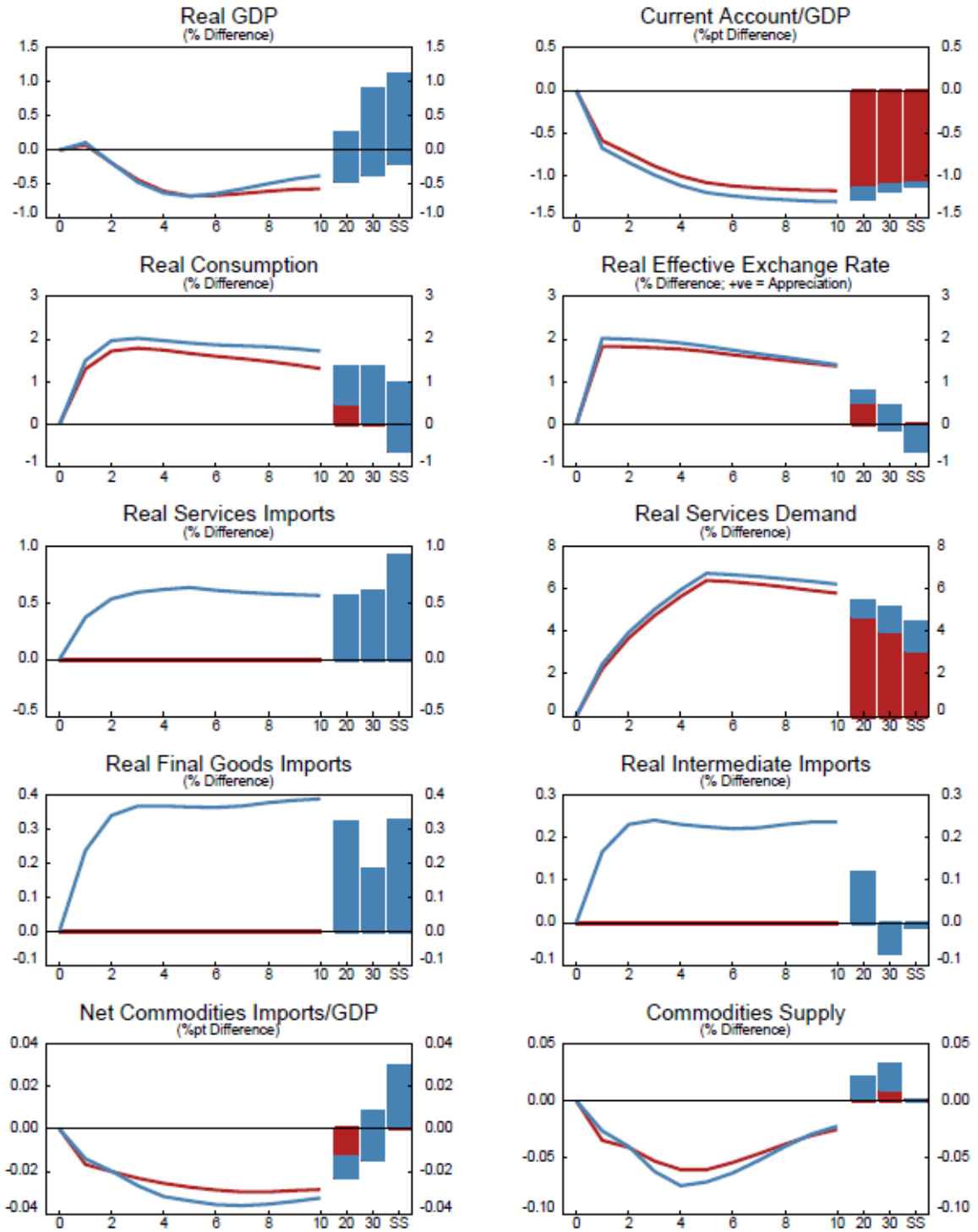
15. However, Australia experiences growth in its services sector (Figure 2). Services exports grow by 2 percent in the first five years, although the long-term supply effect is lower, at 0.9 percent, because of the attenuating REER effect.

Figure 1. Upside Scenario 1 – Results for China

(Deviations from baseline scenario)

___ 1 and 2. Preference shifts lower CHN private saving and increase education and tourism services

___ 3. While accelerated restructuring strengthens CHN productivity



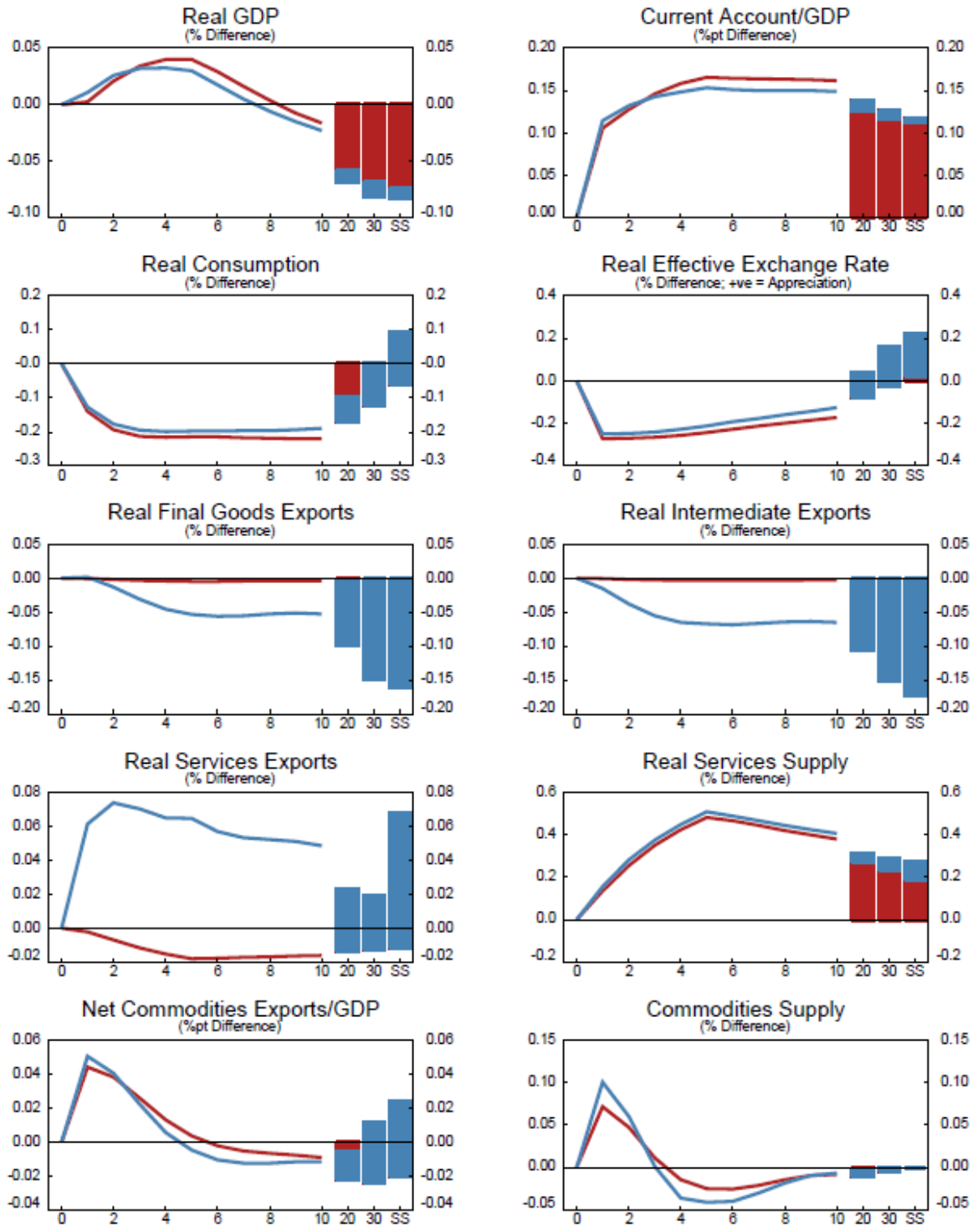
Source: IMF staff calculations

Figure 2. Upside Scenario 1 – Spillovers to Australia

(Deviations from baseline scenario)

___ 1 and 2. Preference shifts lower CHN private saving and increase education and tourism services

___ 3. While accelerated restructuring strengthens CHN productivity



Source: IMF staff calculations

16. Australia experiences distinct short- and long-term effects because of the behavior of its REER. Australia's REER mirrors that of China, depreciating slightly by 0.2 percent followed by a 0.2 percent long-term appreciation. In the short term, all exports increase, about 0.45 percent for final goods, and almost 0.3 percent for intermediate goods. In the long term, Australian final and intermediate exports each decline by about 0.4 percent relative to the baseline scenario, driven by the REER. Similarly, the price of imports cycles in response to the REER so that short-term consumption is 0.2 percent lower, but 0.1 percent higher in the long term.

17. Overall, the Australian economy experiences a long-lived cycle in its reaction to the shock in China. Australia's real GDP moves from less than 0.1 percent higher in the short term to -0.1 percent in the long term, relative to the baseline. The current account is unambiguously stronger, primarily due to services exports. Yet the real trade volume is more variable than the current account because of the REER and its role in the terms of trade, and is the driver for real GDP. Although a surface reading of the China scenario – lower private saving and higher consumption – seem to indicate a steady, constant development in the economy, it actually conceals two long cycles in productivity and consumption/saving behavior that manifest themselves more fully in China's external sector and time-varying spillovers in Australia.

D. Upside Scenario 2 – Improved Opportunities for Foreign Commodities Suppliers in China

Takeaway: *Australia is a diversified economy in which its flexible exchange rate regime and its open economy more generally moderate the effects of any given shock.*

18. China further increases the speed at which it addresses overcapacity and inefficiencies in its steel and commodities production (Figure 3). The government restructures and closes inefficient firms that produce steel than originally announced in the baseline scenario, reducing capacity by an additional 10 percent (about -0.4 percent of GDP, all else being equal). At the same time, the domestic supply of coal and iron ore is reduced by 5 percent because of the government also accelerating and deepening the restructuring process, but without any fall in domestic demand for those commodities outside of the steel industry. This pushes up the global price of these commodities by 3 percent, permanently, with higher short-term increases.

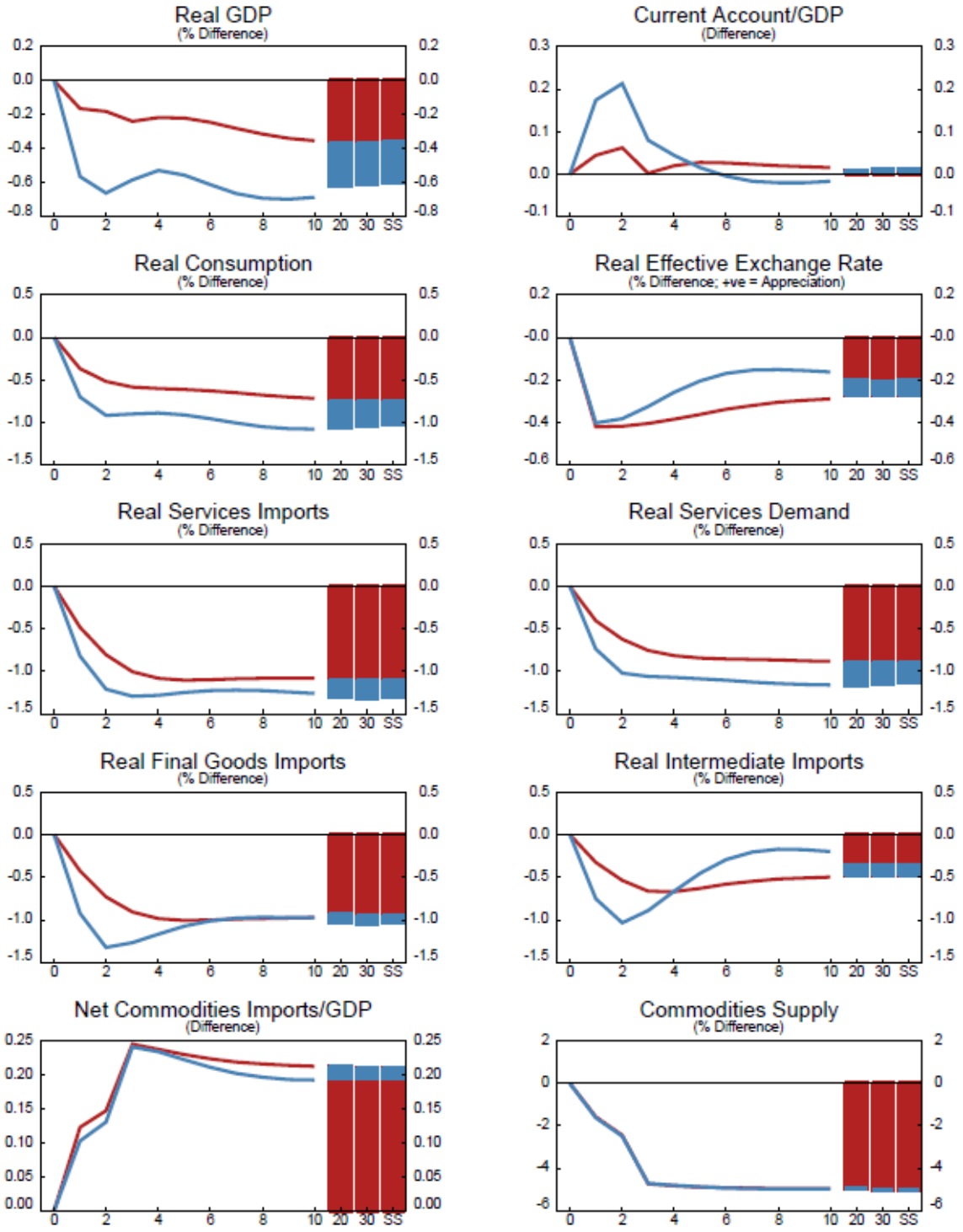
19. The process is not painless, as it induces a mild slowdown in growth, and real GDP is permanently lowered by 0.6 percent relative to baseline. Reducing capacity in these industries lowers demand for other factors of production (labor and capital) which depresses investment, and reduces labor income, so that consumption falls about 1 percent. The REER depreciates permanently, which encourages exports, allowing some rebalancing between the domestic and external sectors, which is why consumption falls more than real GDP.

20. Demand for tourism and education services by China falls in line with consumption. It falls by about 1.2 percent permanently, while imports decline slightly more. This is reflected in Australia's services exports decline of 1.5 percent, leading to a commensurate decline in the supply of those services.

Figure 3. Upside Scenario 2 – Results for China

(Deviations from baseline scenario)

1. Permanent decrease in CHN commodities production
2. Along with a permanent decrease in CHN steel production



Source: IMF staff calculations

21. Overall, the Australian REER appreciates, and leads to mixed results across the Australian economy (Figure 4). Because Australia is a commodity exporter, and there is a permanent rise in the global commodity price, the REER appreciates by 0.7 percent on impact, and 0.5 percent in the long term. This has a mixed effect on the Australian economy. On one hand, the appreciation dampens all exports. Net commodity exports rise in value, with an increase in supply. However, the supply increase is short lived, as the higher commodity prices crowd out some foreign demand in Australia's other markets. The increased commodity wealth allows for permanently higher consumption, augmented by a cheaper consumption basket, because of the appreciation.

22. In sum, real GDP in Australia is slightly lower, but masks a compositional shift induced by its flexible exchange rate, and a diversified economy. The domestic sector is stronger as it benefits from being a commodity exporter. But Australia's external sector is weakened primarily by its decline in services exports, as China's restructuring is not favorable to domestic consumption.

E. Downside Scenario – A Disorderly Rebalancing in China[5]

***Takeaway**: Although Australia is a diversified economy, it depends on the interaction of its commodities sector with its multiple trading partners, beyond China alone.*

23. China's transition does not go as smoothly as expected. The restructuring of state-owned enterprises (SOES), including the steel industry, is not successful, with a number of firms failing. This manifests itself as a 5-year lower-than-expected path for productivity growth by 1 percent of GDP. This means that real GDP is 5 percent lower in the long term, strictly from the direct productivity effect. Furthermore, the bumpy transition causes a disorderly restructuring of the commodities sector, reducing commodities demand in China by 10 percent permanently. The general economic decline results in lower house prices, reducing housing wealth by 10 percent permanently relative to the baseline scenario, and cutting consumption. The downward effect is exacerbated by a permanent 1 percent increase in the corporate risk premium for SOEs as a result of the needed reform to harden SOE budget constraints, by assumption. The short-term impact is 2 percent as the general economic situation is worse than expected because of the severity of the other shocks.

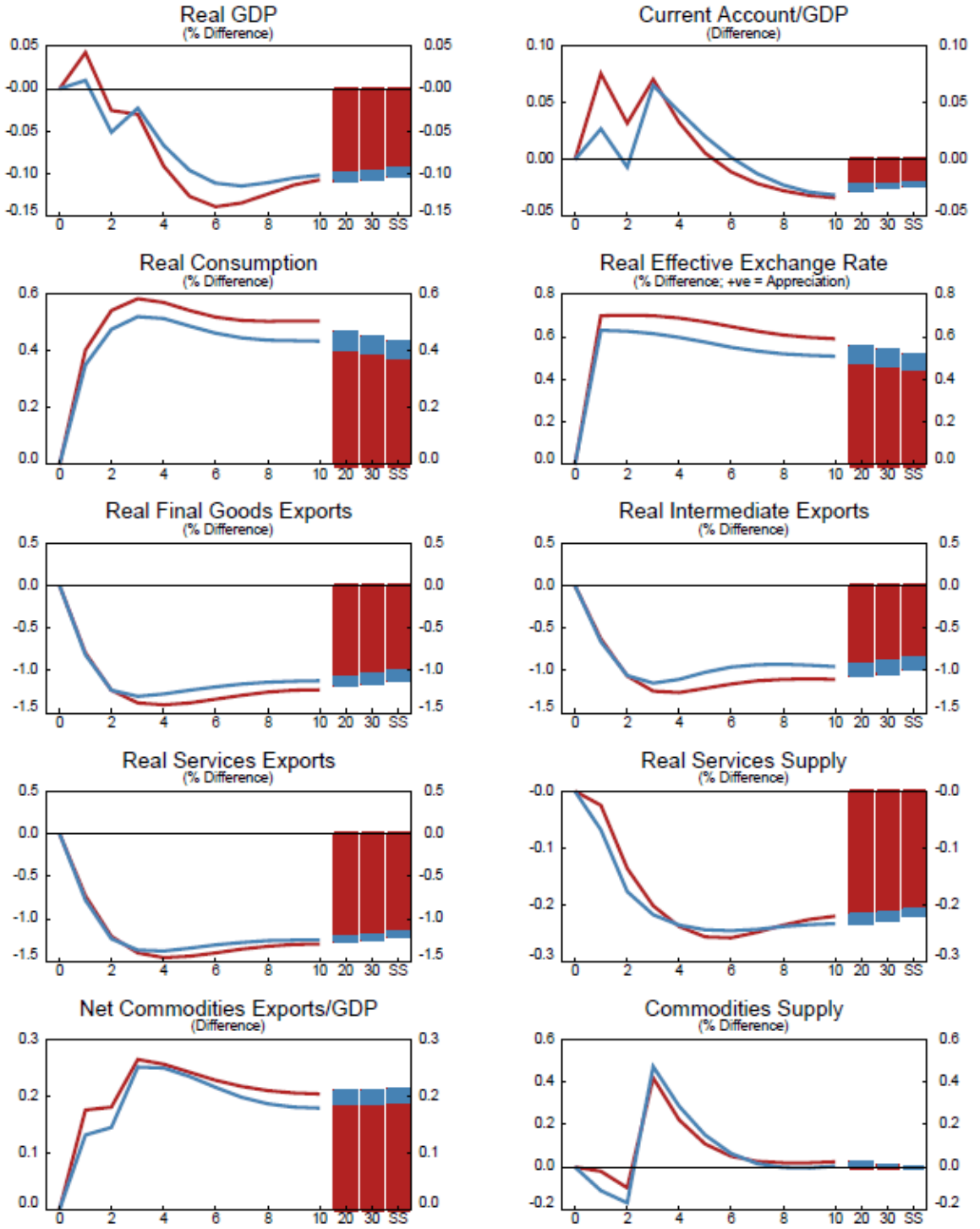
24. In China, real GDP is permanently 10 percent lower (4 percent lower on impact) and there is a widespread growth slowdown across the economy (Figure 5). 60 percent of the decline is attributable to the downward revision in productivity. Consumption falls by the same amount, driven by lower labor income for both saving, and liquidity-constrained, households (as the lower productive capacity reduces firms' demands for both labor and capital), and the negative housing wealth shock. China's REER appreciates, as the fall in productivity leads to more expensive goods for export, reducing foreign demand for their goods. This counteracts any short-term impacts on the REER from capital outflows.

[5] While this scenario is illustrative, the productivity shock in this scenario is broadly in line with the range of possibilities explored in the 2017 China Article IV Staff Report (IMF 2017a).

Figure 4. Upside Scenario 2 – Spillovers to Australia

(Deviations from baseline scenario)

1. Permanent decrease in CHN commodities production
2. Along with a permanent decrease in CHN steel production

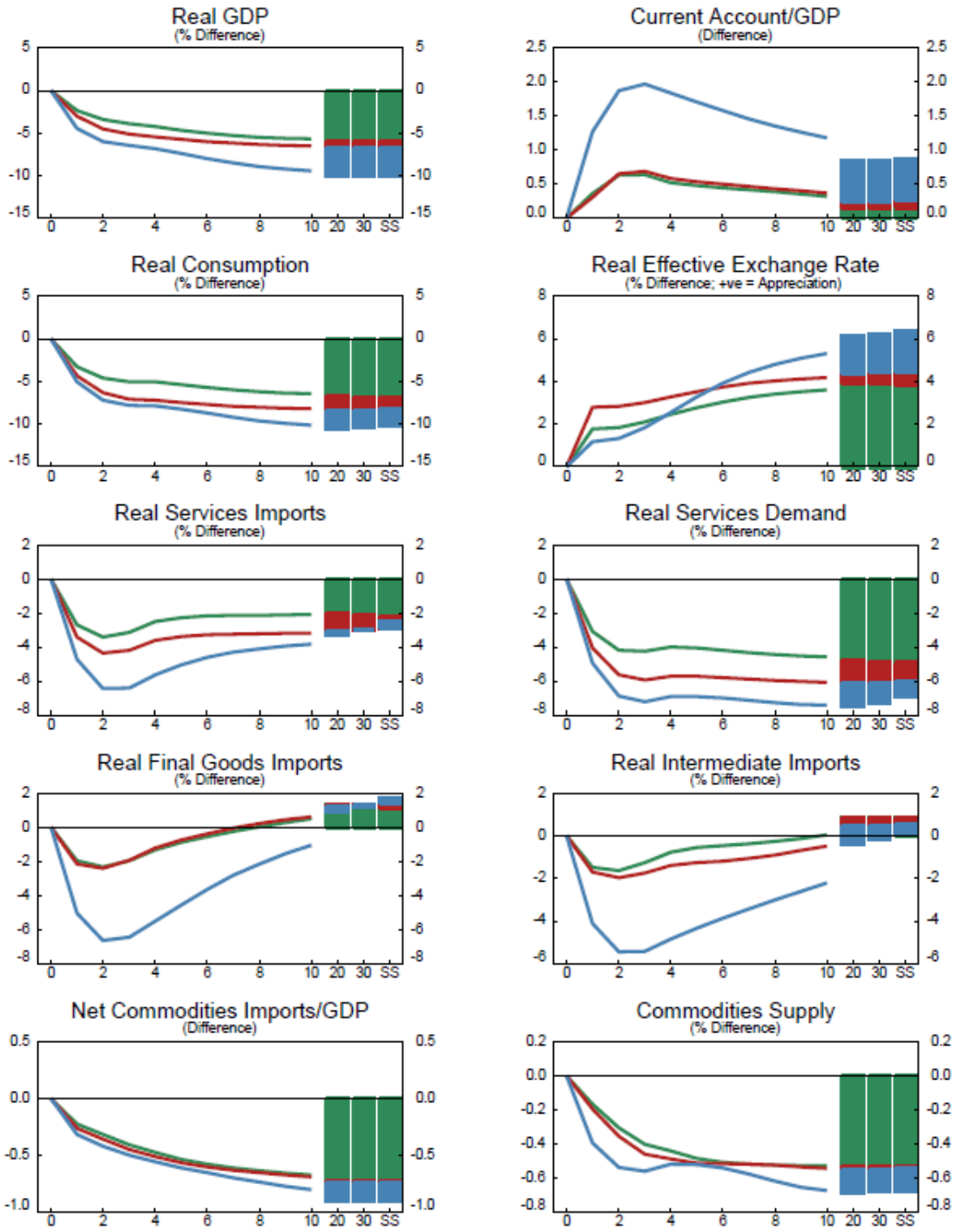


Source: IMF staff calculations

Figure 5. Downside Scenario – Results for China

(Deviations from baseline scenario)

___ 1 and 2. Restructuring in SOEs (especially steel) with a disorderly impact on commodities
___ 3. Coupled with a decline in CHN housing prices (and housing wealth)
___ 4. Exacerbated by a permanent increase in the CHN corporate risk premia (SOEs)



Source: IMF staff calculations

25. Because consumption declines substantially, there is a direct pass-through to tourism and education services, falling by about 10 percent. Imports of these services decline by 6 percent on impact. However, with the appreciating REER, the negative impact is reduced over time, so that services imports are only 4 percent lower after 10 years relative to baseline, and only 3 percent weaker in the long term beyond 10 years.

26. Since the failed restructuring is focused in the steel industry, demand for iron ore and coal is hit directly. Net imports of commodities fall as a share of GDP by 1 percent, despite the offsetting effect of the REER appreciation. This accounts for most of the contraction in demand, although the domestic production of coal and iron ore also declines by about 0.5 percent in the short term. The global price of commodities falls around 12 percent permanently (Figure 7, panel 1). In the long term, domestic commodity supply declines by around 0.7 percent.

27. Australia's outcomes are somewhat mixed, as real GDP falls at first by about 0.4 percent, but then rebounds by an equivalent amount in the long term (Figure 6). In the case of China, real GDP was a sufficient metric for gauging the effects of shocks, but not so for Australia, as the individual sectors exhibit less than straightforward outcomes predicated on Australia's interactions with the rest of Asia. Because of the fall in the global commodities price, and the contraction of Chinese demand, Australian net commodity exports as a share of GDP permanently decline by 1 percentage point in value terms, and its supply declines by 0.7 percent in volume terms. Services exports to China also decline by roughly 3 percent (Figure 7).

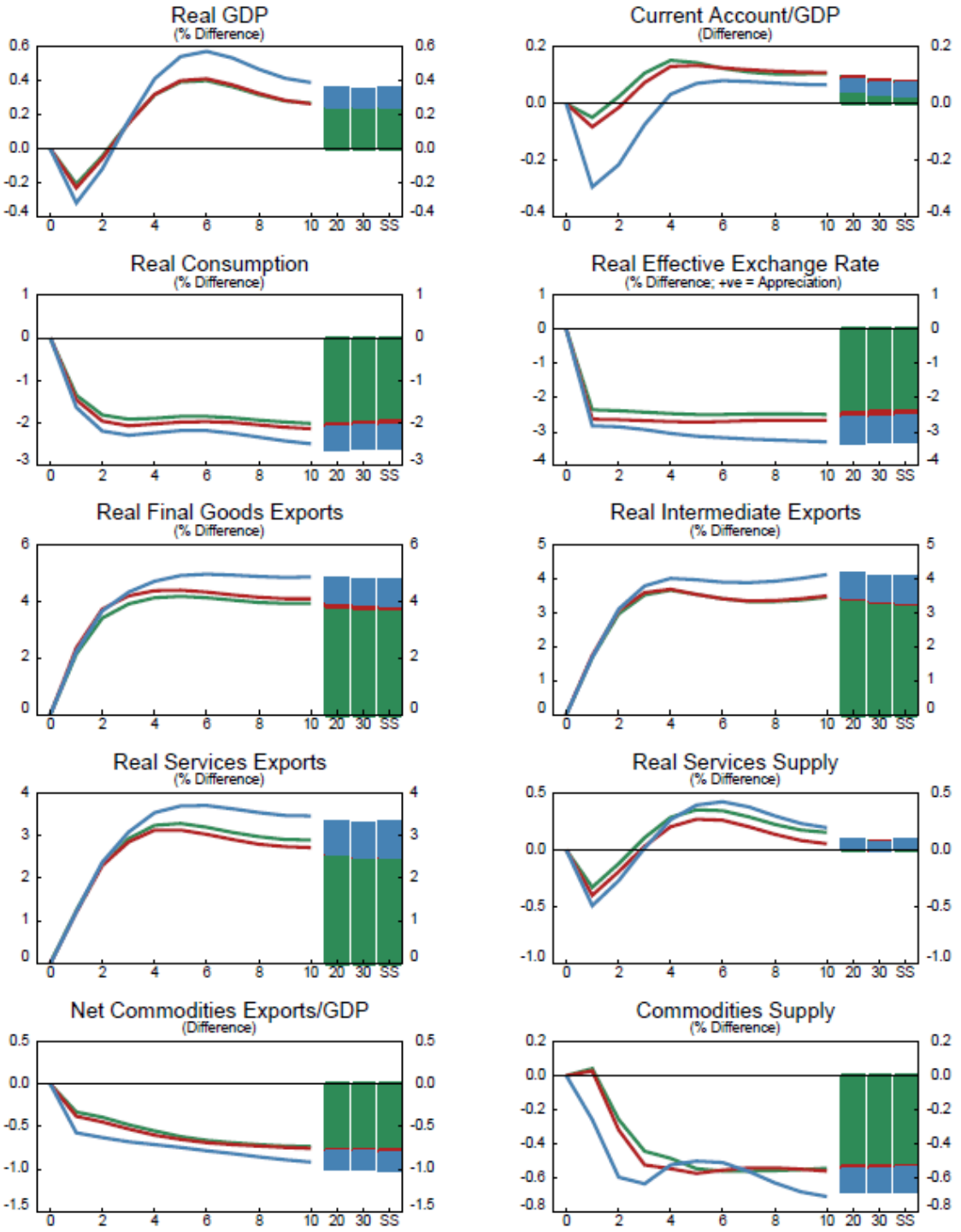
28. Australia's role as a commodity exporter improves its outcomes, as the REER depreciates by 3.5 percent. With weaker global commodity prices, there is a wealth transfer from commodity exporters to importers. Lower wealth in Australia as commodity exporter is exacerbated by the higher cost of imported goods, so consumption is almost 3 percent lower. But the depreciation plays a positive role for Australia as an exporter of a diversified set of goods, and even as a services exporter. Real final goods exports increase by 5 percent, and those of intermediates by over 4 percent in the long term.

29. The linkages between the roles that Australia plays, as both a major commodity and services exporter, are illustrated in Figure 7. The figure compares Australia against its three other trading partners of global importance – emerging Asia, advanced Asia, and the United States. In addition, recall from Table 1 that Australia is the largest commodity exporter, with a net export position of 9 percent of GDP. Therefore, in face of China's downside scenario with its large fall in the global price of commodities (panel 1), Australia sees its commodity exports as a share of domestic GDP decline the most compared to its trading partners (panel 2). This leads to a permanent wealth transfer from commodity exporters (Australia) to importers (also its main trading partners), best measured here by household wealth (panel 3). Australia's loss of wealth (primarily commodities-induced) is only exceeded by China, whose loss is driven by the shocks to productivity and housing wealth. Therefore, Australia depreciates strongly against China, as do Australia's trading partners (panel 4). Taking the cross-exchange rates into consideration, this means that Australia is also depreciating against advanced and emerging Asia and the United States (panel 5). Consequently, Australia's services exports benefit – although its service exports to China decline because of the

Figure 6. Downside Scenario – Spillovers to Australia

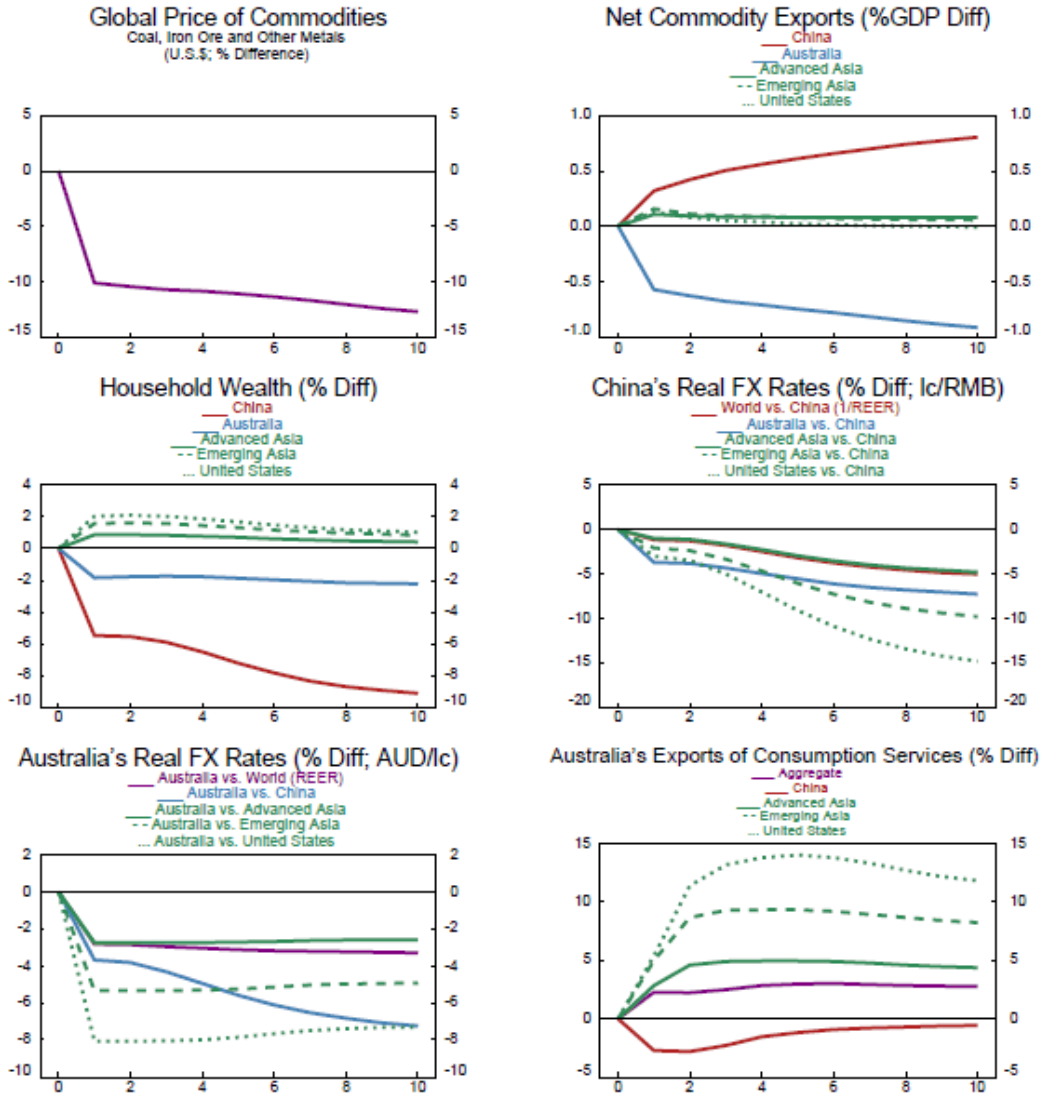
(Deviations from baseline scenario)

___ 1 and 2. Restructuring in SOEs (especially steel) with a disorderly impact on commodities
___ 3. Coupled with a decline in CHN housing prices (and housing wealth)
___ 4. Exacerbated by a permanent increase in the CHN corporate risk premia (SOEs)



Source: IMF staff calculations

Figure 7. Downside Scenario – Interaction of the Commodities and Services Sectors
(Deviations from baseline scenario)



Source: IMF staff calculations

shock in China, its depreciation against its other trading partners makes its services cheaper abroad (panel 6).

30. For Australia's trading partners, especially in the rest of Asia, there are two competing effects which allow for Australia to benefit on net. The first (negative, and weaker) effect is lower Chinese demand for goods. The second (positive, but stronger) effect is the large decline in global commodities prices because of China, which encourages demand for commodities and stimulates GDP in most of the rest Asia as net commodity importers. Other net commodity importers also benefit, with positive spillovers to the rest of Asia.

31. The outcomes of this scenario are conditional on a lack of financial contagion from China, and an unimpeded adjustment of China's REER. A scenario with substantial financial turmoil would dampen an otherwise optimistic outcome for Australia. This said, this scenario outlines qualitatively the intricate decomposed real channels to which Australia responds flexibly.

F. Conclusions

32. Australia and China have strong linkages that are growing over time as China carries on with its economic transition. Trade in commodities and services are constantly growing. Australia has established itself as a dominant player in some key Chinese import needs, particularly for steel. Chinese households also turn to Australia as they increasingly consume abroad (as well as domestically) reflected in both increasing value and volume terms. Outcomes in both countries are heavily dependent on China's continuing transition to a consumer-led, services-driven economy. At the same time, Australia continues to broaden its own services base, and reap the benefits from the aftermath of the commodity price boom that ended around 2011.

33. Scenario analysis based on modifications to China's economic transition was conducted, with the following key takeaways:

- First, the simplest, and most pervasive, takeaway is that while real GDP in Australia experiences only small changes in response to shocks in China, these movements mask much broader movements in the composition of GDP, whether it be between domestic and external demand, or between sectors in the economy.
- Second, a more encompassing analysis of the effects on Australia from these China scenarios, requires a closer understanding the structure of the shocks that are occurring and their ramifications in all sectors within China (as in the case of consumption/saving rebalancing); focusing on the observable outcomes strictly in the sectors that are the source of spillovers to Australia, such as tourism and education flows, or movements in commodities or other trade flows, will render the analysis incomplete.
- Third, once the shock is understood in the context of China, spillovers to Australia should be placed in the context of its relatively diversified economy, and its willingness to accept the moderating influence of its flexible exchange rate and open economy (especially when considering shocks to China's commodities sector).
- Finally, Australia's diversified economy is also reliant on strongly established trading relationships with the rest of Asia, both advanced and emerging countries, not just China alone, which mitigate the effects from widespread shocks to China, as is the case with the downside scenario.

34. The stylized facts also demonstrate that the rest of Asia is increasingly important for Australia. The charts for tourism, education and the destination of exports illustrate that both advanced and emerging Asia already have a growing impact. Table 1 shows that the rest of Asia's trade linkages with Australia are similar in size to the linkages between Australia and China. China may be Australia's largest trading partner, but the rest of Asia is also a rapidly growing region, with potential markets for Australian expansion.

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Annex I. Key Assumptions Underlying the Simulations

Key Model Assumptions for ANZIMF

1. All agents in the model (including households, firms and the fiscal and monetary authorities) have perfect foresight.
2. The model has non-linearities in the financial accelerator, and potential for non-linearities in the conduct of monetary policy by either encountering the zero-interest-rate floor or using monetary accommodation (features not used here). Otherwise, the model is approximately linear for small enough shocks.
3. All countries in ANZIMF have the same economic structures, differing only through their parameterization and calibration.
4. The baseline calibration of ANZIMF is based on parameter values consistent with 2015 for the great ratios to GDP such the capital stock, government debt and deficit, net foreign assets and current account balance, and national accounts aggregates as well as trade flows, and 2015 and 2016 for services data.
5. The real exchange rate is a "jumper," adjusting immediately in the first year to shocks, since it follows the standard forward-looking, risk-adjusted uncovered interest rate parity condition which equates the forward sum of Australia-international interest rate differentials with the one-year in the exchange rate. However, there is no financial friction in the equation required to bring the net foreign asset position to its steady state, as the net foreign asset position and its dynamics solve endogenously as part of the OLG framework.
6. China has a flexible exchange rate, with no capital controls. Capital controls are hard to model in this context, and in the current environment, it is not clear that China would always impose them if there were to be sudden movements in elements of the balance of payments.
7. There are no substantial financial market channels. ANZIMF only has a financial accelerator (albeit using the full general equilibrium form with non-linearities), and assumes complete domestic ownership of firms. All net foreign asset positions are denominated in U.S. dollars, in all countries. Some financial channels could be mimicked by correlated, exogenously-specified shocks.
8. The model is at an annual frequency, so degree of detail for some of the economy's dynamics are lost, particularly in the first year for investment.

Scenario Assumptions

The three scenarios result from shocks originating in China. Australia and the rest of the world interact with spillovers that are either direct, via third countries, or via the global commodities market for coal, iron ore, and other metals.

Upside Scenario 1

This scenario is composed of three separate shocks, where the first two shocks are presented in combination:

1. ***Lower private saving.*** Shift in the preference for private saving for a permanent reduction of 1 percent of baseline GDP, phased in over nine years. This is a permanent reduction in the rate of time preference.
2. ***Higher consumption of services.*** Increase in the household bias to consumption of services over goods over 5 years such that the increase in consumption of imported tourism and education services will be roughly half of the entire increase in aggregate consumption.
3. ***Higher productivity.*** Permanent increase in productivity in the tradable and nontradables sectors such that, in the presence of the reduction in private saving, there is a permanent 1 percent increase in real consumption. It is phased in over 25 years, starting in the sixth year.

Upside Scenario 2

The scenario is composed of two separate shocks:

1. ***Lower commodity supply***. Permanent 5 percent reduction in the domestic supply of commodities. Phased in evenly over 3 years.
2. ***Decrease in steel supply***. The goal is a permanent 10 percent reduction in steel production, translating roughly into -0.4 percent of GDP. Permanent reduction in investment for tradables firms such that their production is lower by 0.4 percent of GDP, including the endogenous decline that occurred by lowering the commodity supply. Phased in over 3 years.

Downside Scenario

The scenario is composed of four separate shocks, where the first two shocks are presented in combination:

1. ***Lower productivity***. Permanent 5 percent reduction in tradables and nontradables productivity. Phased in as a -2 percentage points on productivity growth in year 1, and -1 percentage point on growth in years 2 through 4.
2. ***Lower commodities demand***. Permanent 10 percent reduction in demand for commodities. Phased in, with -4 percentage points in year 1, and -2 percentage points in years 2 through 4.
3. ***Lower housing wealth.*** 10 percent decline on impact in year 1 in nontradable sector net worth, to proxy for the permanent fall in the value of the housing stock.
4. ***Increased corporate risk premia.*** Permanent 1 percentage point increase in the corporate risk premia for both tradable- and nontradable-producing firms after a 2 percentage point increase on impact in year 1.

INFRASTRUCTURE INVESTMENT IN AUSTRALIA: GAPS AND MULTIPLIER EFFECTS[1]

- **There has been an increased emphasis by both the Commonwealth and State governments on spending on infrastructure.** However, it is not clear from a long-term perspective if all of Australia's infrastructure needs are being met.

- **The infrastructure investment gap for Australia is quantified in the *Global Infrastructure Outlook* by Oxford Economics and the G-20.** The report estimates Australia's gap between its current trends and infrastructure needs by 2040. This translates into an average infrastructure investment gap of around 0.35 percent of GDP per year.

- **Closing the infrastructure investment gap is analyzed using ANZIMF (Australia-New Zealand Integrated Monetary and Fiscal model).** It is a version of IMF's GIMF (Global Integrated Monetary and Fiscal model), and is a micro-founded, overlapping generations dynamic stochastic general equilibrium (DSGE) model. ANZIMF's enriched fiscal structure allows for analysis of infrastructure investment based on a variety of sources of funding, including PPPs (public-private partnerships).

- **There can be further gains for the Australian economy from closing the infrastructure gap.** Increasing infrastructure investment has been demonstrated to be productivity-enhancing, with positive economy-wide spillovers; conclusions incorporated into ANZIMF. The long-term real GDP gain can range from 0.4 to 0.7 percent relative to Australia's WEO outlook.

- **The range of outcomes is a result of different forms of financing the additional infrastructure spending by the Commonwealth and/or State governments.** The least productive financing is PIT and/or GST (crowds out consumption) followed by deficit financing (crowds out some private investment, and could increase sovereign risk premia), with PPP as best source, assuming PPPs are carried out fully by the private partner, with their expenses reimbursed by a future income stream.

- **Rather than just closing the infrastructure investment gap by 2040, the government can also use the closure of the gap as a fiscal policy tool.** If the government were to close the gap by 2027 instead, it could generate higher short-term gains in real GDP, without any loss in long-term gains. This would be subject to the ability to quickly scale up the amount of infrastructure investment.

- **Other dimensions can also improve outcomes.** These include better quality infrastructure and a broader definition of infrastructure including human-capital-related infrastructure.

[1] Prepared by Dirk Muir (APD). The chapter benefited from valuable comments by seminar participants at the Treasury of Australia.

A. Introduction

1. There has been an increased emphasis by both the Commonwealth and State governments on infrastructure spending. There is a concerted effort, using advice from government agencies such as Infrastructure Australia (and their State equivalents), to choose projects that have a high level of benefits versus costs. However, it is not necessarily clear from a long-term perspective if all of Australia's infrastructure needs are being met. This paper reports on the current and projected infrastructure investment gap for Australia, using the analysis of Oxford Economics, for the Global Infrastructure Hub. Moreover, given the magnitude of the gap, this paper demonstrates that there can be further gains in terms of growth in the near- and medium-term that can be achieved by fully closing said gap, using the IMF's ANZIMF (Australia-New Zealand Integrated Monetary and Fiscal model).

2. The extent of the infrastructure investment gap is an important question, because it represents foregone gains in productivity that would allow for higher growth. There is an extensive literature that has demonstrated this theoretically (Aschauer, 1989), empirically (Bom and Ligthart, 2014) and through model simulation and consideration of fiscal policy (Abiad and others, 2016). Much of the literature generally concludes that infrastructure of sufficient quality and quantity can improve the quality of the workforce, the provision of capital, and firms' access to domestic and foreign markets. Interconnectivity is particularly important in a geographically distant and large country like Australia, with concentrated but dispersed population nodes on east, south and west coasts (all the major cities except Canberra), and without any neighboring countries on land with which to trade. Governments can have an important role to play in closing the gap, or encouraging the private sector to do so.

B. A Baseline for the Infrastructure Investment Gap

3. The Global Infrastructure Hub is the primary source for the baseline infrastructure investment gap. It is a G-20 initiative, that has published a *Global Infrastructure Outlook* authored by Oxford Economics.[2] It forecasts current trends and needs for infrastructure investment until 2040 (a 25-year period, starting in 2016), deriving the infrastructure investment gap from calculating needed spending less spending based on current trends for seven sectors – roads, rail, airports, ports, electricity, telecoms and water – for 50 countries, comprising over 85 percent of global GDP. These seven sectors are only a subset of the standard definition of government investment in fixed capital in the national expenditure accounts, as it excludes structures (such as hospitals, police stations, schools, and the like) and capital equipment (for example, ambulances and police cars, and military equipment).

[2] The report is the flagship publication for the Global Infrastructure Hub based in Sydney, Australia, and found on-line at https://www.gihub.org/. The report's author is a private, global economics consulting firm, focusing on macroeconomic forecasts, Oxford Economics. Oxford Economics and the Global Infrastructure Hub, *Global Infrastructure Outlook: Infrastructure Investment Needs, 50 Countries, 8 Sectors to 2040*, can be found at https://outlook.gihub.org/ (for the database) and https://gihub-webtools.s3.amazonaws.com/umbraco/media/1529/global-infrastructure-outlook-24-july-2017.pdf (for the report itself).

4. Current trends and needs for the future are determined from extensive calculations. Current trends for infrastructure investment extrapolate spending trends to 2040 through a thorough analysis of the data for each country, combined with regression analysis for each of three groups of countries (low and lower middle income, high middle income, and high income, of which Australia is a member). Infrastructure needs are computed for each of the seven sectors so that a country will match the 75th percentile of current trends infrastructure stock per capita in their income group, adjusted for quality considerations. Box 1 gives a more detailed explanation of the methodology.

Box 1. The Six Step Methodology of the *Global Infrastructure Outlook*

1. Compute the seven infrastructure stocks on a per capita basis for 2015 for all the countries in an income group (such as the high-income group, to which belongs Australia.

2. Estimate single-equation models for each of the seven sectors using panel estimation, with a set of explanatory variables usually drawn from a subset of GDP per capita, the manufacturing and agricultural shares of GDP, population density, and the urban share of population, plus country-specific fixed factors.

3. Given the forecasts of the explanatory variables, forecast infrastructure stocks per capita to 2040. These are then converted using perpetual inventory equations of the form $K_t = K_{t-1}(1-\delta) + I_t$ to calculate the ***current trend investment*** for each of the seven sectors.

4. Using the single-equation models, estimate what the value of the stocks should have been in 2015 given explanatory variables, to compute the expected infrastructure stock per capita.

5. Using the infrastructure quality measures for each country (from the World Economic Forum's *Global Competitiveness Report 2014-15*), derived a quality-adjusted expected infrastructure stock per capita.

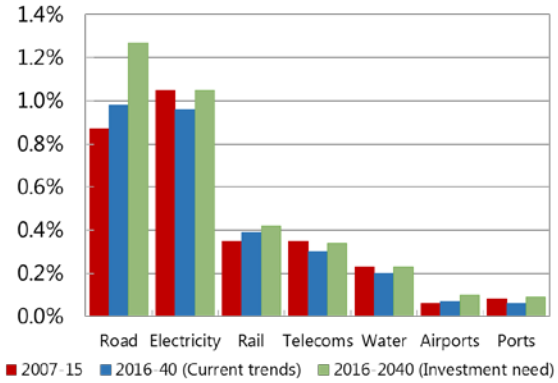
6. Compare the quality-adjusted expected infrastructure stock per capita across countries in a country grouping, to determine the 75th percentile, from which comes for each country, in combination with the perpetual inventory equation, its *investment needs*.

Infrastructure investment gap *= investment needs – current trends in investment*

5. The global infrastructure investment gap is estimated at 2015 US$94 trillion between 2016 and 2040. [3] This is a gap of 19 percent against the current trend investment in infrastructure extrapolated to 2040, an average of 2015 US$3.7 trillion per year. It implies that global infrastructure investment spending as a share of GDP should be 3.5 percent, versus 3.0 percent now. All seven infrastructure sectors have higher needs than current trends, roads being the greatest (Figure 1).

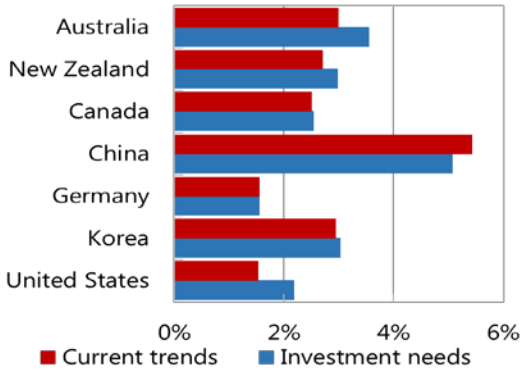
[3] Values in level terms are in constant 2015 U.S. dollars, abbreviated as 2015 US$.

Figure 1. Global Infrastructure Needs versus Trends and Historical Averages
(Percent of global GDP per year)



Source: *Global Infrastructure Outlook*, Oxford Economics

Figure 2. Australia's Infrastructure Needs versus Comparators
(Percent of GDP per year)



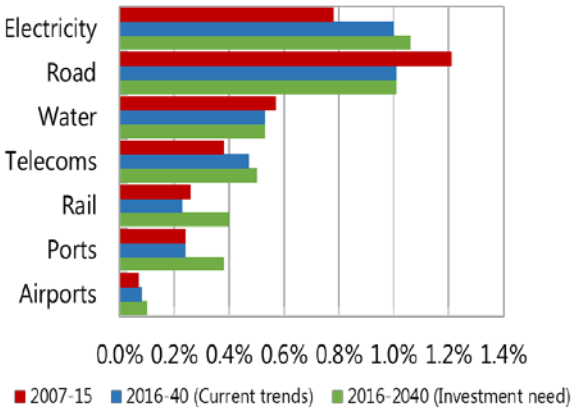
Source: *Global Infrastructure Outlook*, Oxford Economics

6. Australia has a small gap, but not relative to many other advanced economies. According to the *Global Infrastructure Outlook,* Australia's overall gap from 2016 to 2040 is 10 percent of GDP, implying cumulative infrastructure investment needs of 2015 US$1.7 trillion, versus the current cumulative trend spending of 2015 US$1.54 trillion. This translates into additional infrastructure investment spending of almost 0.4 percent of GDP per year until 2040, similar in scope to New Zealand, but larger than other key advanced economies and China (Figure 2).

7. Australia's infrastructure investment gaps for the seven sectors differ from the global picture (Figure 3). There has been extensive investment in roads, and current trends continue to indicate this to be the case, matching the investment needs. Stronger needs exist in the rail and ports sector, since Australia historically has had weak rail linkages (due to great distances with little population inland). It is reliant on sea transportation to connect its major (coastal) population centers, as well as maintain its ever-growing trade linkages with China and the rest of emerging Asia. There is also a recognized need to upgrade and expand the power grid, although not all investment needs are being met by the current trends.

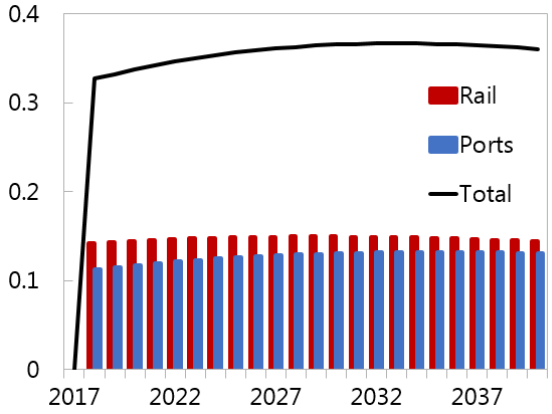
8. An aggregate infrastructure investment gap as a share of GDP is constructed from 2018 to 2040 (Figure 4). It uses the forecasts for GDP from the IMF's *World Economic Outlook, April 2017* (WEO) and infrastructure investment from the *Global Infrastructure Outlook*. The increased spending in the FY2016/17 fiscal outcomes and FY2017/18 fiscal budgets are roughly consistent with closing the gap in 2016 and 2017, so the gap used here is zero in 2016 and 2017. The gap from 2018 forward for Australia differs slightly from that of the *Global Infrastructure Outlook* as nominal GDP growth is more variable in the WEO until 2023, and then slightly higher afterwards. The two most important gaps are in rail (just over 0.1 percent of GDP year) and ports (almost 0.15 percent of GDP per year).

Figure 3. Infrastructure Components for Australia
(Percent of GDP, per year)



Source: *Global Infrastructure Outlook*, Oxford Economics

Figure 4. Infrastructure Investment Gap for Australia
(Percent of GDP)



Sources: *Global Infrastructure Outlook*, Oxford Economics and IMF staff calculations

C. Benefits from Closing the Infrastructure Investment Gap

9. There are benefits to closing the gap for Australia. The closure of this gap would be driven by both the Commonwealth and State/Territorial levels of government. Furthermore, participation can be extended to the private sector. These benefits can be quantified with the help of ANZIMF, which a version of the IMF's GIMF (see Box 2 for further details).

10. Any additional infrastructure spending requires funding. The type of funding is the choice of the Commonwealth and/or the State/Territorial governments. There are three feasible choices for financing – increasing the deficit, using funds from general revenues, or relying on private sector funding through public private partnerships (PPPs).

- ***In the case of deficit financing,*** the appropriate government level (Commonwealth or State) would borrow to finance their expenditures, through its standard mechanisms, and the resulting deficit spending would increase the level of debt permanently
- ***In the case of funding from general revenues***, the most logical approach would be to further increase taxes – either one of, or some combination of, the personal income tax (PIT) if the funding is to come from the Commonwealth level, or the goods and services tax (GST) if the funding is to come from the State/Territory level. Given the division of responsibilities, the Commonwealth could also provide funding for the State/Territory level, by transferring additional funds to the States, likely using National Partnerships.

Box 2. ANZIMF – The Australia-New Zealand Integrated Monetary and Fiscal Model

ANZIMF is an annual, multi-region, micro-founded general equilibrium model of the global economy. It is based on the IMF's Global Integrated Monetary and Fiscal model (GIMF), with supporting documentation that is broadly applicable to ANZIMF (Kumhof and others 2010 and Anderson and others 2013). Structurally, each country/regional block is close to identical, but with potentially different key steady-state ratios and behavioral parameters. This exercise focuses on Australia, and the fiscal block.

Consumption dynamics are driven by saving households and liquidity-constrained (LIQ) households. Saving households face a consumption-leisure choice, based on the overlapping generations (OLG) model of Blanchard (1985), Weil (1989) and Yaari (1962) where households treat government bonds as wealth since there is a chance that the associated tax liabilities will fall due beyond their expected lifetimes, making the model non-Ricardian and endogenizing the long-term determination of the real global interest rate to equilibrate global savings and investment. The real exchange rate serves to adjust each country's saving position (its current account and associated stock of net foreign assets) relative to the global pool. LIQ households cannot save, consuming all their income each period, amplifying the model's non-Ricardian properties in the short term.

Private investment relies on the Bernanke-Gertler-Gilchrist (1999) financial accelerator. Investment cumulates to the private capital stock for tradable and nontradable firms, which is chosen by firms to maximize their profits. The capital-to-GDP ratio is inversely related to the cost of capital, which is a function of depreciation, the real corporate interest rate, the corporate income tax rate, and relative prices, and an endogenously determined corporate risk premia.

Government absorption consists of exogenously determined spending on consumption goods and infrastructure investment. Both affect the level of aggregate demand. In addition, spending on infrastructure cumulates into an infrastructure capital stock (subject to constant but low rate of depreciation). A permanent increase in the infrastructure capital stock permanently raises the economy-wide level of productivity. The calibrated output elasticity of public capital is 0.122 (Bom and Ligthart, 2014).

Trade is tracked bilaterally between all regions. There are flows for goods, services, and commodities, and they react to demand, supply and pricing (i.e. the terms of trade and bilateral real exchange rates) conditions. Commodities trade, and its related demand and supply equations, are based on coal and metals.

The nominal side of the economy depends on implicit Phillips' curves and monetary policy. The core price is the consumer price index, CPI, while relative prices mimic the structure of the national expenditure accounts. There is also wage inflation, which is implicitly a key driver for CPI inflation. In the short term, the nominal side of the economy is linked to the real side through monetary policy, which is conducted under a CPI inflation targeting regime, where with an interest rate function returns expected inflation to target over several years.

Fiscal policy is driven by a sufficiently detailed government sector that can reproduce simplified fiscal accounts for each country. Fiscal policy aims to maintain a debt target (expressed in flow space as a deficit target) using at least one of seven policy instruments. On the spending side, these are government consumption, spending on infrastructure spending, general lumpsum transfers to all households (such as pensions, aged care provisions, unemployment insurance) and lumpsum transfers targeted to LIQ households (such as welfare, certain pensions). On the revenue side, there are taxes on consumption (the goods and services tax, GST), personal income (PIT) and corporate income (CIT).

Box 2. ANZIMF – The Australia-New Zealand Integrated Monetary and Fiscal Model (concluded)

The government does not have to be the sole supplier of infrastructure investment. Nontradable firms can also divert some of their investment into the infrastructure capital stock, but it will still register in the national expenditure accounts as private business investment. These are assumed to be PPP funds, which will be repaid later through a future revenue stream. However, these do not appear explicitly in the model, since it is merely a circular reshuffling of a user fee from households to firms, which would return to household, as they own the firms. The government can also provide equity investment injections into the private sector, which will then be converted by firms over some pre-determined time horizon into private business investment, that will contribute to the infrastructure capital stock rather than the private business capital stock.

- ***In the case of PPPs,*** the assumption is that competitively-tendered private sector firms would be responsible for building the project, and covering the costs of construction. Furthermore, these firms would recoup their costs through a commitment of a future revenue stream from the resulting infrastructure, such as an airport improvement tax levied on air passengers, or road tolls levied on drivers. It is also assumed that the infrastructure would be government-owned, but maintained by the private sector. This minimizes the risks usually associated with PPPs, which if they were more costly or inefficiently implemented would reduce the real GDP gain (see, for example, Corbacho and Schwartz, 2008).

11. There are limitations to using model simulations to capture the economic outcomes from closing an exogenously specified infrastructure investment gap. First, most importantly, there is uncertainty as to quantification of the pass-through of infrastructure investment and stock to productivity growth. Second, and most obviously, whatever caveats are part and parcel of ANZIMF are limitations of this analysis, such as the under-responsiveness of trade flows (common to many DSGE models). Third, the methodological concerns for constructing the gap itself can produce misleading results if the gap is quantified incorrectly.[4] Finally, because closing the gap will stimulate the economy, it will also increase GDP which would affect somewhat the demand for infrastructure, changing the investment needs, and hence the infrastructure investment gap – an effect that is ignored here, but may not be too important given Australia's small gap.

12. Current infrastructure spending by the Australian governments is still consistent with the forecast of the gap used here. The *Global Infrastructure Outlook* dataset was built contemporaneously with the FY2015/16 budget paths. The fiscal budgets in FY2016/17 and FY2017/18 increased those years' spending on average 0.4 percent of GDP, closing the gap for those two years. However, the FY2017/18 budgets do not appear to sustain these increases past FY2019/20.

[4] These can found in the *Global Infrastructure Outlook*, pp. 179-180. The most interesting concern, conceptually, is that technological innovations over the forecast could fundamentally change the role and provision of infrastructure.

13. Figure 5 illustrates the effects of closing the Australian gap. It shows the first 10 years (using lines) followed by snapshots for the end-point at 2040, and the long-term steady-state result from maintaining the new higher level of the infrastructure capital stock (using vertical bars). There are four variants for financing the closure of the gap: deficit financing by the Commonwealth and/or the States and Territories (blue line and bars); full financing by the Commonwealth using PIT (red line and bars); 50/50 financing by the Commonwealth and the States and Territories, using PIT and GST, respectively (green line and bars); and funding by PPPs exclusively (purple line and bars).

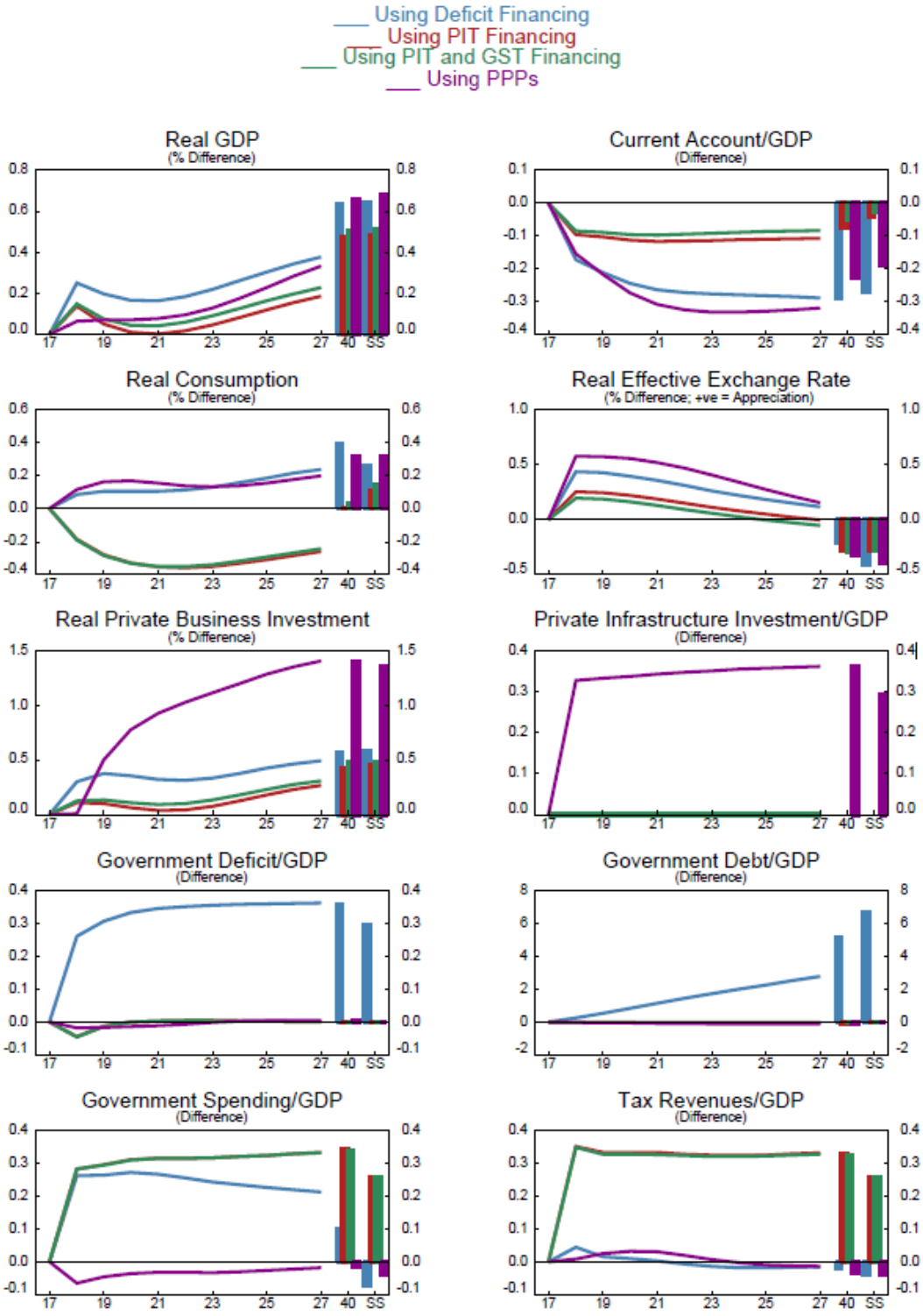
14. In the long term, real GDP would be as much as 0.7 percent higher than otherwise, for a long-term multiplier of about 2. The small gain reflects that Australia's gap is small. With higher productivity, there is a slight long-term depreciation in the real effective exchange rate, allowing for stronger exports. Even though imports cost more, consumption is still between 0.1 to 0.4 percent higher in the long term. Higher infrastructure level means a permanent increase in the level productivity, passing to the level of labor demand and therefore wages and labor income, as well as demand for capital and therefore private business investment. Firms would have more income, and would be a source of further wealth to households, their owners, further stimulating consumption. However, there are variations among the four types of funding.

15. Deficit financing and PPP funding would provide the greatest gains. In the short term, deficit financing would be most advantageous, but it would be exceeded slightly by PPP in the long term, as PPP funding would prevent the government from facing a permanent 6.5 percent increase in the government debt to GDP ratio, which would slightly crowd out private business investment, offsetting some of the productivity gain from the additional infrastructure investment. However, the cumulative deficits required over the 25 years are closer to 9.6 percent of GDP, meaning that the additional growth from infrastructure investment reduces the government debt to GDP ratio in the long term by 3.1 percentage points. Both types of funding increase demand for private saving flows, some of which come from abroad, leading to a current account deficit. In the short term, this leads to an appreciation of the real effective exchange rate, until the economy-wide productivity gains are large enough to lead to a long-term depreciation.

16. Financing with PIT and/or GST would be less beneficial and reduce GDP gains. Such taxation would be a drag on consumption, especially during the initial phases of closing the gap, as LIQ households would adjust their spending downwards immediately. Using PIT financing alone would reduce the gains accruing to the economy the most, as it PIT not only reduced consumer buying power, it taxes a factor of production directly, and reduces labor productivity, counteracting some of the gains from the additional infrastructure investment. Overall, there is less demand for foreign financing – what remains is driven by borrowing for consumption, offset by weaker investment. Therefore, there is less of a short-term appreciation of the real effective exchange rate.

Figure 5. Closing the Baseline Infrastructure Investment Gap by 2040

(Deviations from WEO-consistent forecasts)

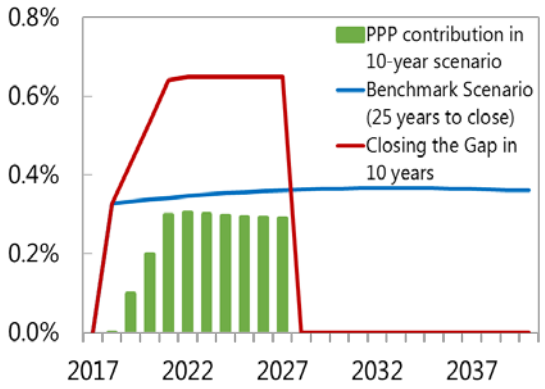


Source: IMF staff calculations

D. Closing the Gap as a Tool for Fiscal Policy

17. Closure of the infrastructure investment gap can be used as tool to further fiscal policy goals. If governments decide to close the gap, they could alter its timing to maximize the benefits in the short term, although long-term benefits would remain unchanged, as doing more than closing the gap would presumably accrue few extra benefits. Instead of closing the gap over 25 years, the governments could choose to help kick-start short-term growth by closing the gap in 10 years (Figure 6). Two cases are considered. First, there is the deficit-financing case (red line alone). However, governments would have to increase their debt load more quickly under this case, and this may pose a risk to credit ratings, and could impose additional sovereign risk premia. Therefore, the second case has the government maintain the same deficit financing path over 10 years as with the 25-year path, but adds in additional financing (red line with green bars). In both cases, it is assumed that moving from roughly 0.3 percent of GDP to 0.7 percent of GDP for infrastructure cannot be done easily (because of procurement processes, for example), so it is phased in over four years.

Figure 6. Infrastructure Investment Gaps for Fiscal Policy



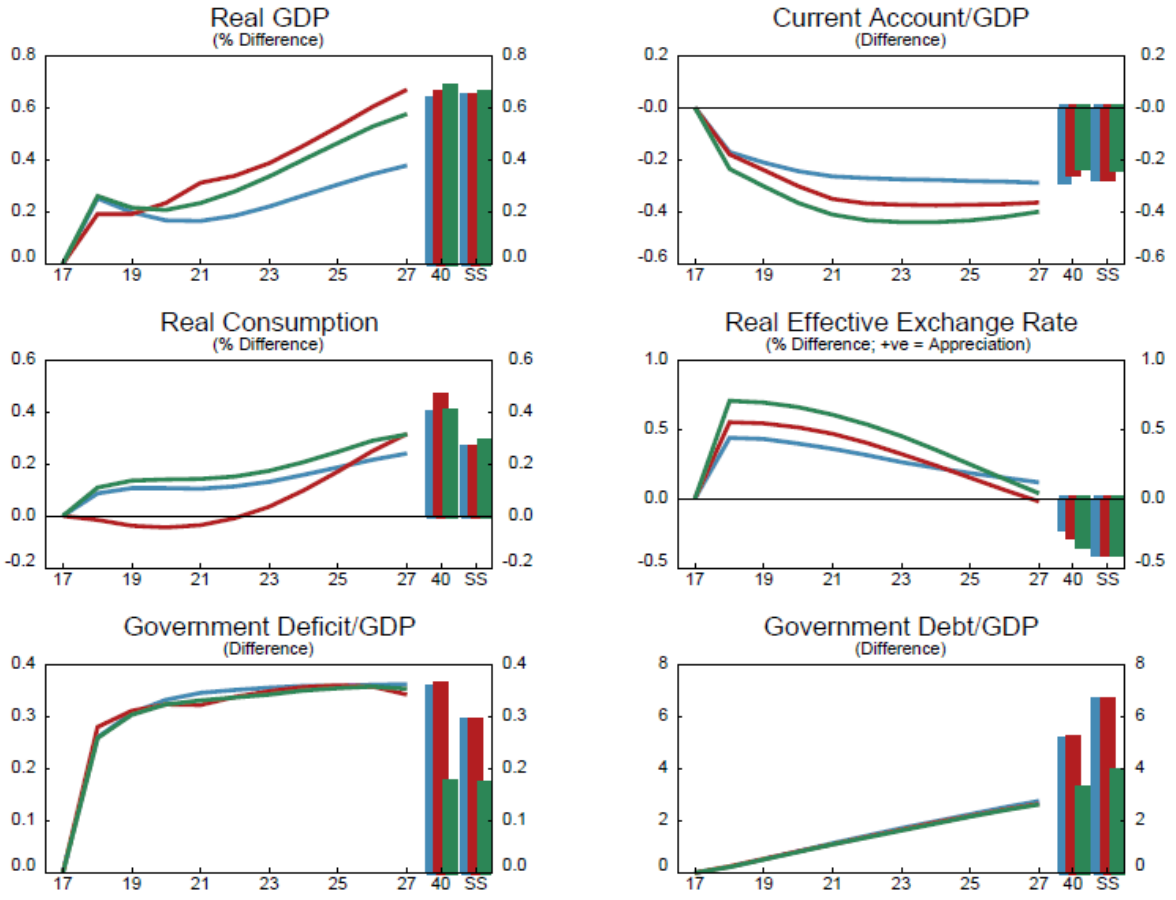
Sources: Global Infrastructure Outlook, Oxford Economics, and IMF staff calculations

18. Figure 7 illustrates the effects of making different fiscal policy choices. There is the benchmark scenario (blue line and bars), the 10-year scenario with deficit financing only (red line and bars), and the 10-year scenario with both deficit financing and PPP funding (green line and bars). The long-term real GDP gains around the same as in the benchmark scenarios, at 0.8 percentage points. The one notable long-term difference is for government debt – if the government uses PPPs to fund part of the infrastructure build-up when choosing to close the infrastructure gap more quickly, it only accumulates 4 percent of GDP in debt, instead of 6.5 percent of GDP.

19. By shortening the time horizon, economic gains are moved forward, and there is much more fiscal stimulus in the short term. Real GDP lifts much more rapidly in the short term, adding twice as much to growth over the first 10 years relative the benchmark scenario. Consumption also lifts more strongly. However, if the government does it solely through deficit financing, there is greater crowding out of private business investment in the first several years, also leading to crowding out of labor demand and income, and therefore consumption. If the additional funding (relative to the benchmark scenario) is provided by PPPs, then there is no additional crowding out, and consumption can rise more strongly in the first five years, before moderating. Under both forms of financing, there is increased demand for foreign financing through the current account, leading to

Figure 7. Closing the Infrastructure Investment Gap as Fiscal Policy
(Deviations from WEO-consistent forecasts)

___ Benchmark Scenario (Deficit Financing)
___ Closing the Gap within Ten Years (Deficit Financing)
___ Closing the Gap within Ten Years (Deficit Financing and PPP Funding)



Source: IMF staff calculations

a stronger short-term appreciation, although the permanent productivity effects still lead to a long-term depreciation of the real effective exchange rate. Overall, changing the speed at which the gap closes can provide short-term benefits to growth, and fiscal policy can provide a more prominent role in short-term demand management, but with productive spending ensuring long-term gains.

20. In practice, changing the horizon for fiscal policy implementation requires careful planning and consideration. It may not be possible to reduce some projects to a shorter horizon, such as the ten-year example above, such as the western Sydney airport project. If the economy is already in an expansionary phase, it may be difficult to attract the resources, whether under the aegis of government or PPPs, required to carry out the investment. However, as of 2017, Australia still has spare capacity in its labor and capital markets, and is mostly likely to be able to absorb the needs of a faster expansion of infrastructure investment.

E. Other Considerations When Closing the Gap

21. Other infrastructure-related factors can augment the productivity of the economy when closing the infrastructure investment gap. First there is the issue of the quality of the infrastructure that is produced by the investment. Second, the broader definition of infrastructure can also be considered, which includes structures and other investments (as outlined at the beginning of Section B).

22. Two alternative scenarios are designed based on these issues. The outcomes from these alternative scenarios are only rough approximations, as they are complicated to implement within the extensive framework used to calculate the gap derived from the *Global Infrastructure Outlook* (recall Box 1 for the methodology used to calculate the baseline gap, and see Box 3 for the methodologies in detail used for the two alternative scenarios outlined below).

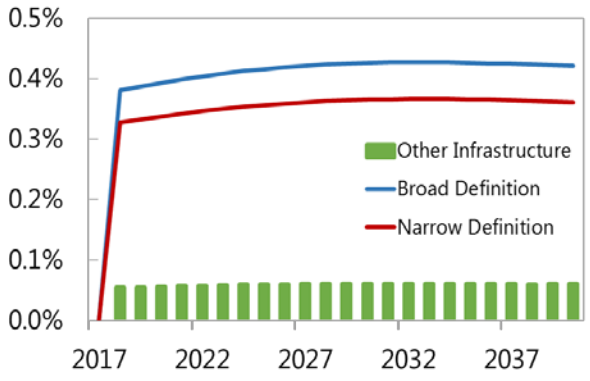
- ***Alternative Scenario 1*** assumes that that Australia achieves the quality of infrastructure found in one of the leaders of the high-income group, Singapore. In this case, the infrastructure investment gap is unchanged, as is the spending is required to close it, but Australia experiences greater gains because of better quality outcomes from better use of funds and (presumably) better technology (quality scores are in Table 1).
- ***Alternative Scenario 2*** assumes a broader definition for the infrastructure investment gap that includes the rest of infrastructure capital outside of the seven sectors examined thus far. The broader definition of the gap is presented in Figure 8. Note that the difference between the red line (the baseline gap, or the narrow definition) and the blue line (the broad definition) is the gap resulting from the needs for the rest of infrastructure investment (the green bars).

Table 1. Infrastructure Quality Scores
(Range of 1 to 7; 7 is best)

	Australia	Singapore
Energy	5.7	6.9
Airports	5.2	6.9
Ports	4.9	6.7
Rail	4.1	5.9
Roads	4.1	6.3

Sources: *Global Competitiveness Report, 2017-18*

Figure 8. Infrastructure Investment Gaps
(Percent of GDP)



Sources: *Global Infrastructure Outlook*, Oxford Economics, and IMF staff calculations

23. Figure 9 below compares the scenarios. The first and second alternative scenarios are the red line and bars, and the green line and bars, respectively, while the benchmark scenario is the blue

line and bars. For ease of comparison, only the case of deficit financing is considered. The differences between the alternative and the benchmark scenarios would be roughly the same under other variants for funding the gap.

24. Australia can experience further gains under both alternative scenarios. If the quality of the newly-built infrastructure is higher than in past, then the productivity gain for the economy is larger, leading to real GDP being almost 0.9 percent higher in the long term, an additional gain of almost a third over the benchmark scenario. Similarly, the broader definition of infrastructure investment leads to real GDP being 0.8 higher in the long term, a gain of about a quarter over the benchmark scenario case. Most of the effects on the economy are the qualitatively the same as the benchmark scenario, but quantitatively amplified. There is one exception – the gains under the scenario with higher-quality investment does not incur any additional government spending, and consequently does not require any additional government debt. When the broader definition of infrastructure investment is considered, the crowding out effect of government debt will be amplified, including a weaker current account, and slightly lower GDP in the short term relative to even the benchmark scenario.

Box 3. Methodologies for the Alternative Scenarios

Alternative Scenario 1

In order to move Australia's infrastructure capital stock contribution up to the same level as Singapore, a "conversion factor" is built using the Singaporean and Australian quality scores from the World Economic Forum's *Global Competitiveness Report 2017-18*. the conversion factor is the weighted sum of the ratio of Singapore quality score to than of Australia one for each of five sectors (energy, airports, ports, rail, and roads), where the weights are based on the average share of each sector in Australia's infrastructure capital stock. It is assumed that the conversion factor is also valid for the water and telecommunications sectors. The conversion factor of 1.38 is then multiplied with the coefficient which governs the pass-through of new infrastructure capital into Australian productivity. The new value of the pass-through coefficient is then used to simulate the first alternative scenario, with its results presented in Figure 9. Note that these results are probably the upper limit from quality improvements, as the construction of the pass-through coefficient assumes that a percentage change in quality maps directly into a percentage change in the effect on productivity growth.

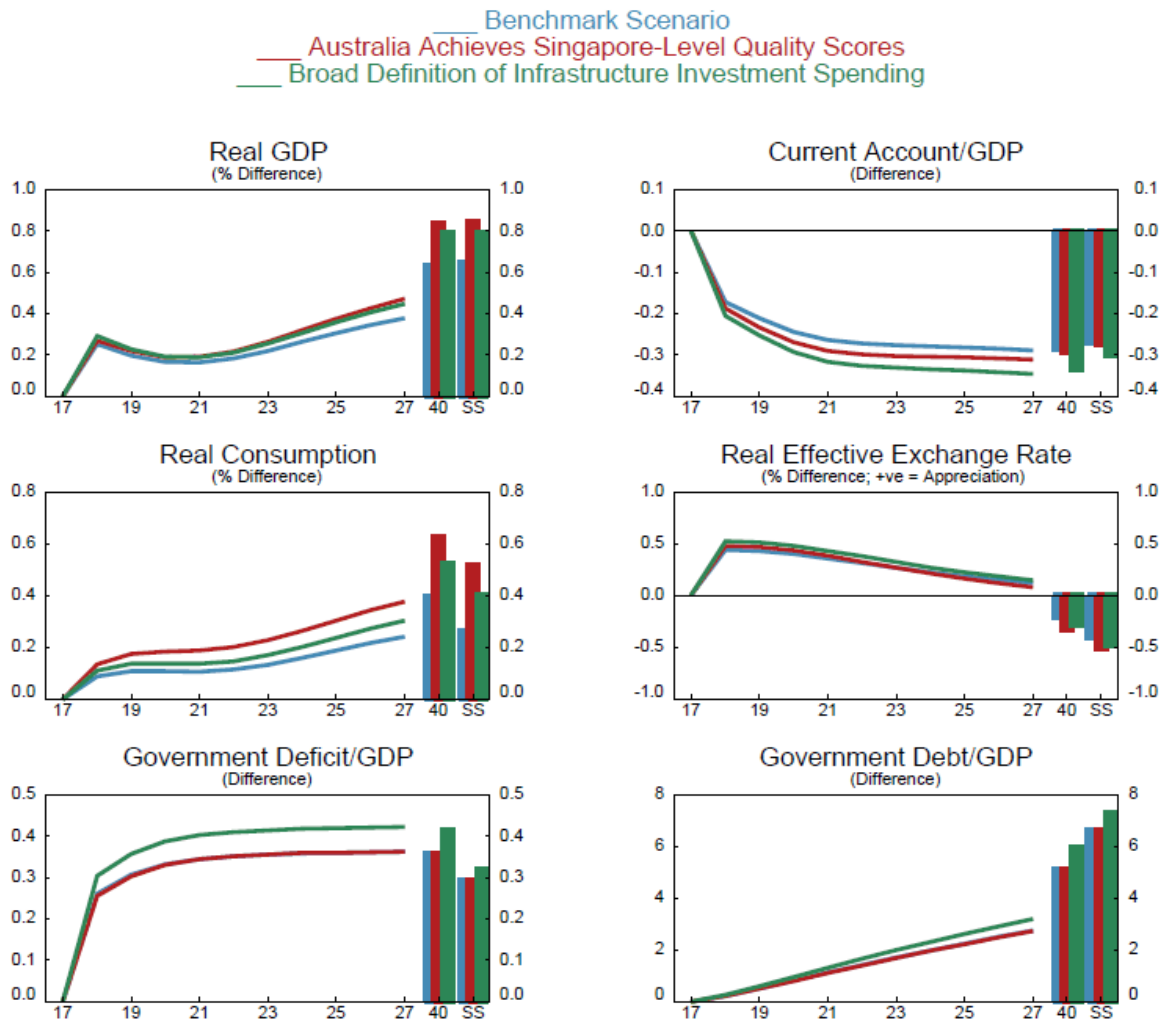
Alternative Scenario 2

A broad definition of the infrastructure investment gap is constructed, expanding from the narrow definition using the seven sectors to include structures and other minor inputs (but still excluding military infrastructure). First, the narrow definition of the gap is adjusted for the fact that the broad definition is consistent with an average depreciation rate of 4 percent rather than 5 percent (structures have a lower rate of depreciation than the seven sectors). Then the adjusted gap is further transformed by multiplying it by the ratio of the IMF WEO's long-term forecast of broad infrastructure investment in Australia (roughly 4.2 percent of GDP) to the narrow definition of the current trends infrastructure investment (roughly 3.5 percent of GDP). This is the broad definition of the infrastructure investment gap used to simulate the second alternative scenario, with its results presented in Figure 9. As with the first alternative scenario, the results are probably the upper limit from the broader definition of the capital stock, as it assumes the infrastructure investment needs and current trends in infrastructure investment are directly scalable based on the WEO-based flows used for the broad definition.

F. Conclusions

25. **Summary.** There has been high quality work done to quantify the infrastructure gap for Australia by Oxford Economics on behalf of the Global Infrastructure Hub, drawing on international experiences and local data sources. What is done in this paper is to provide further information about the effects of closing the infrastructure gap on the Australian economy. Closing the gap has quantifiable benefits, not just because it is a short-term stimulus to aggregate demand, but because of longer-lived effects on productivity in the economy, benefiting all sectors of the economy.

Figure 9. Alternative Scenarios for Closing the Infrastructure Investment Gap
(Deviations from WEO-consistent forecasts)



Source: IMF staff calculations

26. The form of funding for the additional spending matters. While there are economic gains in all cases, the magnitude of those gains depends on whether the spending uses debt (either public government debt which crowds in net foreign liabilities, or PPPs that either acquire net foreign liabilities directly, or crowd them in elsewhere in the economy as they draw on domestic resources) or tax financing (collected exclusively by the Commonwealth, or jointly by the Commonwealth and the States and Territories). In the long term, because of the small amounts required to finance the expenditure, financing by deficits and funding by PPPs are preferable to tax financing. If the infrastructure needs were much greater, the level of debt incurred would be costlier in the long term, by outweighing the productivity gains in the economy as it would crowd out too much investment, and possibly lead to an additional sovereign risk premium on Australian borrowing from abroad. In that case, tax financing would most likely be preferred.

27. Closure of the gap can be used to further fiscal policy objectives. By altering the time horizon over which governments work to close the infrastructure investment gap to achieve the same level of infrastructure stock in the long term, they can provide additional short-term stimulus to the economy. To help prevent short-term fiscal distress from increasing debt too quickly, a shorter time horizon could be coupled with the use of PPPs, thereby preventing a higher short-term debt burden of the government, and lowering its long-term level relative to the benchmark deficit-financing scenario.

28. There is uncertainty as to the magnitude of the effects of closing the gap. Two alternative scenarios illustrate some of that uncertainty, although there are additional sources of uncertainty not dealt with here related to the structure and parameterization of the model.

29. Nonetheless, there are prospective gains. Australia has improved its infrastructure spending in the last several years, but there is scope to expand it further, to reduce its (admittedly small) infrastructure gap to match other advanced and leading economies in the world.

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HOUSING MARKET IMBALANCES IN AUSTRALIA: DEVELOPMENT, PROSPECTS, AND POLICIES[1]

- **After a housing boom over the past 6 years, Australia's housing market imbalances and the macro-financial impact of their possible resolution have become a concern.** House prices in the country's eight capital cities have increased by 50 percent since early 2012, raising the value of Australian residential property from around 4 to over 5 times gross household disposable income and household debt to around twice the level of that income.

- **The housing boom has primarily been a regional boom, driven by demand shifts, and amplified by legacy imbalances and a slow supply response.** Developments in Sydney and Melbourne have driven national house prices, reflecting shifts in the strength of regional economic activity and population growth since the end of the mining investment boom.

- **While housing markets may stabilize soon, housing affordability issues will likely remain a concern given prospects for further population growth in the eastern capitals.** With such growth, the capitals need to prepare for affordable housing supply in the future, as both short-and long-term price elasticities of supply are low. In the long-term, urbanization, labor mobility, and productivity can be closely linked.

- **Housing-related policies have begun to address related imbalances and could usefully be complemented by tax reform.** Reducing the imbalances requires a multi-pronged approach amid strong demand fundamentals. The combination of more infrastructure investment and recent zoning and planning regulatory reform should contribute to increase the supply of developable land and enable its more efficient use. Prudential policies have increased the resilience of household balance sheets and the banking sector to housing and other shocks. But household debt remains high, and continued prudential policies are important to manage the risks to domestic financial stability. Housing tax reform would support the effectiveness of the overall policy response.

A. Introduction

1. Australia has experienced a housing boom over the past 6 years, with above-average residential investment growth. Prices of existing houses in the country's eight capital cities have increased by 50 percent since early 2012, with considerable variations across cities. Prices in Sydney and Melbourne have risen the most among the capital cities, by around 80 and 60 percent, respectively. With these price increases, the value of Australian residential property has risen from around 4 to over 5 times gross household disposable income over the same time, and household debt has risen from 168 to over 190 percent of gross household disposable income.

[1] Prepared by Thomas Helbling (APD) and Grace Bin Li (RES), with inputs from Dirk Muir and Siegfried Steinlein (both APD). The chapter benefited from valuable comments by seminar participants at the Treasury of Australia.

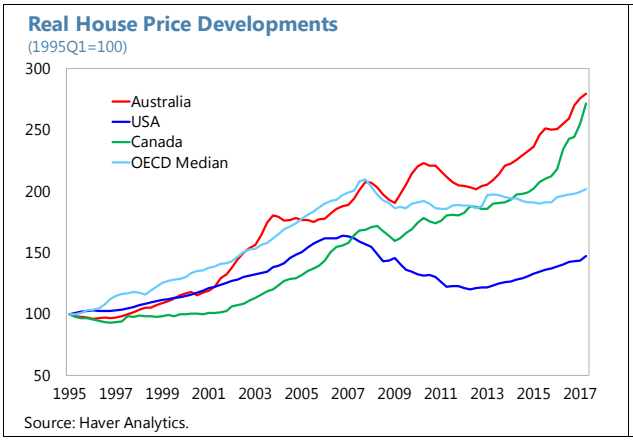
2. Concerns have been raised about the housing market imbalances that have emerged in the boom and the macro-financial impact of their possible resolution. With the strong upward momentum in housing prices, some house price overvaluation has emerged. At the same time, housing affordability has decreased markedly. A return to fair value in housing markets and greater affordability could potentially have a large macroeconomic impact, depending on whether it happens as a soft or hard landing. High household debt-to-income ratios could present risks to financial stability and amplify the impact of housing and other shocks on the economy.

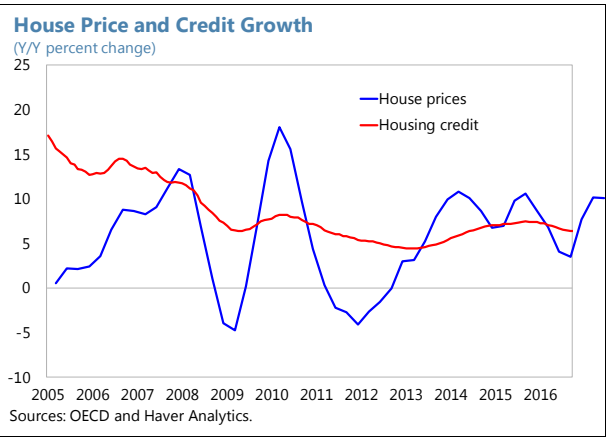
3. On the structural side, a low housing supply elasticity has amplified the price impact of demand shocks and contributed to housing affordability issues. Australia is highly urbanized, and cross-country experience suggests that low supply elasticities are common in such a context. Nevertheless, housing affordability may become a constraint on the future growth of the main cities and their role as catalysts for productivity gains and future economic growth.

4. Against this background, this paper surveys housing market developments, prospects, and policies in Australia. It provides evidence to diagnose the housing boom and summarizes recent policy measures. It also links urbanization and housing affordability to long-term growth.

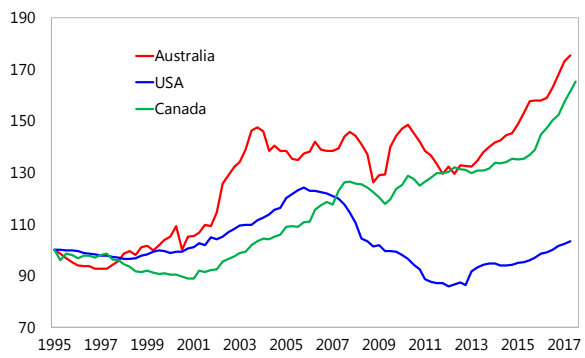
B. Diagnosis of the Housing Boom

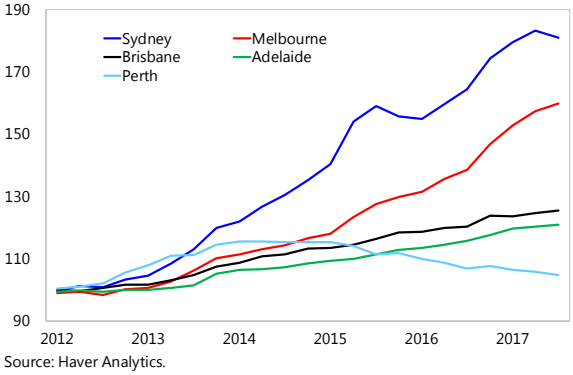
5. Australia's housing boom over the past six years has been regional, concentrated in Sydney and Melbourne. The average real price of existing houses in the 8 capital cities has increased—when the boom began—but much of the increase has been driven by prices in the two major capital cities. This suggests that the housing market imbalances have been a regional phenomenon, and local factors have played an important role influencing the price dynamics.





6. Domestic demand fundamentals explain much of the price increase, although external factors have also contributed. On the domestic side, the beginning of the housing boom broadly coincided with the current monetary easing cycle, which began in November 2011 when commodity prices started declining. But a substantial narrowing of interest differentials across the entire maturity spectrum relative to major advanced economies has also contributed to lowering the financing costs of mortgages. The main reason for the regional nature of the housing boom is the



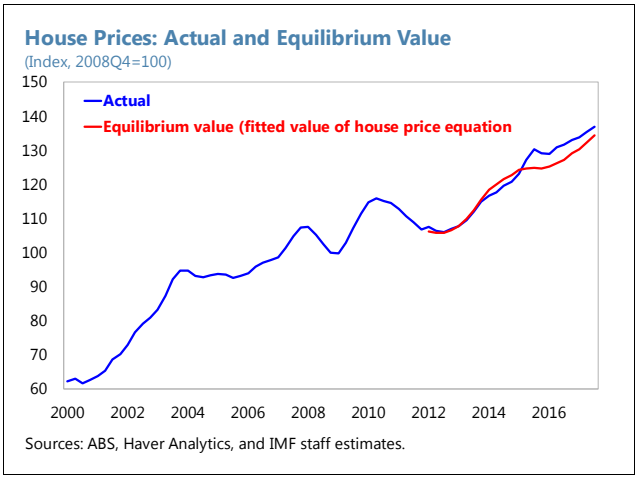


geographic shift in the underlying demand for housing from the rebalancing of the economy after the end of the mining investment boom around 2011-12. In this process, the greater metropolitan areas of Sydney and Melbourne have seen stronger growth in economic activity and have experienced increases in population growth above the national rate of 1.5 percent. Both cities have also seen growing foreign investor interest, particularly from the dynamic economies in East Asia. Inner-city apartments in Sydney and Melbourne are now part of the integrated global market for high-end real estate.

7. House price valuation models suggest overvaluation. To assess valuation, we use a simple reduced-form house price equation, following Igan and Loungani (2012). Using Australian time-series data we regress changes in real house prices on demand fundamentals.[2] The fitted values of the equation are the implied equilibrium real house prices. This approach suggests that average house prices as of 2017Q3 are moderately stronger than economic fundamentals would suggest, by some 5 percent to 15 percent, depending on econometric specifications and sample period for the estimation. One limitation of these estimates is that they are based on estimates for national house prices, which leaves the possibility that individual urban areas might be more, or less overvalued.[3]

[2] We regress the quarterly change in the average real house price for 8 capital cities on changes in affordability (measured by the log of the ratio of house prices to income per capita), the change in real income per capita over the previous quarter, the change in working-age population over the past year, the change in stock prices over the previous year, short- and long-term interest rates, and the real cost of construction, using ordinary least squares (OLS).

[3] Another potential limitation is the estimation uncertainty around these estimates.



8. Prospects for housing market imbalances depend on prospects for demand shifters, and the longer-term resolution of the demand-supply imbalances. The unexpected shifts in demand beginning in late 2011 when commodity prices started declining seem to have run their course. On the valuation side, interest rates seem to have broadly bottomed out, and further upward pressure on prices from this channel seems unlikely absent any adverse demand shocks. Population growth is not expected to change, after increases from the mid- to late-2000s, related, among other factors, to the mining boom and higher arrivals on student visas. As for prospects for Sydney and Melbourne, the economic rebalancing away from mining to other activities will likely be completed soon, and activity and related recent increases in population growth will likely also slow somewhat. Across cities, internal migration patterns could be changing for some time, driven by the high house prices and costs of living in Sydney and Melbourne, with higher population growth in second-tier cities.

9. Price dynamics in the housing market also depend on long-term and short-term price elasticities of demand and supply. With demand factors likely stabilizing, much will depend on price elasticities. If longer-term elasticities are higher than short-term, some of the accumulated house price appreciation will be reversed, as higher supply will hit the market. In the next section, we will focus on the price elasticity of supply. While the price elasticity of demand also matters, it will play less of a role in the longer term if the supply elasticity is very high.

C. The Price Elasticity of Housing Supply in Australia

10. To quantify the supply elasticity, we model residential investment using Tobin's Q framework. The model (Tobin, 1969) posits that the ratio of investment to the capital stock is an increasing function of the ratio of the market price of capital to its replacement cost. Studies using this approach include Follain (1979), Green and others (2005), Vermeulen and Rouwendal (2007), and Grimes and Aitken (2010). The empirical settings are reduced form equations with price and cost shifters (typically, land cost, material cost, labor cost and various interest costs) as independent variables. It captures the intuition that investors and developers will produce more new housing when the margin between the price of a completed housing unit and its production costs is greater. Tobin's Q in the housing market is the ratio of the house price HP (market value) to the house

producing costs RC (book value). The investment-to-stock ratio $\frac{I}{K}$ is positively related to Tobin's Q, which, in the case of housing, is the ratio of house price HP and producing costs RC, $\frac{HP}{RC}$.

$$\left(\frac{I}{K}\right)_t = \beta_0 \left(\frac{HP}{RC}\right)_t^{\beta_1}, \qquad \beta_0, \beta_1 > 0$$

11. Taking logs of the above equation, we obtain our econometric specification:

$$\log\left(\frac{I}{K}\right)_t = log\beta_0 + \beta_1 \log\left(\frac{HP}{RC}\right)_t + \epsilon_t$$

where $log\beta_0$ presents the constant term in our regression, β_1 shows the increasing relationship between Tobin's Q and the housing investment, and ϵ_t is an error term. Our sample covers the period 1988Q3 to 2017Q3.[4]

12. Our estimates suggest a low price elasticity of supply. Our analysis suggests that the housing supply elasticity (the elasticity of residential investment with respect to real house prices) in Australia is low in international comparison. The econometric estimation over the full sample confirms the positive and significant long-term price elasticity of residential investment. All variables in the equation are integrated or order one, and co-integration tests indicate the existence of one co-integrating vector. In Table 1, we present full sample regression results using three estimators: simple OLS (column 1), Dynamic OLS (DOLS) with one-lead and one-lag (column 2), and DOLS with 2 leads and 2 lags (column 2). All coefficients have the expected sign and yield an average elasticity of about 0.56 at the national level.

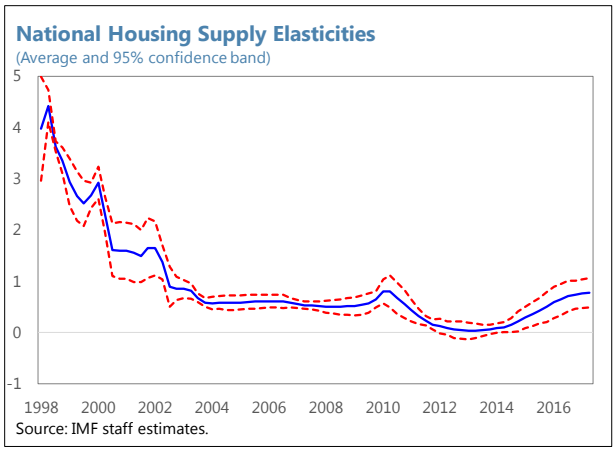
13. The long-term price elasticity of housing supply (residential investment) fell significantly between 2001-08 and 2012-14. We examine the evolution over time of the long-term price elasticity by running rolling regressions using 40-quarter windows. As documented in Stock and Watson (1993), DOLS allow us to obtain the time-varying elasticity over shorter samples. The national level housing supply elasticity was higher than unity before 2000s. However, when the recent housing boom started six years ago, the price elasticity of supply was considerably lower, although it recently increased again. Hsieh and others (2012) highlight the policy constraints on supply from the planning process, zoning restrictions, the provision and funding of infrastructure, land ownership patterns, and geographical constraints. Attitude toward higher density construction also matters.

[4] All the data (national average house price index, construction price index, residential investment, real GDP, GDP deflator, and residential investment, as well as other controls such as nominal interest rates and population growth) are data from the Australian Bureau of Statistics that we downloaded from Haver Analytics.

Table 1. Australia: The Long-term Elasticity of Housing Supply			
Specification	**Specifications**		
log(Housing prices/Construction Costs)	0.593***	0.551***	0.528***
	[17.616]	[12.305]	[11.493]
FD.log(Housing prices/Construction Costs)		-0.551	-0.255
		[-1.066]	[-0.770]
D.log(Housing prices/Construction Costs)		-0.689***	-0.674***
		[-5.138]	[-5.124]
LD.log(Housing prices/Construction Costs)		-0.280	-0.563***
		[-0.940]	[-3.113]
F2D.log(Housing prices/Construction Costs)			-0.390
			[-1.078]
L2D.log(Housing prices/Construction Costs)			0.150
			[0.630]
Constant	9.905***	9.921***	9.922***
	[1,056.998]	[551.746]	[526.709]
Estimation method	Simple OLS	DOLS(1,1)	DOLS(2,2)
Observations	84	81	79
R-squared	0.791	0.808	0.800
t-statistics in brackets			
*** p<0.01, ** p<0.05, * p<0.1			
Source: IMF staff estimates.			

14. Australia's price elasticity of supply is low in international comparison, consistent with its high degree of urbanization. In the United States, the average price elasticity of supply for metropolitan cities with population above a half million is well above unity (Saiz, 2010). Using a different approach, a recent study found price elasticities of supply of supply above 1 not only for the United States, but also Canada, Denmark, and Sweden (Caldera and Johansson, 2013). Using state-level data, we find that the regional supply elasticities in Sydney and Melbourne are estimated at 0.21 and 0.61, respectively. The low elasticities for the two main capital cities is within the range found in some other, more densely populated OECD countries (for example, Caldera and Johansson, 2013, among others) and other studies.[5] That said, the elasticity for Sydney is at the lower end of the range, consistent with anecdotal evidence of limiting zoning restriction, geographical constraints, and a period of underinvestment in infrastructure.

[5] Gitelman and Otto (2012) use disaggregated house price data over the 43 local government areas and also estimate the supply elasticity in metropolitan Sydney. They find that the elasticity also depends on the type and the location of the property. Berger-Thomson and Ellis (2004) use a three-stage least squares system and analyze the sensitivity of the housing investment to the underlying factors.

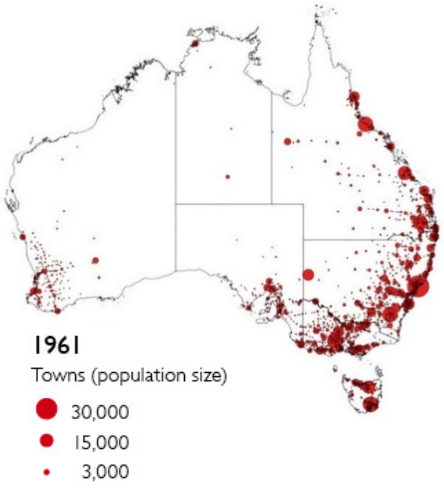


D. Urbanization, Housing Supply, and Long-term Growth

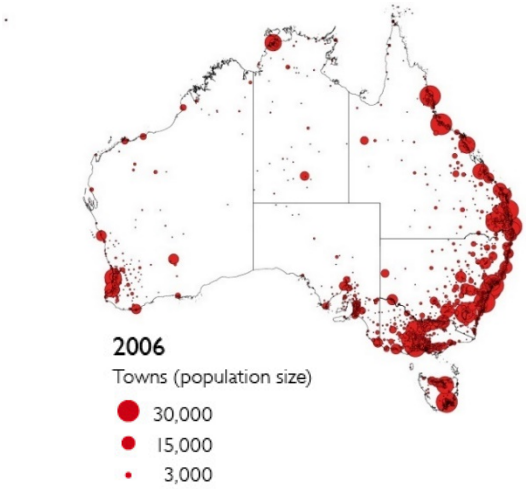
15. The context to Australia's housing market imbalances and low supply elasticity is its urbanized development. Australia is highly urbanized, with some three-fourths of the population living along the eastern coast. The share of the population living in urban areas rose from 82 percent in 1960 to about 90 percent in 2016. Economic activity is similarly concentrated geographically.

Australia Town Populations

(1961 Census)



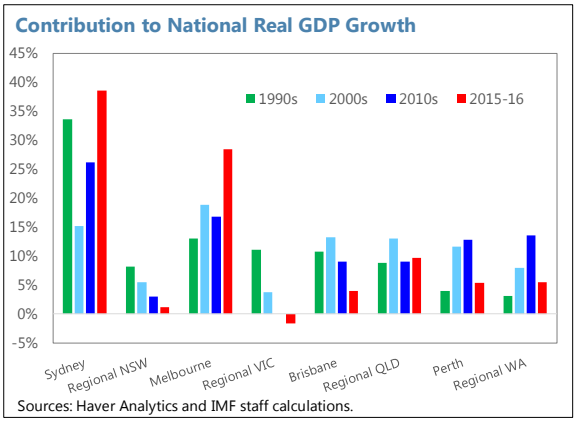
(2006 Census)



Source: *The evolution of Australian towns, Report 136.* Bureau of Infrastructure, Transport and Regional Economies. Department of Infrastructure and Regional Development. Canberra, Australia.

16. Mirroring urbanization, the largest cities have accounted for much of national economic growth. In the 1990s, the five larger capital cities (Sydney, Melbourne, Brisbane, Adelaide, and Perth) contributed about two-thirds to national real GDP growth. In 2015-2016, this share increased to four-fifths. Among the larger capital cities, Sydney and Melbourne dominate, both in terms of population and contributions to economic activity. The two cities house some two-

fifths of Australia's population and generate more than half of the country's value added. Recently, with the economic rebalancing after the mining boom, Sydney and Melbourne have again become the main engines of economic growth and have experienced population growth above the national rate.



17. Rapid urban growth can clash with housing affordability. Krugman (1991) and others have pointed out that economic activity tends to cluster around cities; proximity can generate increasing returns to scale or agglomeration externalities. Historically, when cities experienced outsized economic success, they would accommodate large increases in the demand for housing. New housing allowed thousands to participate and, at the same time, provide the basis for productivity increases in the locality (Hsieh and Moretti, 2015, and Glaeser and others, 2004). However, when cities grow, density increases, and with those increases come higher housing prices and rents relative to prices of other goods and services, as urban land is in limited supply. While productivity and wages tend to be higher in urban areas, the rising costs of living can still lead to conflicts between urbanization and housing affordability, especially in transitions, and challenge traditional social values (e.g., high home ownership) and preferences (detached single family houses).

18. Affordability and supply will likely remain policy issues even with a soft-landing in the housing market. First, the adjustment to higher real house prices in Sydney and Melbourne will continue, as relocation is costly and takes time. Anecdotal evidence already suggests interstate migration from Sydney to Melbourne, given lower housing costs in the latter. At the same time, there is some migration from the two capital cities to smaller cities within their respective states. While this may provide temporary relief, there will be additional demand for housing, given expectations of continued rapid population growth in Sydney and Melbourne. However, such expectations will only materialize if the two cities can accommodate this demand at a cost commensurate with productivity and incomes. Hence, housing affordability and long-term growth are linked.

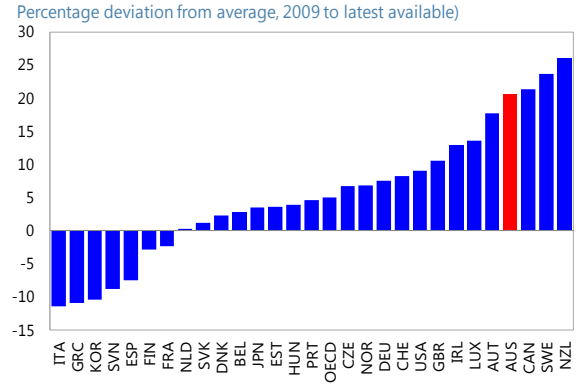
E. The Policy Response to Housing Market Imbalances

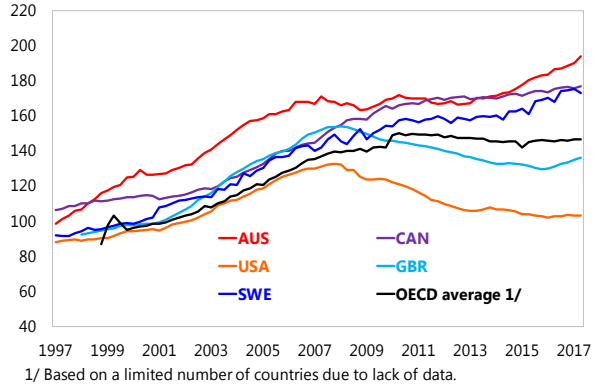
19. The Commonwealth and eastern States' governments have intensified efforts to address housing market imbalances. The policy packages were announced as part of the FY2017/18 budgets and aim to improve housing affordability. Table 2 provides an overview of the measures. Analytically, the measures can be broadly classified into supply and demand-side measures. The housing affordability packages were preceded by prudential policy measures to address the risk to domestic financial stability from the increased banking sector exposure to housing risks. This paper primarily discusses these housing-related measures, although it also touches on policy issues related to housing taxation. It takes the view that macroeconomic policies

are either too blunt a tool or involve undesirable tradeoffs between housing market objectives, mostly regional in the recent boom, and economy-wide stabilization objectives.[6]

Prudential Policies to Address Vulnerabilities and Risks from Housing

20. Rising housing market imbalances have coincided with higher household debt and bank exposure to related risks. Declining interest rates have raised equilibrium house prices and household mortgage debt has correspondingly increased. They have also raised concerns about speculative dynamics in housing markets with asymmetric information, the potential for myopic expectations, slow supply responses, and other frictions (e.g., borrowing or collateral constraints). Another concern is that negative shocks could trigger negative feedback loops between house prices, household and bank balance sheets, and aggregate demand, and lead to deep and protracted slowing in economic activity. The four large, systemically important Australian banks have a substantial exposure to these risks, which, in turn, can pose risks to domestic financial stability.





1/ Based on a limited number of countries due to lack of data.

Source: OECD.

21. Prudential measures have been deployed to strengthen the resilience of household balance sheets and the banking system to housing and other shocks. Responding to increases in household debt ratios and related risks to banks' mortgage asset quality, the Australian Prudential Regulation Authority (APRA) has issued guidance asking banks to strengthen mortgage loan underwriting standards, through guidance on both loan-to-value (LTV) ratios and debt serviceability. It has also applied caps on new interest-only loans and caps on total domestic lending to private housing investors. APRA guidance on lending standards and growth was issued in December 2014, December 2016, and March 2017 (see Table 3). Following these measures, the share of riskier mortgages in new lending has decreased, gradually increasing the asset quality of the stock of

[6] Consider, for example, the case of monetary policy, which has a direct influence on credit growth, household leverage and liquidity, thereby affecting housing demand, in addition to the direct valuation effects through interest rates. Using monetary tightening to improve housing affordability in the two main eastern capitals would run counter to stabilization objectives in an economy hit by the adverse aggregate demand effects of the end of the mining boom.

mortgage credit while decreasing the riskiness of the stock of household debt, everything else equal. The risks from household debt have also decreased because borrowers have used the savings from lower interest rates to build up buffers and as housing leverage (value of housing stock over mortgage debt) has declined.[7] Banks have also become more resilient to housing market shocks because of increased capital. Their capital adequacy ratios place the four largest banks at the lower end of the upper quartile among international peers. Regulatory requirements for higher capital adequacy requirements had already been raised before the housing boom, also they have been refined since. Lending practices have also been scrutinized by the Australian Securities and Investment Commission (ASIC), including in 2014 when it investigated whether interest-only loans were consistent with responsible lending conduct.

22. Australia's strategy to lower housing risks to household balance sheets and domestic financial stability has relied more on credit supply measures than in some other countries. The prudential measures operate through credit supply—tighter lending underwriting standards reduce the amounts of riskier loans in new mortgage lending and refinancing, everything else remaining the same. While this can also reduce actual credit growth, such reductions tend to be temporary amid strong demand fundamentals. Other countries have also applied macro-prudential policy instruments that directly affecting household demand for housing and related credit. In Hong Kong SAR, for example, different stamp duty rates are applied to different types of buyers or property (IMF, 2017). Buyers of a second home for investment purposes, for example, face a higher stamp duty for macro-prudential reasons. In Australia, such policies have only been applied to foreign buyers.

Policies to Affect the Demand for Housing

23. Demand-side policy measures have provided tax-relief to first-time home buyers and raised the after-tax price of property purchases by foreign buyers. On the domestic side, the focus has been on supporting first-time home buyers' purchases, given the strong social preference for home ownership. For example, New South Wales and Victoria have exempted first-time home buyers from stamp duties since July 2017. In addition, first-time buyers also receive a grant (in effect a subsidy). On the external side, the costs of house purchases of foreign buyers have been raised through several measures. Victoria, New South Wales, and Queensland have levied stamp duty surcharges on foreign buyers, while Victoria and New South Wales have also levied land tax surcharges on foreign owners. Under the IMF's so-called Institutional View, measures that differentiate between residents (or domestic buyers) and nonresidents (or foreign buyers[8]) are

[7] With most mortgages being variable rate mortgages, the savings from lower interest rates can be used to build repayment buffers at unchanged debt service payments. Such buffers are supported by tax incentives.

[8] Foreign buyer specifically refers to those buyers that need a purchase approval from Australia's Foreign Investment Review Board. This group of buyers includes nonresidents and foreigners who are temporary residents.

classified as capital flow management measures (CFMs).[9] At the Commonwealth level, the CFMs include limits on sales for foreign investors by developers (but not individual owners).

24. The impact of demand-side measures on general housing affordability is ambiguous. These measures are in the first-instance redistributive, that is, they increase or lower housing affordability for specific groups of buyers, not for buyers overall. For example, the measures for first-time home buyers lower the purchase price after taxes (or after the grant) for this category of buyers. Everything else equal, demand from first-time home buyers is higher, and with unchanged supply in the short term, house prices before taxes might have to increase, for other buyers to hold off on a purchase.

25. The case for applying policies specifically aimed at foreign buyers is not clear-cut. Australia housing market has seen increased interest for residential real estate from foreign buyers seemingly for investment purposes since about 2011. Nationwide, such interest currently accounts for around 5 percent of housing sales (Kearns, 2017). In some local markets, it seems to play a more substantial role, including in that for newly built apartments in Melbourne and Sydney, in which foreign buyers are believed to account for around 25 percent of sales. With such a market share, foreign buyers will be among the marginal buyers influencing prices, although this role does not necessarily call for policy intervention aimed at this group of buyers. One reason for intervention could be the pecuniary externality arising from the demand of foreign buyers—the fact that the increase in their demand raises house prices—in the presence of constraints (or frictions) for other buyers. Under such circumstances, the market outcome would not be optimal. With borrowing constraints because of tighter lending standards for many buyers, this condition seems meet. Supply constraints and social considerations (e.g., affordability and home ownership) could be other reasons. Others considerations are macro-financial externalities (e.g., fire sale externalities) or the possible price pro-cyclicality induced by uninformed foreign buyers that primarily respond to price momentum rather than domestic fundamentals. While there are reasons to be concerned about the participation of foreign buyers in local housing markets, it should be noted that some of the same issues may also apply to other buyers, including, for example, domestic investors. An important question therefore is whether separate measures for foreigners are needed. In Australia's case, the prudential regulatory measures are unlikely to influence foreign buyers since, unlike domestic investors, they rarely borrow from Australia's banking system.

Supply-Side Policies

26. Recent policy measures at the Commonwealth and State levels should increase the housing supply elasticity over time. Supply-side policies aim to increase the supply of housing. The Commonwealth has announced the release of some federal land in Melbourne as part of the FY2017/18 housing affordability package, and established a Government Property Register owned

[9] The Institutional View on capital flow liberalization refers to the removal of CFMs, which are specifically designed to limit capital flows. However, liberalization does not rule out the maintenance of prudential measures nor the temporary re-imposition of CFMs under certain circumstances, if capital flows pose risks to macroeconomic or financial system stability. For details, see IMF (2016).

by non-corporate Commonwealth entities, with a view to encourage proposals for alternative uses. Higher density building in urban areas increases the efficiency of land use and housing supply, and States have changed zoning rules to allow for such density increases. Infrastructure is a precondition for land to be developable, and both the Commonwealth and States have increased infrastructure spending recently. Longer-term plans provide more certainty for developers, investors, and potential home owners on where to build and settle. In urban areas, common zoning, planning, and other regulatory standards can lower the cost of building and, possibly, for a more rapid supply response. Streamlining standards across local councils in urban areas or common standards in States have been important developments in this respect.

Tax Policy

27. Housing tax reforms could complement recent policies to address housing market imbalances. The existing policy packages have not involved changes to tax policy settings. Such changes could, however, also contribute to reducing housing market imbalances, including by encouraging transactions and alternative use of land and property, and through changes in incentives in the demand for housing. Table 4 summarizes the current housing tax regime.

28. Stamp duties discourage housing transactions at a time of structural transformation in urban areas. The States' stamp duty regimes are inefficient—they have a narrow tax bases---only transactions---and discourage transactions in existing properties that could have more productive alternative uses. It should be replaced with a systematic land tax regime applying to all residential and commercial properties. A land tax is an efficient tax on a largely fixed factor. Such a change would raise challenging transition issues, given the importance of stamp duties as a revenue source for States and the cash flow problems this could raise for so-far untaxed owner-occupiers. As demonstrated by the recent reform in the Australian Capital Territory, the transition can be gradual, which helps to avoid a disruptive impact on State revenues. Cash flow problems for low-income homeowners can be addressed through deferment and other options too.

29. The Commonwealth housing tax settings favor leveraged housing investment in upswings and might encourage excess demand for housing. In international comparison, Australia's federal housing tax regime provides strong tax incentives for home ownership and for leveraged housing investment (Table 5). While some tax incentives for home ownership are the norm, some of the incentives are not limited (e.g., the capital gains tax exemption or the exemption from means testing for old age pensions). Such settings may encourage "excess" demand for housing, excess in the sense that families prefer more to less space. On the investment side, the combination of high capital gains tax discount rates and unlimited negative gearing can encourage leveraged real estate investment in market upswings. While similar tax incentives are also present in other countries, they tend to be more limited.

F. Summary and Conclusions

30. The recent housing boom in Australia is primarily a regional boom, driven by demand shifts and amplified by legacy imbalances and a slow supply response. While Australia's real

house prices have risen significantly faster than the OECD average over the past few years, much of this rise has been driven by developments in Sydney and Melbourne even though some of the demand drivers have been national, notably lower interest rates. The regional nature of the boom reflects the shifts in the strength of regional economic activity and population growth since the end of the mining investment boom. In the denser urban setting of the two cities, supply constraints amplify the price impact of demand shocks, especially in Sydney.

31. While the boom may be over soon, housing affordability issues may not disappear given prospects for further growth in the eastern capitals. In the dense urban settings of Sydney and Melbourne, any shift in demand will tend to have a larger price impact than in less urbanized settings. But prospects for the eastern capitals turning into considerably larger cities also means that these capitals need to prepare for affordable housing supply in the future, as both short-and long-term price elasticities of supply are low. In the long term, urbanization, labor mobility, and productivity can be closely linked.

32. Housing-related policies have begun to address housing-related imbalances and should be complemented by tax reform. Reducing the imbalances requires a multi-pronged approach amid strong demand fundamentals. The combination of more infrastructure investment and recent zoning and planning regulatory reform should contribute to increase the supply of developable land and enable its more efficient use. Continued prudential policies are important to manage the risks to the financial sector from housing. Housing tax reform would strengthen the effectiveness of the overall policy response.

Table 2. Australia: Key Features of Government Housing Supply and Affordability Measures as of End-2017

Measure	Effective date	Description
Commonwealth Level		
First Home Super Saver Scheme	Jul 1 2017	Contribute money from annual superannuation contribution limit (up to $15,000 per year for a maximum of $30,000) for a first-home deposit. Provides tax advantages to saving within superannuation framework.
National Housing Infrastructure Facility (NHIF)	Jul 1 2018	Administered by newly established National Housing Finance and investment Corporation (NHFIC). $1bn ($600 mn concessional loans; $$225 mn equity investment; $175 grants) to provide financing to State/Territory and local-government owned corporations for housing and utilities, and Community Housing Providers (CHPs). Will also invest its funds to become self-sustaining.
Affordable housing bond aggregator	Jul 1 2018	The affordable housing bond aggregator is designed to provide cheaper and longer-term finance to CHPs and will be underpinned by a government guarantee.
Western Sydney housing package	2018	Deliver a coordinated package of planning reform to accelerate housing supply in Western Sydney. The package will be delivered as part of the Western Sydney City Deal, a collaborative partnership between the Commonwealth, New South Wales and eight local governments.
National Homeless and Housing Agreement (NHHA)	Jul 1 2018 (projected)	The new National Housing and Homelessness Agreement sets out a small number of specific conditions which States need to meet to receive 100 per cent of their share of the Commonwealth housing and homelessness funding. This will secure improved outcomes, but in a way that is achievable for the States and Territories and does not jeopardise the funding of core social housing and homelessness services. The new agreement will maintain the level of funding under existing agreements and, for the first time, ensure that funding allocated to homelessness services will be ongoing and indexed. The new agreement is needed because three out of four of the benchmarks under the current National Affordable Housing Agreement have not, or are unlikely, to be met."
Release surplus Commonwealth lands	Jul 1 2017	The Commonwealth has established an Australian Government Property Register, which encourages proposals for alternate use of Commonwealth land. Commonwealth land in Melbourne has been released for approximately 6,000 new dwellings.
Adding home sale proceeds to superannuation funds for Australians 65+	Jul 1 2018	Up to $300,000 from the sale of a home owned as a principal residence for at least 10 years may be deposited into their superannuation account. Incentivizing further sales of homes.
Capital gains tax (CGT) discount for investors in affordable housing	Jan 1 2018	Additional 10 percent discount on CGT for affordable housing managed through a CHP, and must be held as affordable housing for at least 3 years.
New South Wales		
Infrastructure investment to unlock housing supply	Jul 1 2017	$1.6 bn for priority projects; $369 mn grants and $500 mn concessional loans to local government; additional $545 mn over 4 years for Special Infrastructure Contributions to speed up development in more regions.
Stamp duty exemptions and grants for first time buyers	Jul 1 2017	No stamp duty for first time buyers for any home under $650,000; discount for up to $800,000; $10,000 grant.
Rezoning as Priority Precincts	Jul 1 2017	Allow for faster and easier approvals, to allow fast-tracking of house building.
Victoria		
First Home Owner Grant	Jul 1 2017	Up to $20,000 for regional Victoria (next 3 years); retained at $10,000 in Melbourne.
Social Housing Growth Fund	Jul 1 2017	$1 bn to support up 2200 social housing places over 5 years
Stamp duty exemptions for first time buyers	Jul 1 2017	No stamp duty for first time buyers for any home under $600,000; discount for up to $750,000
Vacant Residential Property Tax	Jan 1 2018	Applies to dwelling vacant more than 6 months in previous calendar year, in inner and middle rings of Melbourne; relies on self-reporting.
HomesVic	Jul 1 2017	Co-purchase properties for up to 400 first home buyers without a large enough deposit (2-year pilot)
Queensland		
First Home Owners' Grant	Jul 1 2016	$15,000 ($20,000 in FY2017/18) grant to first-time home buyers for new houses under $750,000
Queensland Housing Strategy	Jul 1 2017	$1.8 bn over 10 years. Encourages partnership between private firms and CHPs to build up to 8000 units across state of social and affordable housing. Support homeownership for disadvantaged and aboriginal populations.

Sources: Commonwealth, New South Wales, Victoria and Queensland budget documents for FY2017/18; Commonwealth Mid-Year Economic and Fiscal Outlook 2017; https://www.qld.gov.au/housing/building-home/first-home-grant; http://www.hpw.qld.gov.au/housingstrategy

Table 3. Australia: Regulatory Activity on Lending Practices, 2014-17

Measures	Authority	Date introduced
Introduction of Prudential Practice Guide, which outlined APRA's expectations for sound mortgage lending practices	APRA	Late-2014
Supervisors would be alert to annual growth in a bank's investor housing lending above a benchmark of 10 percent	APRA	Late-2014
Supervisors would be alert to high levels of higher-risk mortgage lending, such as lending with a high LVR and/or loan-to-income ratio and lending to owner-occupiers with lengthy interest-only periods	APRA	Late-2014
Serviceability assessments for new mortgage lending should include interest rate buffers of at least 2 percentage points above the effective variable rate applied for the term of the loan, and a minimum floor assessment rate of at least 7 percent to allow borrowers to accommodate future increases in interest rates	APRA	Late-2014
A loan review was undertaken to determine whether lenders' interest-only housing lending practices complied with responsible lending obligations	ASIC	Late-2014
Increased its analysis of lenders' underwriting standards, including strengthening household income definitions in pre-loan serviceability calculations, e.g. applying a discount to some income such as bonuses and overtime	APRA	Early-2015
Additional scrutiny of lenders' underwriting standards for interest-only loans, including tighter requirements for the assessment of the borrowers' ability to repay after the initial interest-only period	APRA	Early-2015
Conducted onsite reviews of past and new loan documents to spotlight additional areas where stronger actions are needed to enhance resilience	APRA	Early-2015
Countercyclical capital buffer (Basel III) was incorporated into the capital standards for banks and other ADIs	APRA	Early-2016
Reviewed large mortgage broker lending practices	ASIC	Late-2016
Revisions to Prudential Practice Guide to formalize the recent tightening of standards on serviceability buffers and interest-only lending for residential mortgages.	APRA	Late-2016
Introduction of a limit on the flow of new interest-only lending to 30 percent of new residential mortgage lending, and within that: • Strict internal limits on the volume of interest-only lending at loan-to-valuation ratios (LVRs) above 80 percent • Strong scrutiny and justification of any instances of interest-only lending at an LVR above 90 percent	APRA	Early-2017
Lending to investors to remain below the benchmark of 10 percent growth (first introduced in 2014)	APRA	Early-2017
Serviceability metrics, including interest rate and net income buffers, to be set at appropriate levels for current conditions	APRA	Early-2017
Lending growth in higher risk segments of the portfolio, e.g. high LTI loans, high LVR loans and very long-term loans, to be constrained	APRA	Early-2017

Notes: APRA is the Australian Prudential Regulation Authority. ASIC is the Australian Securities and Investments Commission

Table 4. Australia: Taxation of Residential Real Estate and Other Assets

	Housing Assets		
Commonwealth	**Owner-occupied**	**Investment (Non-owner-occupied)**	**Equity**
Taxation of (imputed) rent	No	Yes	Equivalent to housing investor
Taxation of capital gains	No	Yes (a standard income tax rate, with 50 percent concession if owned for more than one year)	Equivalent to housing investor
Deductibility of interest payments (and other expenses)	No	Yes (including from non-rental income categories)	Equivalent to housing investor
States and Territories			
Property taxation			
(1) State land taxes	No	Yes	…
(2) Council rates	Yes	Yes	
Transaction tax (stamp duty)	Yes	Yes	(no or lower – *to be double-checked*)
GST on new housing construction and improvement	Yes	Yes	…
Benefit system: means test exemption for old age pension	Yes	(No)	(No)

Table 5. Real Estate Taxation in Selected Countries

	Capital Gain Tax	Land or Property Tax	Negative Gearing	Land or Property Transfer (Stamp) Duty
Australia	As part of national income tax, capital gain tax applies to real estate assets (acquired after September 20, 1985) with exemption for main residence property. Some concession or discount (50%) will be granted for investment property if owned for more than one year (discount also applies to non-property assets held for more than one year).	States collect land tax usually with exemption for owner-occupied properties, or below state-specific thresholds. States also enable each council to levy rates and charges on properties to help fund local infrastructure and services. Some surcharges are on vacant land or absentee owners.	Australia allows property investors who make a loss to reduce the tax they pay on other types of income (e.g. wage or business income), without total ceiling of the deductions.	Stamp duty is applied by individual States to the sale or transfer of land or a business, with assistance and concessions to the first-home buyers.
Canada	The capital gains inclusion rate is currently 50 percent, with exemption for the sale of a principal residence property.	Municipal governments levy property tax, generally proportional to the full value of the properties for mostly all households across income groups.	Canada does not allow the transfer of income streams. Net capital loss can be deducted with limitation to only taxable capital gain for the year (carry back for three years and carry forward indefinitely.)	Land or property transfer tax is collected by the provincial governments, with rebates for a newly built home and/or first-time buyers in a few provinces.
Hong Kong SAR	No capital gains tax.	Property tax is charged at a standard rate of 15% of the property's net assessable value, which is the assessable value after deduction.	No negative gearing.	In October 2012, the Special Stamp Duty was raised to up to 20 percent on resales within 36 months (20 per-cent within first six months of purchase, 15 percent between six and 12 months, 10 percent between 12 and 36 months), while a buyer's stamp duty of 15 percent was introduced for buyers of residential properties who are not HKSAR permanent residents. This was followed by a doubling of the existing ad valorem stamp duty rates to a maximum of 8.5 percent in February 2013. The ad valorem stamp duty is levied on nonresidential and multiple residential property purchases.
New Zealand	New Zealand does not have a general capital gains tax. However, gains on the sale of personal property are taxable where the taxpayer's dominant purpose in acquiring the property is for resale. In 2015, New Zealand introduced a presumption of resale intention at purchase if an investment property is being resold within two years ("bright -line test"), to strengthen the enforcement of existing capital gains taxation rules.	Local authorities charge property tax on land based on the official valuation of land. The rates vary considerably from one locality to another.	New Zealand allows negative gearing and the transfer of losses to other income streams, with some restrictions.	New Zealand does not levy stamp duty or transfer taxes.

Table 5. Real Estate Taxation in Selected Countries (concluded)

	Capital Gain Tax	Land or Property Tax	Negative Gearing	Land or Property Transfer (Stamp) Duty
Singapore	Generally, the gains derived from the sale of a property in Singapore are not taxable. However, the gains may be taxable if you buy and sell property with a profit seeking motive.	Based on the Annual Value of the property, a yearly property tax is levied depending on the type of the property (residential or non-residential, owner-occupied or non-owner occupied), and is usually on a progressive scale by the value bands.	No negative gearing.	Stamp duty is applied to buyers and sellers, with a surcharge for foreign buyers. In 2017, the duty rates for sellers were reduced by 4 percentage points for each year of holding and eliminated beyond three years.
Sweden	A tax rate of 22% applies to the sale of private real property and tenant owner's apartments. Under certain circumstances, it is possible to defer the taxation of gains, up to a certain amount, from selling a private real property when a new private real property (house or apartment) is bought either in Sweden or the EU/European Economic Area (EEA) area. The deferred gain will be subject to investment income tax on a notional income computed based on the deferred gain.	Properties are subject to a state real estate tax, ranging between 0.2% and 2.8% on the tax assessed value of the property. The rates depend on the property type and use.	No negative gearing.	Stamp duty is levied on the transfer of real estate and on mortgage loans, at rates of 4.25% for companies and 1.5% for individuals.
United Kingdom	Capital gains tax is levied for buy-to-rent, business premises, or land, when the properties are not under the Private Residence Relief exemption.	Properties are subject to the council tax on the annual basis. The rates depend on the property type and use.	UK adopted the negative gearing in 2012, with the ceiling of £50,000 or 25 per cent of income, whichever is the higher.	Stamp Duty Land Tax is levied when buying properties or land in England, Wales and Northern Ireland, above the threshold of £125,000 for residential properties and £150,000 for non-residential land and properties. Certain tax discount or relief is applied for first-time buyers.
United States	Capital gains tax on property is imposed with deduction of $250,000 for individual ($500,000 for a married couple filing jointly) on the sale of real property if the owner owned and used it as primary residence for two of the five years before the date of sale.	Most local governments in the United States impose a property tax based on the assessed fair market value of the property.	In principle, the US federal tax does not allow the transfer of income streams. Taxpayers can deduct expenses of renting property from their rental income.	Stamp duty is levied on the legal transfer of assets or properties by counties.

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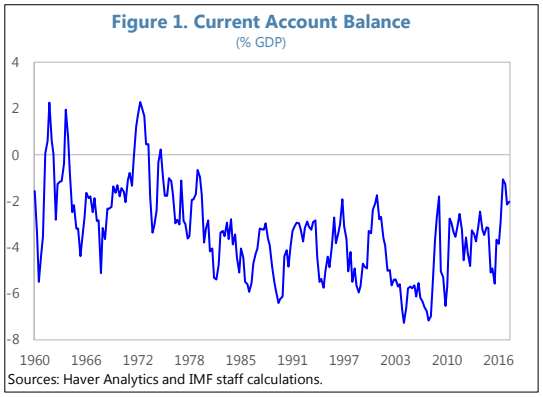
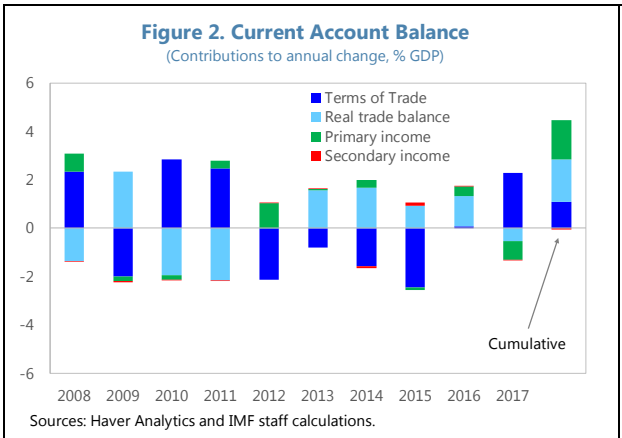
PROSPECTS FOR AUSTRALIA'S CURRENT ACCOUNT DEFICIT: LOWER FOR LONGER?[1]

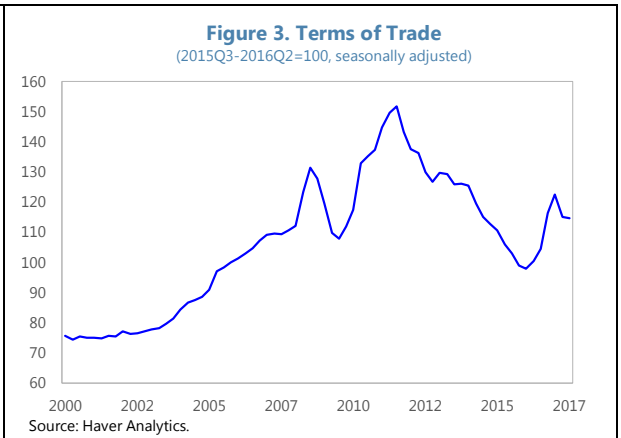
A. Current Account Balance Developments Over the Past Decade

1. Australia's current account has been in deficit for most of its history. In the 1960s and 1970s, the current account deficit fluctuated around 1-2 percent of GDP (Edey and Gower, 2000). The deficit widened from the early 1980s and averaged around 4 percent of GDP for around 3 decades after that (Kearns and Lowe, 2011). The current account deficit sharply decreased immediately after the Global Financial Crisis (GFC) and again in 2016-17, fluctuating at a lower level (Figure 1). This paper examines the narrowing of current account deficit since the GFC and seeks to draw the implications for the current account going forward, using primarily a sectoral saving and investment balance approach. It focuses on developments in Australia, taking developments elsewhere as given.



2. The narrowing of the current account deficit over the past decade can be broadly divided into two phases.[2] During the first phase, which can be defined between the GFC and the end of commodity price boom at roughly the end of 2011, most of the adjustment occurred, from an initial position of a large deficit. The substantial narrowing to a deficit smaller than average in that phase was driven primarily by favorable terms of trade, leading to higher savings in non-financial corporates. In the second phase, the current account deficit narrowed further, but by a smaller amount, with the largest positive contribution coming from the real trade balance, driven by the end of mining investment boom and weaker consumption. In both phases, improvements in primary income balance also contributed.





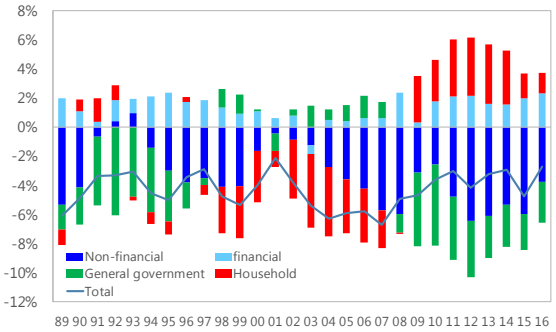
[1] Prepared by Kyungsuk Lee (APD).

[2] For more details, see Belkar and others (2007) and Bishop and Cassidy (2012).

B. Dissecting the Narrowing of the Current Account Deficit

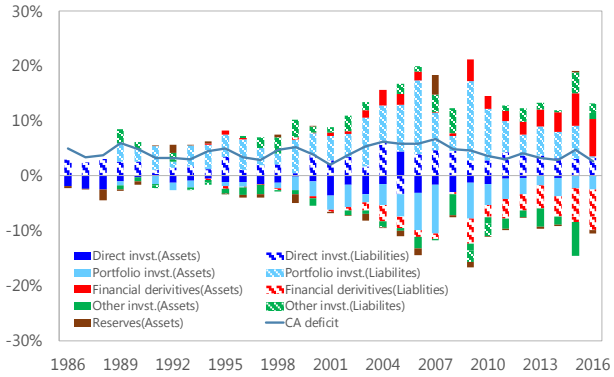
3. The narrowing of underlying current account deficit started with the GFC and has been maintained since, with offsetting dynamics across sectors. The adjustment has been most notable in the household and non-financial corporate sectors (Figure 4). The overall patterns in the narrowing are broadly consistent with sharper slowdowns in Australian domestic demand relative to its trading partners (see Blanchard and Milesi-Ferretti, 2009 and Garton and others, 2010). The changes in the global financial conditions because of the GFC were also reflected in lower gross capital inflows (Figure 5). More broadly, the following five developments are key to understanding the narrowing of the current account deficit and its prospective development going forward.

Figure 4. Current Account Balance by Sectors
(% GDP)



Sources: Haver Analytics and IMF staff calculations.

Figure 5. Gross Capital Flows
(% GDP)



Sources: Haver Analytics and IMF staff calculations.

4. First, Australia experienced larger slowdown s in domestic demand growth relative to its major trading partners. In the GFC, from 2007-09 with annual data, growth in Australia's domestic demand dropped by around 7 percentage points, while the weighted average of the growth rate in its major trading partners' domestic demand declined by 4 percentage points, with developments in the latter strongly influenced by China's continued relative strength. The domestic demand gap relative to trading partners widened again in the beginning of the second phase as Australia was hit by the decline in global commodity prices leading to a persistent (and perhaps permanent) decline in mining investment (Figure 6).

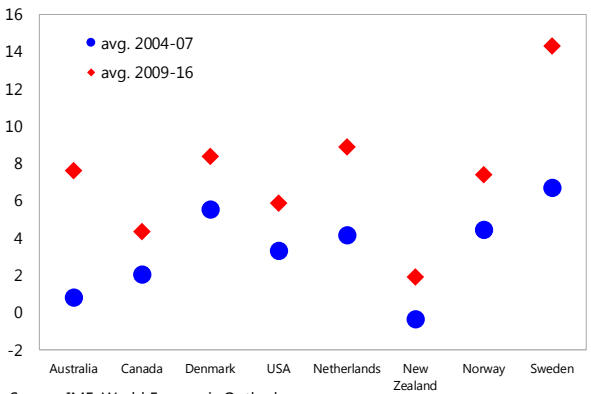
Figure 6. Domestic Demand
(Y/Y percent change)

Source: IMF staff calculations.

5. Second, household saving ratios sharply increased around the GFC (see Finlay and Price, 2014). The increase in the household saving ratio since the GFC mirrors that observed in other advanced countries, although the extent of the increase in Australia is relatively large (Figure 7). The increase in Australia's ratio partly reflects the transfers to households during the fiscal stimulus of

2008-09. But it is also consistent with two developments after the GFC: households' more cautious attitude, which is also reflected in a notable increase in share of cash and deposits in total financial assets (Figure 8); and the presence of tighter lending standards by banks, including higher collateral requirements for households. While households' savings-investment balance has remained elevated compared to its pre-GFC level, it has narrowed in recent years, with a decrease in saving to GDP ratio and some increase in the dwelling investment to GDP ratio because of the housing market boom (Figure 9).

Figure 7. Household Saving Ratio



Source: IMF, World Economic Outlook.

Figure 8. Share of Total Households Financial Assets
(Percent)

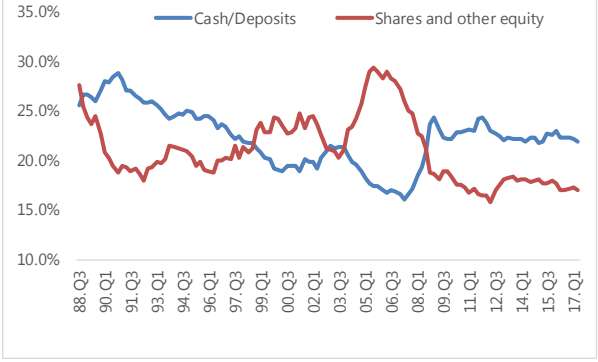
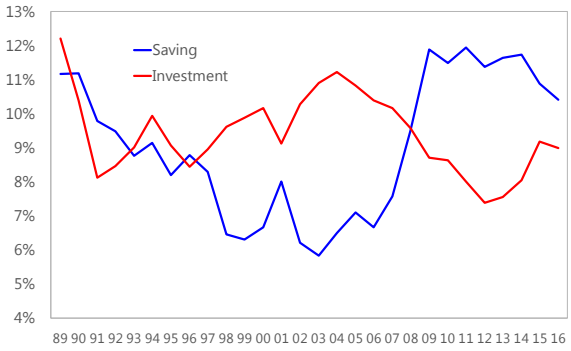


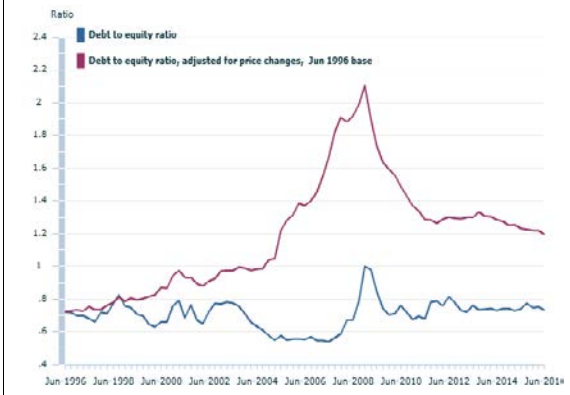
Figure 9. Household's Saving and Investment
(% GDP)



Sources: Haver Analytics and IMF calculations.

6. Third, non-financial corporates (NFCs) reduced net borrowing. In the first phase, firms increased their saving with the support from the favorable terms of trade while reducing investment in the wake of the GFC. This was reflected in the sharp decline in balance sheet leverage. In terms of the debt-to-equity ratio adjusted for price changes[3], non-financial corporates reduced their leverage ratio by almost half (Figure 10). This decline was mirrored in a decline in the ratio of business credit to GDP, the extent of which is broadly comparable to the decline associated with the 1991 recession. During the second phase, the negative savings and investment gap initially widened as the economy went through the commodity price bust, exerting downward pressure on saving. However, mining investment remained high, as it

Figure 10. Non-Financial Corporates' Debt to Equity Ratio

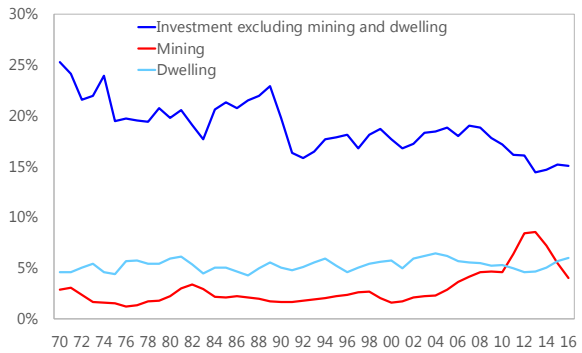


Sources: ABS

[3] According to the ABS (Australian Bureau of Statistics), the adjusted ratio reflects the removal of price change from the original series and therefore provides an indicator of leverage without the market price changes.

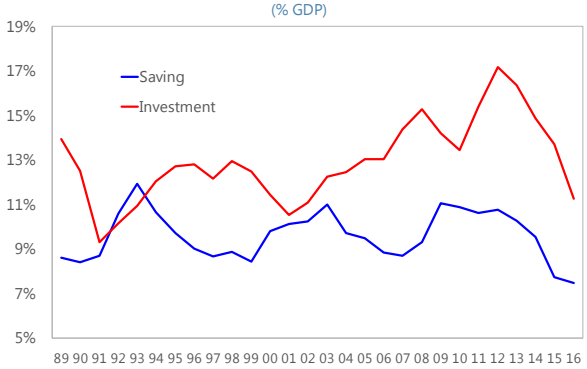
lagged the decline in commodity prices. In the most recent period, the gap has largely stabilized as the decline in mining investment is almost complete, the terms of trade has improved and there has been deleveraging by NFCs in particular among resources companies. (Figures 11, 12).

Figure 11. Investment
(% GDP)



Sources: Haver Analytics and IMF staff calculations.

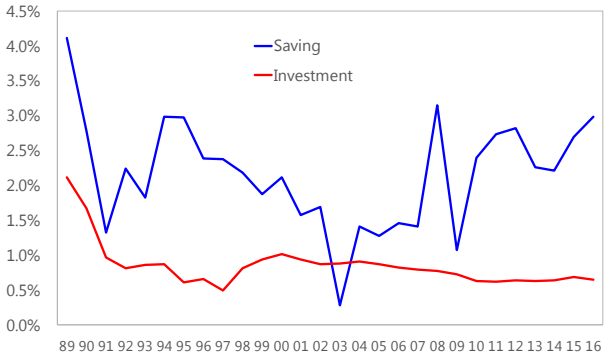
Figure 12. Non-financial Sector's Saving and Investment
(% GDP)



Sources: Haver Analytics and IMF staff calculations.

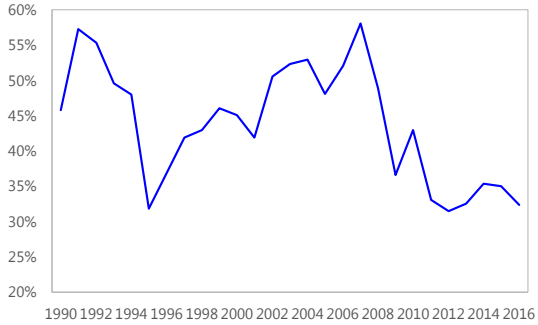
7. Fourth, less benign global financial conditions and tightening regulatory requirements have led the financial corporations to increase their saving (Figure 13). Banks lowered the share of dividend payments out of gross operating surplus by one third, from 60 percent to 40 percent. Consequently, retained earnings and saving have increased, contributing to higher capital adequacy ratios (Figure 14).

Figure 13. Financial Sector's Saving and Investment
(% GDP)



Sources: Haver Analytics and IMF staff calculations.

Figure 14. Share of Dividends to Gross Operating Surplus
(Percent)

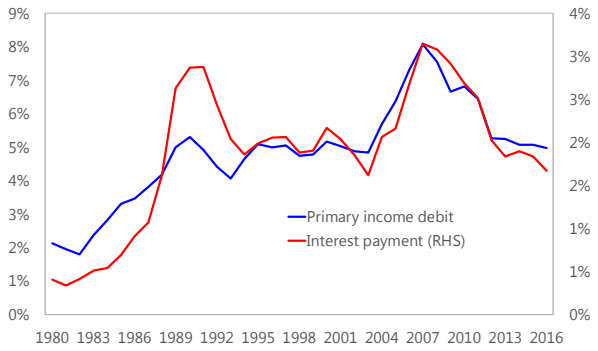


Sources: Haver Analytics and IMF staff calculations.

8. Fifth, interest payments to non-residents declined, reducing the primary income deficit (Figure 15). Interest payments to non-residents as a percent of GDP decreased by one half, from about 3 percent before the GFC to 1.5 percent. Two factors are at work. First, the composition of external debt shifted toward government bonds away from bank liabilities. The share of general government external debt almost quadrupled while that of banks dropped by 20 percentage points (Figure 16). The increase in the government external debt to GDP ratio is mostly due to fiscal policy producing a larger government deficit in response to a weaker economy after the GFC. Banks reduced reliance on external funding while increasing their share of domestic deposits mainly due to tighter external funding condition and liquidity requirement. Second, risk-free government bond

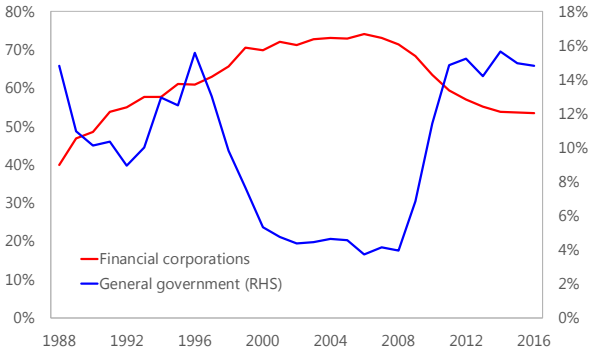
yields and risk premia on Australian bonds decreased, largely because of a relatively more accommodative monetary policy stance in Australia since the GFC. The lower interest burden, other factors being are equal, has likely resulted in higher saving by governments and banks.

Figure 15. Interest Payment to Non-Residents
(% GDP)



Sources: Haver Analytics and IMF staff calculations.

Figure 16. Share of Gross External Debt
(Percent)

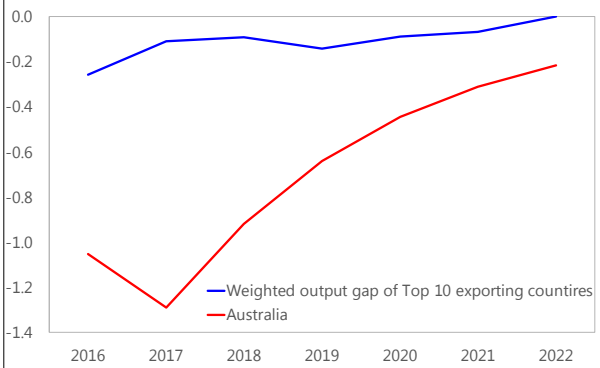


Sources: Haver Analytics and IMF staff calculations.

C. Prospects for the Current Account Balance

9. Australia's underlying current account deficit is likely to remain lower than pre-GFC period. The improvement in the terms of trade in 2017 relative to the previous year should result in a current account deficit of around 2 percent of GDP, given developments to 2017Q3. While the current account deficit is expected to widen as the output gap closes with strengthening domestic demand, the widening of current account deficit will be small, given the size of the gap (Figure 17).

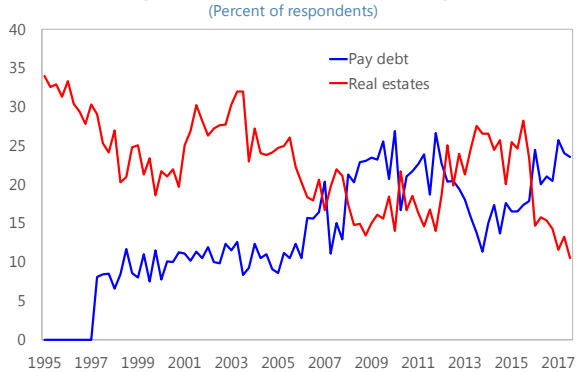
Figure 17. Projected Output Gap
(Percent)



Source: IMF staff calculations.

10. Other considerations support this expectation. First, mining investment is expected to remain lower, as the industry will focus more on maintaining its capital stock after a substantial expansion during the recent commodity price boom. Staff forecast non-mining business investment to strengthen, but a substantial pick-up relative to GDP is less likely with capacity utilization rates of mining capital not far away from their long-term averages and trend declines in the prices of many investment goods. Second, household saving is expected to remain at around current levels, with continued higher precautionary saving and some deleveraging (Figure 18). Dwelling investment is likely to moderate toward longer-term averages, given the expected cooling in the housing market. Third, government saving is expected to improve on the back of the overall economic recovery and the government's commitment to return its budget to balance. Fourth, interest spreads in Australia relative to other major advanced economies are expected to remain low, contributing to a continued lower primary income deficit, also supported by a narrower inflation differential (Figure 19).

Figure 18. Wisest Place for Savings
(Percent of respondents)



Sources: Haver Analytics and IMF staff calculations.

Figure 19. Australia Sovereign Spreads
(Australia Commonwealth bond spread over U.S. Treasury bond yields)

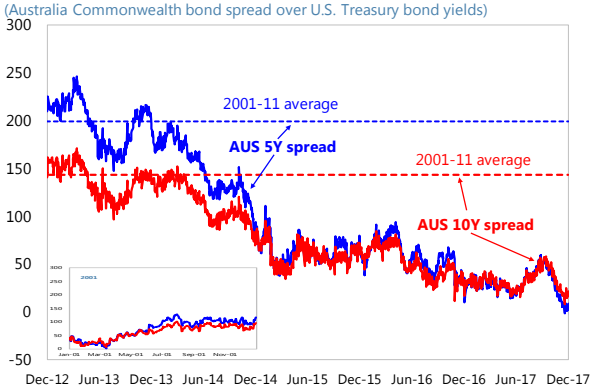
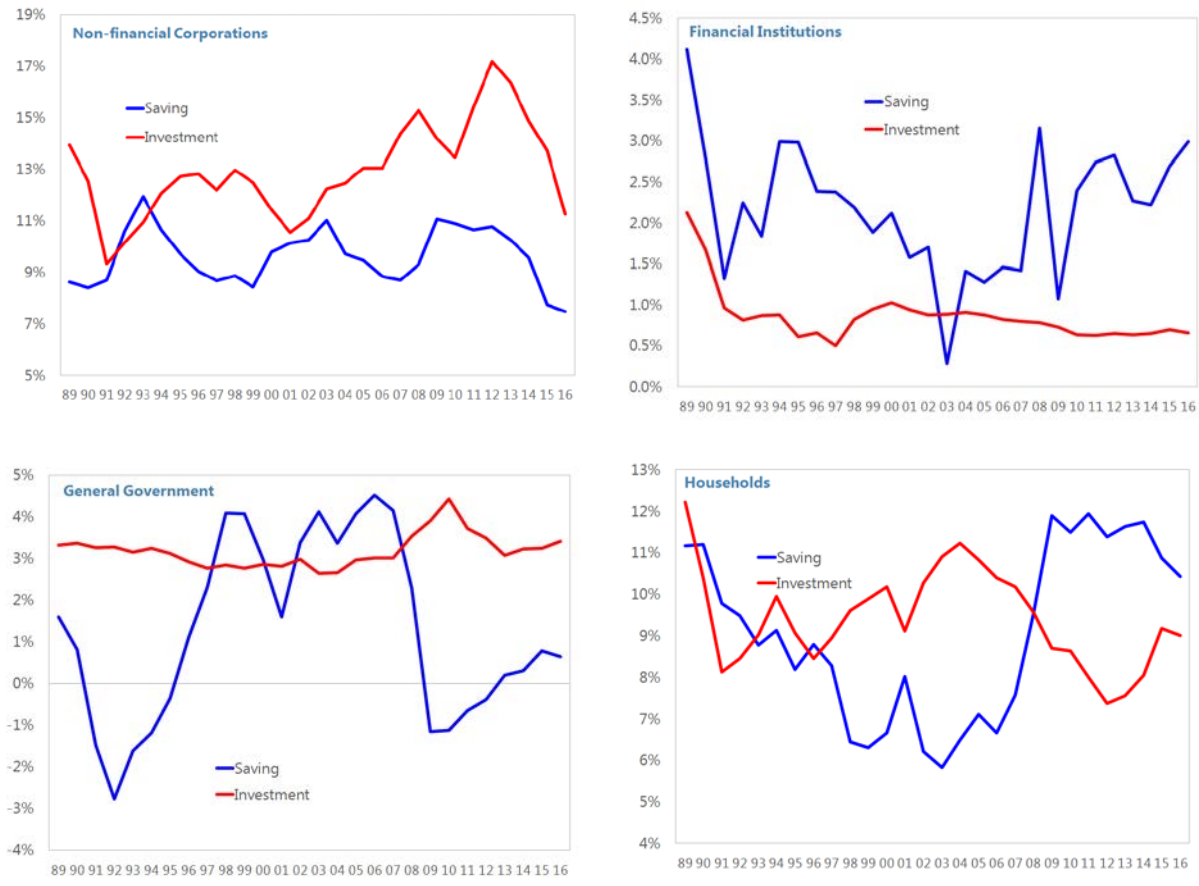


Figure 20. Australia: Sectoral Savings and Investments Balance (% GDP)



Sources: Haver Analytics and IMF staff calculations

Note: Statistical discrepancy between current account balance and savings and investments balance of national account is allocated to each sector in calculating sectoral savings and investment balance.

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INSIGHTS INTO RECENT INFLATION DYNAMICS IN AUSTRALIA [1]

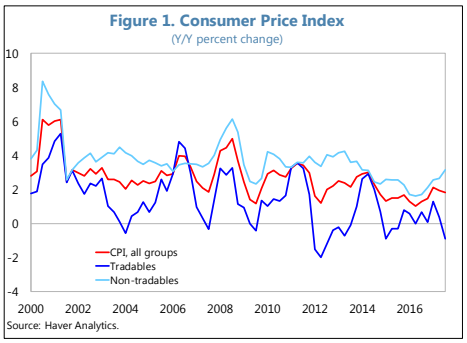
- **This paper examines recent disinflation dynamics in Australia.** Australia's inflation has been below the 2-3 percent inflation target range for nearly three years, despite the more recent turnaround in the economy with rising employment growth. Core goods inflation has generally been lower than core services inflation reflecting the relatively greater impact of global pressures. In terms of tradable inflation, it has been particularly weak, although non-tradable inflation has also declined with a small reversal over the past year mostly due to increases in utilities prices.
- **The paper analyzes the differing inflation dynamics in the CPI components, by estimating separate Phillips curves** for core goods, core services (which exclude housing services), and housing services inflation. This approach sheds light on the channels by which domestic versus external, cyclical versus structural, and sector-specific, factors have affected the different inflatio components.
- **The standard factors in the Phillips curves are found to be significant drivers of inflation.** Economic slack, inflation expectations, and non-oil import prices and oil prices (to capture the inflation effects from price level shifts) are generally significant, but their relative importance differs in core goods and services inflation. Non-oil import and oil prices are more significant for core goods because of their higher import content in core goods. The unemployment gap, which proxies domestic costs better in services than in goods, plays a more significant role under core services inflation. The results are robust to alternative measures of inflation expectations and slack.
- **A decomposition of inflation since 2014 is conducted to further analyze the contribution of special factors (reflected in the residual term) to disinflation.** Core goods inflation respond to the standard factors relatively more and residuals less compared to core services inflation. The residuals are found to be large and consistently negative for core services, likely picking up the effect of special factors such as increased flexibility in labor markets in Australia (with less hiring on standard, full-time contracts), reduced workers' bargaining power, and increased global and domestic competition. This has happened amid a large adjustment of the economy to the end of the mining boom.
- **The Phillips curves are also used for scenario analysis to evaluate alternate paths for inflation dynamics, starting in 2017Q4.** The baseline scenario points to inflation gradually returning to the target range of 2-3 percent by 2019. Under alternative scenarios, the inflation target could be reached earlier if slack closes faster or the Australian dollar depreciates because of U.S. policy tightening and rising long-term interest rates. On the other hand, more persistent shocks may further delay inflation returning to its target range.
- **Considering this uncertainty, a cautious approach to unwinding Australia's accommodative monetary stance remains appropriate.** In this regard, decomposition-

[1] Prepared by Philippe Karam (APD) and Mikhail Pranovich (ICD). The chapter benefited from valuable comments by seminar participants at the Reserve Bank of Australia and by staff from the Treasury of Australia.

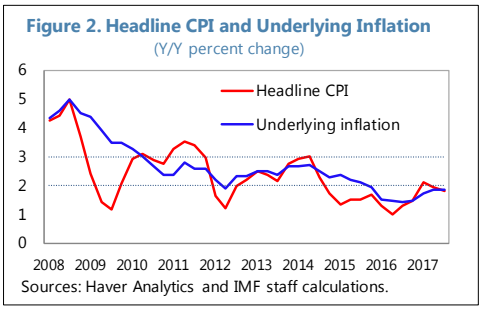
oriented inflation analyses could help in determining the appropriate timing and extent of monetary policy decisions.

A. Introduction

1. Australia's inflation has been on a slight downward trend over much of the past decade. Inflation broadly rose during the terms-of-trade boom and it broadly declined after the Global Financial Crisis and, especially, after the turnaround in the terms of trade and the end of the mining investment boom. Tradable inflation has been particularly weak in recent years, although non-tradable inflation has also declined—its reversal over the past year was mostly due to increases in tobacco excise and utilities prices (Figure 1).



2. With such persistent disinflation, headline inflation has been below Australia's target range for nearly three years. Price pressures have remained weak even as the economy has started to turn around with rising employment growth and falling unemployment, and CPI inflation is still below the lower bound of the 2-3 percent inflation target range (Figure 2).



3. Special factors related to supply seem to have contributed to disinflation. Inflation has declined more than one would have expected based on the economic slack that emerged after the end of the mining boom and import price declines in the context of a weak global economy. As elsewhere, supply factors may also have contributed to the decline, factors associated with technology-driven quality and productivity improvements in telecommunications and computing equipment and some services, increased labor market flexibility and reduced bargaining powers of workers and unions, and increased competitive pressures (see RBA, 2017, and Bishop and Cassidy, 2017). In the Australian context, more intense competition in the retail sector and firms' efforts to reduce costs along their supply chains is also mentioned as a factor contributing to disinflation (Ballantyne and Langcake, 2016).

4. The paper asks two questions: what explains the persistent disinflation and how much could special factors have contributed? To answer these questions, separate Phillips curve models of inflation are estimated for core goods, core services (which excludes housing services), and housing services. The determinants of inflation and their impact differ across goods and services. Inflation for core goods, many of which are tradable, tend to be driven relatively more by external forces, through import prices, while inflation for core services tends to be driven more by domestic factors. Important sector-specific factors (e.g., net migration and price-to-rent ratios) are found to explain the price dynamics in the housing component of consumer price inflation. Furthermore, after estimating the regression with a standard set of factors (some measure of economic slack, inflation

expectations and relative oil and non-oil import prices), the residuals contribute significantly to inflation, by more than half in the case of core services.[2]

5. The structure of the paper is as follows. Section B highlights salient stylized facts. Section C describes the methodology used, reports the estimation results, and provides a historical decomposition of the contribution of factors to inflation since 2014. Section D provides simulations of alternative scenarios that may bring inflation back to its target range earlier in time. Section E concludes.

B. Stylized Facts and Trends

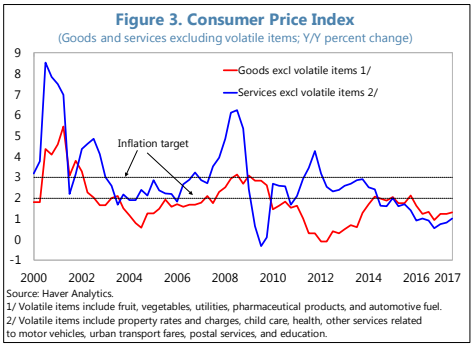
6. Australia's inflation in core goods, core services, and housing have evolved differently.

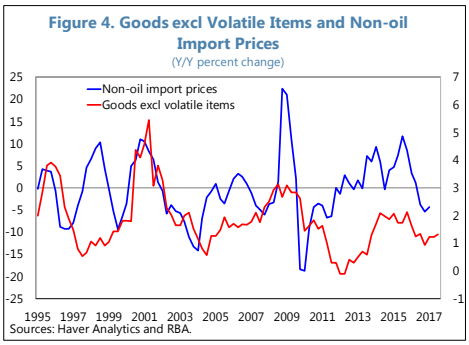
- *Core* measures as indicators of inflation pressures eliminate the effect of volatile items (food, energy, and others) that can drive major swings in 'headline' inflation (Figure 3). Within core CPI, goods represent 52 percent of the consumption basket, and services make up the rest: core services and housing are 31 and 17 percent, respectively.

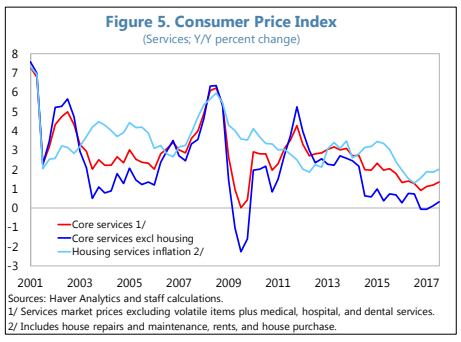
- *Core goods* inflation has generally been lower than core services inflation reflecting the relatively greater impact of global pressures, reflected in weak non-oil import price inflation (Figure 4).

- *Core and housing services* inflation declined through 2001-2007, spiked above 6 percent before the Global Financial Crisis (reflecting excess demand), then fell significantly in the Global Financial Crisis. It has recovered to an average of close to 2.5 percent until 2014 before dropping below target for a prolonged period, starting in 2015.

- *Core services (excluding housing services) inflation* has oscillated between below 1 and 7 percent from 2001 until the Global Financial Crisis, at which time it declined significantly. It gradually increased to about 3 percent on average until 2013, followed by a decline toward zero, before recently beginning to rise (Figure 5).

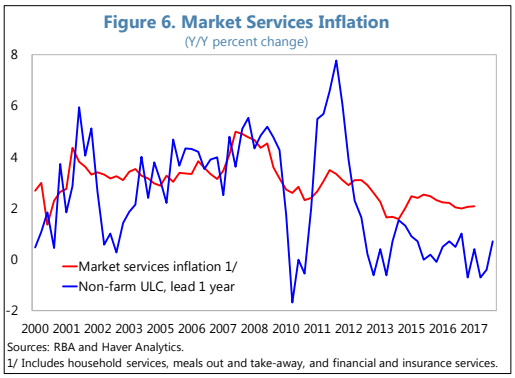






[2] Further extension of the equations to include structural forces have been discussed theoretically for the case of Australia (Treasury, 2017), and empirically tested in IMF (2017b) for advanced economies. These factors were found to be significant in certain cases.

- Consistent with the fact that a large share of input costs in the service-producing sectors is labor costs (accounting for 40 percent of final nontradable prices), Figure 6 supports the idea that labor costs (and by extension, wages) have remained a key driver for domestic market services inflation and appears to have stabilized in recent quarters. Therefore, early signs of market services inflation lifting from its lows would correspond to labor costs lifting as well, which would support domestic inflationary pressures in time.



- *Housing services inflation*, following the Global Financial Crisis, has declined steadily nearing a low of close to 1.5 percent by mid-2016. The pickup followed by the gradual fall does not seem to coincide with the housing boom accompanied by a long period of house price inflation.

C. Empirical Analysis of Recent Inflation Dynamics in Australia

Methodology and Model

7. The econometric analysis is based on Phillips curves that are estimated for overall inflation, core goods inflation, core services inflation, and housing services inflation. Core services excluding housing are hereafter referred to as "core services". The reduced-form approach is similar to Abdih and others (2016) and IMF (2013) building on the hybrid New Keynesian Phillips Curve. The equations depend on a standard set of factors, including cyclical variables (output gaps or unemployment gaps), inflation expectations, and factors that capture the inflation effects from price level shifts (non-oil import prices and oil prices). For housing-related CPI inflation, variables that capture housing-specific demand and cost pressures (i.e., net migration, and price-to-rent ratio) are also used. Many explanatory variables are defined in terms of deviations from their trend levels, that is, in gap terms (see Annex I for detail).

8. The robustness of the results is examined by using different measures of inflation expectations, and economic slack. While inflation expectations market-based measures are simple and timely, they do not adjust for the effect of risk premia on asset prices or low liquidity. On the other hand, survey-based measures using professional forecasters (consensus economics) are argued to be more accurate reflecting the true expectations of inflation of economic agents (Adeney and others, 2017). Furthermore, traditional product and labor markets slack measures were tried to reflect the difference in the effect of imported versus domestic costs pressures in core goods and services.

Empirical Results

Aggregate and Core Goods Phillips Curves

9. Lagged inflation, long-term inflation expectations, domestic slack, and relative prices of imports and oil are the key drivers (Annex Tables I.1, I.2). The coefficients have the expected

signs and are generally significant. The results appear robust with respect to alternative measures for inflation expectations and slack. The impact of the unemployment gap in core goods inflation is half the size of that in core services inflation. The coefficient on the import price gap in the aggregate equation is smaller compared to the core goods inflation equation.

Core Services Phillips Curve[1]

10. This relies on the same standard set of explanatory variables as in the aggregate equation, with the normalization of relative prices adjusted to reflect core services. Empirically, the coefficient on the unemployment gap, which proxies domestic costs better in services than in goods, is larger relative to that in the core goods equation, consistent with the intuition gleaned from Figure 6. The pass through from labor costs to services is significant—a 1 percentage point increase in the unemployment gap is estimated to result in an increase in core services prices by over 1 percentage point after one quarter (Annex Table I.3). The relative import and oil prices are not significant, probably because of the lower import content for services relative to goods.

Housing Services Phillips Curve

11. The lagged output gap, inflation expectations, and import prices gap (imported material in construction costs) are statistically significant. Other suggested explanatory variables include rental vacancy rates (higher rates indicate satisfied demand for house purchases, so lower house prices), mortgage interest rates (lower rates lower housing costs, encouraging housing demand and putting upward pressure on prices), price-rent ratios (increasing ratios indicate higher demand for housing relative to renting, so housing prices are increasing) and net migration (higher migration increases housing demand and hence housing prices). Of these additional factors, lagged net migration and price-to-rent ratio gaps are also significant (Annex Table I.4). These results are in line with prior work in this area (for example, Wokker and Swieringa, 2016).

In Summary

12. The coefficients on the standard variables are statistically significant, have signs in line with the literature and are robust to alternative measures of inflation expectations and slack. The relative size and magnitude of coefficients are also intuitive. The unemployment gap, for instance, which more closely proxies the domestic costs is more significant in the case of core services. Housing services further shows the important role of sector-specific drivers of inflation, such as the price-rent ratios and net migration which may have dynamics of their own not necessarily tied to the economic cycle.

Contributions to Inflation: A Historical Decomposition Since 2014

13. A decomposition of inflation since 2014 demonstrates the influence of slack, inflation expectations, relative prices and residuals in determining Australian inflation. Figures 7.A-9.A

[1] A separate equation for healthcare inflation is not estimated, given its relatively small weight (5 to 6 percent of Australia's consumption basket compared to 20 percent in the U.S.) and the difficulties in modeling the idiosyncratic factors and the policies affecting the sector.

examine contributions of factors to inflation for core goods, core services, and housing services inflation, respectively, over 2014Q1-2017Q1, measured as quarter-over-quarter inflation, annualized. Figures 7.B-9.B present contributions in terms of changes in between first quarters of each year. The (in-sample) values of explanatory variables are multiplied by the corresponding estimated regression coefficients to measure the contribution of factors to inflation; the contribution of shocks (unexplained dynamics embodied in the residuals) is the difference between predicted (sum of impacts of all explanatory variables) and actual inflation rates. Annex I, presents the estimation results for *Regressions 1-3* with different slack and inflation expectations measures. Figures 7 to 9 correspond to *Regression 1*.

Core Goods

14. Residuals did not drag core goods inflation persistently in a negative direction (Figure 7.A). *Domestic slack* (the output gap) weighed on inflation mildly, contributing little on net and on average over 2016, but more positively in the last two quarters. *Inflation expectations* exerted a downward pressure on inflation throughout 2014Q1-2017Q1. This effect became more pronounced for the most part of 2016, before abating in the last two quarters. *Relative import prices* (in AUD) pushed inflation up during 2015Q1-2016Q3, contributing about 0.5 percentage points on average, primarily due to the depreciating AUD; the positive contribution diminished in the last five quarters to 2017Q1 and since 2016Q4 turned negative, because AUD appreciated (by close to 5 percent) during 2015Q4-2017Q1. High *relative oil prices* supported inflation in 2014; during 2015Q1- 2016Q3, the drop in oil prices subtracted on average 0.2 percentage points from inflation, but since then oil prices have recovered and have progressively added to inflation (0.2 percentage points in 2017Q1).

15. Table 1 (column 1) reports the contribution of factors to the deviation of core goods inflation in 2014Q1-2017Q1 from its sample mean. Inflation dropped 0.3 percentage points below the sample mean. The residuals played a smaller role relative to standard factors, with a dominant market-based inflation expectations effect – the latter declined in 2014Q1-2017Q1, which likely captured downward pressures on inflation (beyond oil price level effects). In the alternative formulation of the Phillips curve with survey-based inflation expectations, the unemployment gap exerted more downward pressure on inflation and the contribution of inflation expectations was cut by two-thirds (Table 2, column 1).

Core Services

16. Residuals were large and consistently negative (Figure 8.A). They were likely picking up the effect of reduced workers' bargaining power, and other labor market institutional effects such as flexibility which has affected hiring on standard, full-time contracts, and increased competitive pressures on firms' pricing power.[2] A gradual decline in market-based inflation expectations in recent years likely fed into lower wages, with the expectation that rising pricing pressures in the expansionary phase of the cycle would lead to stronger wage growth and inflation. The largest

[2] Measurement errors in the slack measure and slower inflation in administered prices (i.e., specific individual services, such as health, not captured in the model's core services inflation equation) could have also played a role.

negative contribution of change in the residuals to the change in the inflation rate occurred between 2015Q1 and 2016Q1 (Figure 8.B).

17. Average core services inflation over 2014Q1-2017Q1 was 1.6 percentage points below the sample mean of 2.7 percent (Table 1, column 2). Declining *inflation expectations* dragged down core services inflation by 0.4 percentage points per quarter on average, but special factors exerted the largest negative drag on inflation (-1.2 percentage points). The alternative model with unemployment gap and survey-based expectations (Table 2, column 2), suggests a larger drag effect of the unemployment gap on core services inflation (-0.9 percentage points), as the unemployment rate was consistently above the NAIRU. The estimate of the drag effect of the shock is reduced, but remains negative (-0.6 percentage points).

Housing Services

18. Residuals behave in a similar way to the ones estimated for core services inflation (Figure 9.A). Substantially lower housing services inflation in 2014Q1-2017Q1 seemed to be largely driven by a sequence of negative supply shocks (notably between 2015Q3 and 2016Q2 and the last two quarters). Low *inflation expectations* slowed housing services inflation somewhat. The impact of market *slack* on housing services inflation changed from mildly negative to positive between 2014 and 2015 and was broadly flat in 2016. Declining, and remaining below its long-term trend, *net migration* slowed housing services inflation during 2014Q1-2016Q4 with the strongest drag at end-2014. As migration started to pick up again in mid-2015, the drag on housing services inflation diminished and after a sharp uptick in the second half of 2016, this factor appeared to have pushed up inflation in 2017Q1. *Housing prices* continued to increase during 2014Q1-2016Q4, supporting housing services inflation from 2015 to recent quarters.

19. Average housing services inflation in 2014Q1-2017Q1 fell by 1.7 percentage points below the sample mean of 3.9 percent (Table 1, column 3). Negative shocks contributed the most in slowing inflation (-1.2 percentage points). Lower inflation expectations and net migration slowed housing services inflation by 0.4 and 0.2 percentage points per quarter on average. Output gap and price-to-rent mildly supported housing services inflation (less than 0.1 and 0.1 percentage points respectively). Applying the alternative Phillips curve with survey-based inflation expectations and the unemployment gap to estimate the contributions of factors reveals that the labor market slack substantially dragged down inflation (-1.1 percentage points). The contribution of the shock is less, but remains relatively large (-0.6 percentage points) (Table 2, column 3).

In Summary

20. Core goods inflation responded to the standard factors relatively more and, residuals played less of a visible and persistent role than in core services inflation. The role of the residuals is in line with changes in labor market institutions, contract and pay arrangements in Australia, along with increased international competition, amid a large adjustment of the economy to the end of the mining boom, which all weighed down on the wage-price dynamics. As the labor market tightens, compositional shifts within industries abate, and other structural factors stabilize, it is expected that Australian wages should accelerate and inflation should rise back into the target range. Going forward, how high trend labor productivity growth will be and how much of the improved labor market slack will feed through to wages is key to the dynamics of core services inflation. At the same time, the extent and persistence of the increase in competition could keep core services inflation (and inflation more generally) at an average level below that experienced before the Global Financial Crisis.

Table 1. Contribution of Factors to the Deviation of Inflation Components from Sample Averages with Market-Based Expectations

(In percentage points of total deviation of the component from its mean (i.e. average level of inflation))

	Core Goods	Core Services	Housing Services
Lag	-0.04	-0.11	-0.11
(Market-Based) Inflation expectations	-0.51	-0.37	-0.36
GDP Gap	0.04	0.02	0.03
Relative Import Prices	0.23		
Relative Oil Prices	-0.02		
Net Migration Gap			-0.15
Price-to-Rent Gap			0.09
Shock	0.05	-1.18	-1.17
Total deviation	**-0.26**	**-1.62**	**-1.67**

Table 2. Contribution of Factors to the Deviation of Inflation Components from Sample Averages with Survey-Based Expectations

(In percentage points of total deviation of the component from its mean (i.e. average level of inflation))

	Core Goods	Core Services	Housing Services
Lag	-0.03	-0.13	-0.07
(Survey-Based) Inflation expectations	-0.16	0.01	0.01
Unemployment Gap	-0.30	-0.90	-1.08
Relative Import Prices	0.26		
Relative Oil Prices	-0.05		
Net Migration Gap			-0.09
Price-to-Rent Gap			0.19
Shock	0.02	-0.62	-0.64
Total deviation	**-0.26**	**-1.62**	**-1.67**

Note: "-" indicates a drag on inflation

Note: Sample averages for core goods, core services, and housing services are 1.9, 2.7, and 3.9 percent over the sample periods of 1992Q1-2017Q1, 1999Q1-2017Q1 and 1999Q1-2017Q1 respectively.

Figure 7.A. Decomposition of Core Goods Inflation

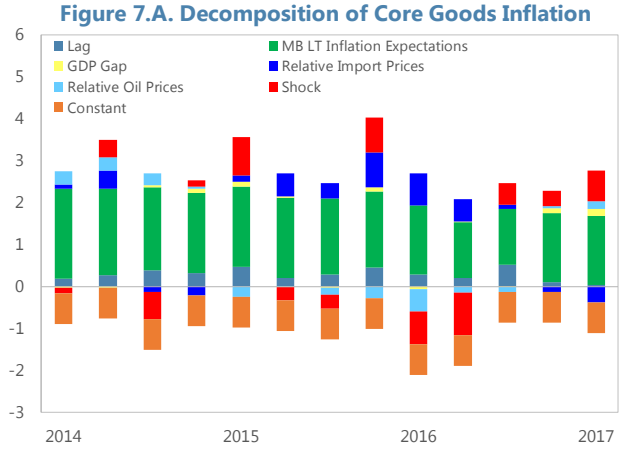
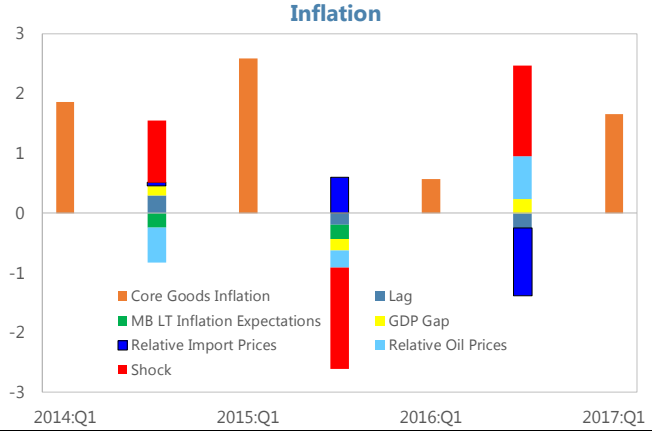


Figure 7.B. Decomposition of Changes in Core Goods Inflation



Sources: Haver Analytics; RBA; and IMF staff calculations.

Figure 8.A. Decomposition of Core Services Inflation

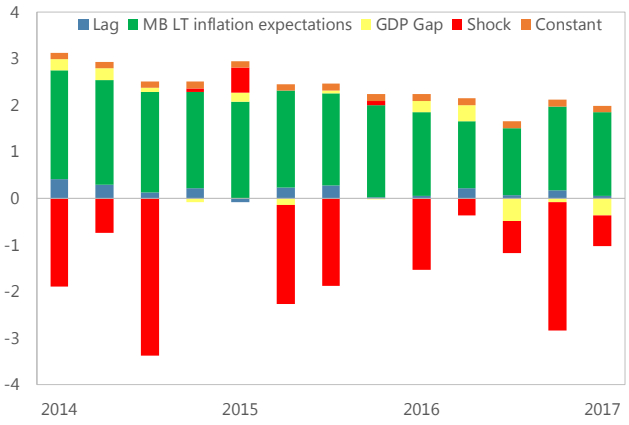
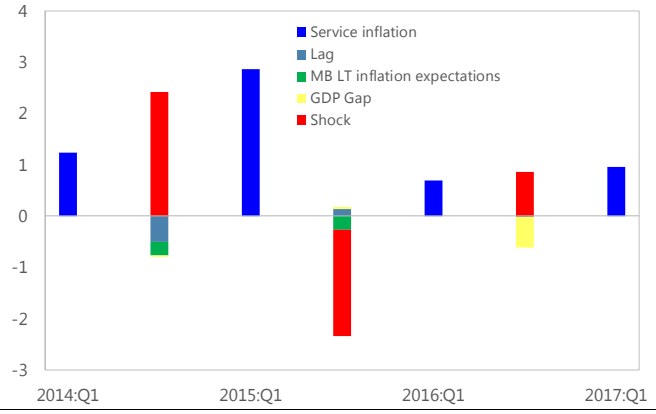


Figure 8.B. Decomposition of Changes in Core Services Inflation



Sources: Haver Analytics; RBA; and IMF staff calculations.

Figure 9.A. Decomposition of Housing Services Inflation

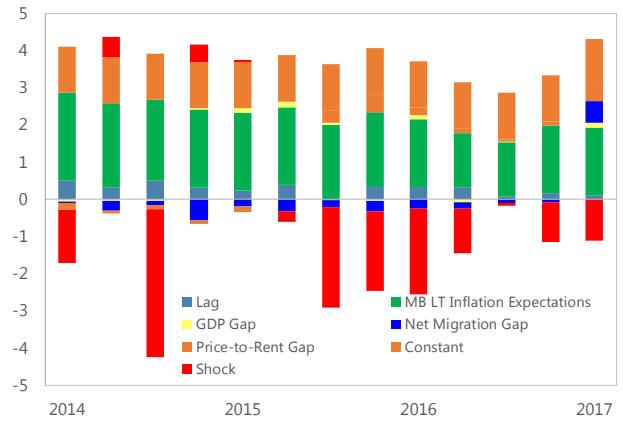
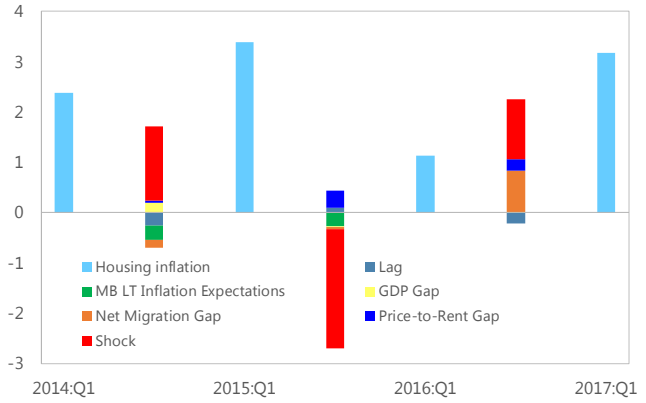


Figure 9.B. Decomposition of Changes in Housing Service Inflation



Sources: Haver Analytics; RBA; and IMF staff calculations.

D. Scenario Analysis Using the Phillips Curves

21. The three equations for the components of inflation (based on *Regression 3* in each case) can be used for simple scenario analyses. Projecting each inflation component allows for construction of a trajectory for aggregate core inflation in the baseline scenario, which can then be varied to produce several alternative scenarios (charts of the results can be found in Annex III). The shortcoming of this approach based on Phillips curves is its assumption that movements across inflation components are independent and there is no feedback from them to other macroeconomic variables and policy stance, unlike, for example, a general equilibrium approach based on a structural macroeconomic model which would allow for this interaction. Despite its limitations, scenario analysis is still an instructive tool to evaluate alternate paths for inflation dynamics.

22. Simple autoregressive models for stationary processes are assumed to forecast the trajectories of the different gap variables that enter Phillips curves on the right-hand side:

$$\hat{x}_t = \alpha_1 \hat{x}_{t-1} + \ldots + \alpha_n \hat{x}_{t-n} + \cdots + e_t^x.$$

Hence, the future predicted values of gaps are:

$$E_t \hat{x}_{t+i} = \alpha_1 E_t \hat{x}_{t+i-1} + \ldots + \alpha_n E_t \hat{x}_{t+i-n},$$

$$E_t \hat{x}_{t+i-n} = \hat{x}_{t+i-n}, for\ i \leq n.$$

23. In the baseline scenario, a survey-based measure of expected inflation moves to its mean level and all gap variables gradually close. The slack in the economy remains relatively large. Therefore, inflation for core goods, core services and housing services runs below the mean values of 1.9, 2.7 and 3.9 percent and the total core inflation returns in the 2-3 percent target range by 2019Q1, but remains near its lower bound.

24. The first alternative scenario analyzes how quickly unemployment should return to NAIRU for inflation to rise from its current trough and reach the midpoint of the 2-3 percent inflation target range by mid-2018. All other explanatory variables follow their baseline trajectories. Unemployment would need to decline to NAIRU by 2018Q1 to ensure that core inflation returns to 2.5 percent in 2018Q3 and remains inside the target range thereafter.

25. The second alternative scenario analyzes what the depreciation of the Australian dollar needs to be so that the resulting movement in import and oil prices drives inflation to 2.5 percent in 2018. Other explanatory variables follow their baseline trajectories.[1] Back-of-the-envelope calculations show that to offset the drag on inflation from unemployment persistently below NAIRU the Australian dollar would need to depreciate by about 7 percent in 2018, about 5.5 percent in 2019 and 3 percent in 2020 relative to the baseline scenario. This would generate on average 1.1 percentage points higher core goods inflation from 2018 to 2020 compared to that in the baseline scenario, bringing core inflation close to 2.5 percent.

[1] A richer structural model, which captures the indirect exchange rate channel of monetary transmission mechanism would provide for a fuller analysis. Nominal depreciation should also make aggregate monetary conditions more accommodative, stimulate demand and hence generate additional inflationary pressures.

26. In the third alternative scenario, the unidentified shocks are persistent. The average value of a shock to each inflation component, estimated over 2016Q2-2017Q1, is assumed to decay at a rate of 0.9 in subsequent quarters. For example, based on an average value of the shock to core services inflation of -1.2 percentage points, the shock imposed in the first out-of-sample quarter is -1.1 percentage points in 2017Q2, -1 percentage points in 2017Q3, and so on. Other explanatory variables follow their baseline trajectories. The shocks drag down inflation for most components and core inflation returns close to the midpoint of the target range only in the beginning of 2020, which is slower than in the baseline.

In Summary

27. Inflation is likely to remain subdued going forward. Inflation is likely to be suppressed by persistent economic slack. Returning core inflation to the midpoint of the inflation target range earlier would require a faster closing of the unemployment gap by early in 2018, and/or a depreciation of the Australian dollar. Greater persistence in the unidentified shocks would delay a return of core inflation to its target range.

E. Conclusions

28. The bottom-up empirical analysis shows that structural factors affected core inflation in the goods and services components differently. Core goods inflation seems to respond primarily to the standard factors. In contrast, core services inflation seems to be substantially influenced by structural forces, reflected in the residual term.

29. Signs of persistent disinflation and the role of special factors were gleaned from the analysis of the historical decomposition of inflation since 2014. The large and consistently negative residuals for core services point to the significant effect of structural factors which have likely contributed to the prolonged decline in headline inflation. These factors are believed to be embedded in the reduced bargaining power of workers and unions, employment contracts and pay arrangements pointing to less full-time employment and smaller and less frequent price increases, in an environment of rising domestic and global competition.

30. Considering the scenario analysis of inflation, inflation is likely to gradually return to the target range of 2-3 percent by 2019. Returning inflation to the midpoint of the inflation target range earlier would require a faster closing of the unemployment gap by early in 2018, and/or a depreciation of the Australian dollar. Greater persistence in the unidentified shocks would delay a return of inflation to target.

31. As the labor market tightens, compositional shifts within industries abate, and the long-run competition forces stabilize, wage and price growth are expected to rise in response. Going forward, how much of the improved labor market slack will feed through to wages is important to increased core services inflation. At the same time, persistence of competitive forces could keep core services inflation (and inflation more generally) at an average level below that experienced before the Global Financial Crisis, and as such, supporting a continuing cautious approach to unwinding Australia's accommodative monetary stance.

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Annex I. Empirical Methodology, Model Specification and Results

The number of potential explanatory variables to the different inflation components can be large requiring a careful selection of variables and their lag lengths to accurately capture their dynamics. A *general-to-specific* approach is followed. To start with, a general model is estimated, including all potential explanatory variables of lags 0 to *N*, where *N* is relatively large, then move to a specific, more parsimonious form by eliminating statistically insignificant variables. The maximum lag length of the right-hand side variables is limited to four quarters (*N*=4). Disadvantages of this approach can be small degrees of freedom for the general model and possibly path-dependency when testing down the general model to its specific form.

Pairwise cross-correlations of the left-hand-side variable (inflation) and the explanatory variables are pre-screened, excluding the ones related to inflation at less than the 10 percent significance level. In addition, alternative potential proxies for domestic costs in the general formulation are considered. Potential endogeneity problems are addressed by using an instrumental variables approach in a two-stage OLS estimation procedure; in selecting the instruments, lags of simultaneously dated right-hand-side variables are included. In conducting the residual diagnostics, a battery of standard tests (serial autocorrelation, homoscedasticity and normality) have been applied to models' residuals. Only the final models with significant variables are presented in Annex Tables I.1-I.4.

- Two measures of inflation expectations are used: *market-based* (difference between spot and forward rates on inflation-linked and nominal government bonds) and *survey-based* (surveys of professional economic forecasters in 'consensus economics') measures.

- Different slack measures are used: *output gap* and *unemployment gap*. The output gap measures the percent deviation of real GDP from the level of potential output. The unemployment gap measures the level deviation of the unemployment rate (in percentage points) from its level consistent with no inflationary or deflationary pressures (the non-accelerating inflation rate of unemployment, NAIRU).

- Three regressions are estimated for all four cases: *Regression 1* includes market-based long-term inflation expectations $\pi_t^{MBLTExp}$ and the output gap $\hat{y}_t$. *Regression 2* replaces $\pi_t^{MBLTExp}$ with consensus forecast inflation expectations $\pi_t^{CFLTExp}$. Regression 3 replaces $\hat{y}_t$ with the unemployment gap $\hat{u}_t$ and $\pi_t^{CFLTExp}$ is used.

- Lagged values of inflation and long-term inflation expectations are restricted to sum to one.

- Annex II provides the definitions of variables used in this paper.

- A '*hat*' *(^)* denotes a gap between a variable and its equilibrium value.

- Inflation rates are quarter-over-quarter, annualized, which would potentially avoid autocorrelation in the modeled inflation rates (relative to a year-over-year measurement) and reduce the problem of possible spurious significance of lags.

The Aggregate Phillips Curve

The specification of the final core inflation equation (π_t^{crcpi}) is rather standard. Inflation varies negatively with the relevant domestic slack measure, and positively with changes in relative prices and inflation expectations. These are often close to the central bank's inflation target and the coefficient can be interpreted as the degree to which the inflation is linked to long-term inflation expectations.

Regression 1 is modeled as a function of: $\hat{y}_{t-3}$, lagged value of the output gap; $\widehat{rel\_impr}_{t-1}$, lagged value of relative price of imports (excluding energy) in gap form; $\widehat{rel_{oilpr}}_t$, current value of relative price of oil in gap form; and π_t^{LTExp}, market-based inflation expectations. A dummy variable is added to the specification; it takes the value of unity in 2000Q3 and zero otherwise to capture the GST introduction. The coefficient on the latter captures an outlier (following a rule of thumb, considered as three times larger than the standard deviation of the dependent variable and the standard error of the regression). e_t^{crcpi} captures the impact of other factors as driven by broader supply shocks, or possible measurement error in variables (such as measures of slack). The results of *Regression 2 and 3* (with alternative measures of inflation expectations and slack, identified above) are also reported (Annex Table I.1).

Regression 1

$$\pi_t^{crcpi} = b_1\pi_{t-2}^{crcpi} + (1-b_1)\pi_t^{MBLTExp} + b_2\hat{y}_{t-3} + b_3\widehat{rel_{impr}}_{t-1} + b_4\widehat{rel_{oilpr}}_t + \ldots$$
$$\ldots + b_5 d2000q3 + e_t^{crcpi}$$

Annex Table I.1. Aggregate Phillips Curve for Core Inflation, π_t^{crcpi}

	Regression 1	Regression 2	Regression 3
π_{t-2}^{crcpi}	0.155 (0.058)**	0.121 (0.065)*	0.108 (0.067)
$\pi_t^{MBLTExp}$	0.845 (0.058)**		
$\pi_t^{CFLTExp}$		0.879 (0.065)**	0.902 (0.067)**
$\hat{y}_{t-3}$	0.315 (0.114)**	0.163 (0.142)	
$\hat{u}_{t-4}$			-0.273 (0.210)
$\widehat{rel\_impr}_{t-1}$	0.034 (0.020)*	0.020 (0.021)	0.049 (0.026)*
$\widehat{rel\_oilpr}_t$	0.011 (0.005)**	0.017 (0.006)**	0.018 (0.008)**
$d2000q3$	9.961 (0.850)**	10.341 (0.903)**	10.360 (0.923)**
Number of observations	101	97	97
R^2	0.683	0.655	0.653

Core Goods Phillips Curve

Lagged inflation, inflation expectations, output gap, lagged relative import price and current oil price gaps are found to be significant (Annex Table I.2).

Regression 1

$$\pi_t^{crgds} = \alpha_1\pi_{t-3}^{crgds} + (1-\alpha_1)\pi_t^{MBLTExp} + \alpha_3\hat{y}_{t-3} + \alpha_4\widehat{rel_{impr}}_{t-1} + \alpha_5\widehat{rel_{oilpr}}_t + \ldots$$
$$\ldots + \alpha_6 d2000q3 + e_t^{crgds}$$

Annex Table I.2: Phillips Curve for Core Goods Inflation, π_t^{crgds}			
	Regression 1	**Regression 2**	**Regression 3**
π_{t-3}^{crgds}	0.174 (0.066)**	0.169 (0.065)**	0.154 (0.066)**
$\pi_t^{MBLTExp}$	0.826 (0.066)**		
$\pi_t^{CFLTExp}$		0.831 (0.065)**	0.846 (0.066)**
$\hat{y}_{t-3}$	0.391 (0.130)**	0.400 (0.155)**	
$\hat{u}_{t-3}$			-0.566 (0.237)**
$\widehat{rel\_impr}_{t-1}$	0.141 (0.025)**	0.140 (0.025)**	0.160 (0.025)**
$\widehat{rel\_oilpr}_t$	0.013 (0.008)**	0.024 (0.008)**	0.026 (0.008)**
$d2000q3$	8.235 (0.992)**	8.130 (0.974)**	8.055 (0.990)**
Number of observations	101	97	97
R^2	0.631	0.657	0.649

Core Services Phillips Curve

Import prices and oil prices, pointing to the insignificant role of imported costs in inflation in services, were not found to be significant (Annex Table I.3).

Regression 1

$$\pi_t^{crsrv} = \beta_1 \pi_{t-2}^{crsrv} + (1-\beta_1)\pi_t^{MBLTExp} + \beta_3 \hat{y}_t + \beta_4 d2000q3 + \ldots$$

$$\ldots + \beta_5 d2002q1 + \beta_6 d2009q1 + e_t^{crsrv}$$

Annex Table I.3: Phillips Curve for Core Services Inflation, π_t^{crsrv}			
	Regression 1	**Regression 2**	**Regression 3**
π_{t-2}^{crsrv}	0.099 (0.067)	0.111 (0.073)**	0.089 (0.082)
$\pi_t^{MBLTExp}$	0.801 (0.067)**		
$\pi_t^{CFLTExp}$		0.809 (0.073)**	0.911 (0.082)**
$\hat{y}_t$	0.815 (0.484)*	0.947 (0.542)*	
$\hat{u}_{t-1}$			-1.044 (0.757)*
$d2000q3$	15.403 (1.774)**	15.709 (1.919)**	15.086 (1.872)**
$d2002q1$	6.224 (1.778)**	6.624 (1.921)**	6.413 (1.879)**
$d2009q1$	-10.467 (1.781)**	-10.777 (1.922)**	-10.900 (1.870)**
Number of observations	72	71	71
R^2	0.688	0.641	0.651

Housing Services Phillips Curve

Regression 1

$$\pi_t^{hs} = \gamma_1 \pi_{t-4}^{hs} + (1-\gamma_1)\pi_t^{MBLTExp} + \gamma_3 \hat{y}_{t-4} + \gamma_4 \widehat{mgr_{net}}_{t-2} + \gamma_5 \widehat{price_{rent}}_{t-1} + \ldots$$

$$\ldots + \gamma_6 d2000q3 + \gamma_7 d2012q3 + e_t^{hs}$$

The fourth lag of housing services inflation π_{t-4}^{hs}, inflation expectations π_t^{LTExp}, lagged output gap $\hat{y}_{t-4}$, and import prices gap $\widehat{rel\_impr}_{t-3}$ are statistically significant. The equation includes additional factors that likely capture demand pressures, which go beyond economic slack—lagged net migration $\widehat{mgr\_net}_{t-2}$ and price-to-rent ratio gaps $\widehat{price\_rent}_{t-1}$. The two dummy variables in 2000Q3 and 2012Q3 capture outlier events (Annex Table I.4).

Annex Table I.4: Phillips Curve for Housing Services Inflation, π_t^{hs}

	Regression 1	**Regression 2**	**Regression 3**
π_{t-4}^{hs}	0.095 (0.056)*	0.095 (0.061)	0.104 (0.061)*
$\pi_t^{MBLTExp}$	0.905 (0.056)**		
$\pi_t^{CFLTExp}$		0.905 (0.062)**	0.906 (0.061)**
$\hat{y}_{t-4}$	0.464 (0.283)*	0.501 (0.300)*	
$\hat{u}_{t-3}$			-1.299 (0.628)**
$\widehat{mgr\_net}_{t-2}$	0.059 (0.020)**	0.057 (0.022)**	0.050 (0.021)**
$\widehat{price\_rent}_{t-1}$	0.150 (0.046)**	0.162 (0.050)**	0.221 (0.061)**
$d2000q3$	17.188 (1.281)**	17.571 (1.394)**	18.199 (1.406)**
$d2012q3$	6.277 (1.293)**	6.265 (1.408)**	6.429 (1.410)**
Number of observations	73	73	73
R^2	0.780	0.638	0.741

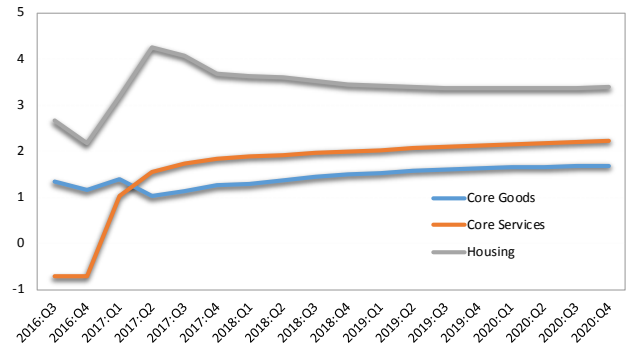
Annex II. Definitions of Variables

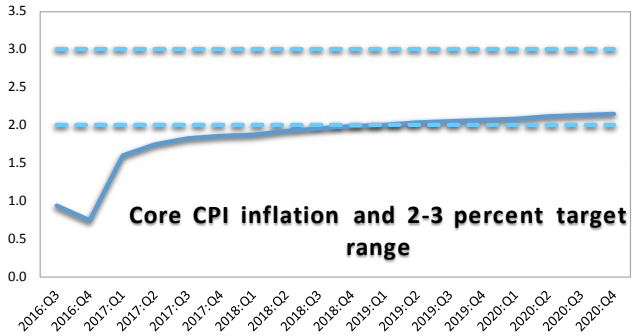
The data in this paper are publicly available from the Australia Bureau of Statistics, Reserve Bank of Australia, Haver Analytics, and the IMF World Economic Outlook Database. The following table reports the definition of all the variables used in this paper.

List of Variables	
π_t^{core}	Inflation of Core Goods and Services Prices, excl. volatile items.
π_t^{crgds}	Inflation of Core Goods, excl. volatile items.
π_t^{crsrv}	Inflation of Core Service Prices incl. health services, excl. housing and excl. volatile items.
π_t^{hs}	Inflation of housing prices: rents, costs of building new dwelling, house repairs and maintenance.
$\pi_t^{MBLTExp}$	Market-based long-term inflation expectations, approximated by the 10-years breakeven inflation.
$\pi_t^{CFLTExp}$	Survey-based long-term inflation expectations, of professional forecasters (Consensus Economics).
$\hat{y}_t$	Output gap, the difference between the nat. log GDP in constant prices less the trend estimated using HP-filter.
$\widehat{rel\_impr}_t$	Gap in relative prices of imports excl. energy imports: calculated as (i) the difference between the nat. log of import prices in AUS less the nat. log of prices for core goods and services and (ii) less the trend of relative prices, estimated using HP-filter.
$\widehat{rel\_oilpr}_t$	Gap in relative prices of oil: calculated as (i) the difference between the nat. log of oil prices in AUS less the nat. log of prices for core goods and services and (ii) less the trend of relative oil prices, estimated using HP-filter.
$\widehat{mgr\_net}_t$	Gap in net migration: net migration less the trend of net migration, estimated using HP-filter.
$\widehat{rel\_hspr}_t$	Gap in relative housing prices: calculated as (i) the difference between the nat. log of housing prices and the nat. log of core goods and services and (ii) less the trend of relative prices, estimated using HP-filter.
$d2000q3$	Example of on impulse dummy, equals 1 at 2000q3 and 0 otherwise. Similar definition for other dummy variables assuming value of 1 for the specified year/quarter.

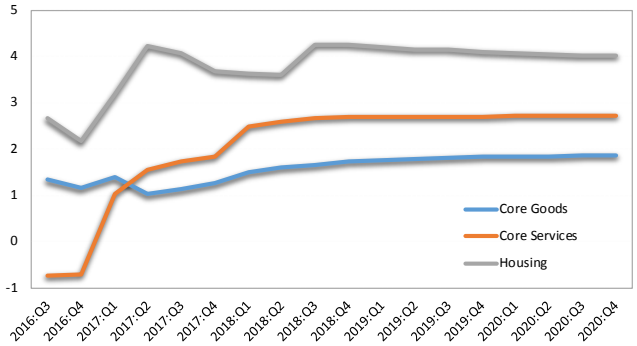
Annex III. Scenario Analyses

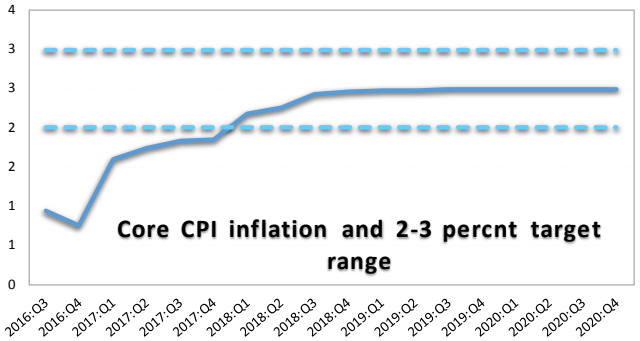
Baseline Scenario



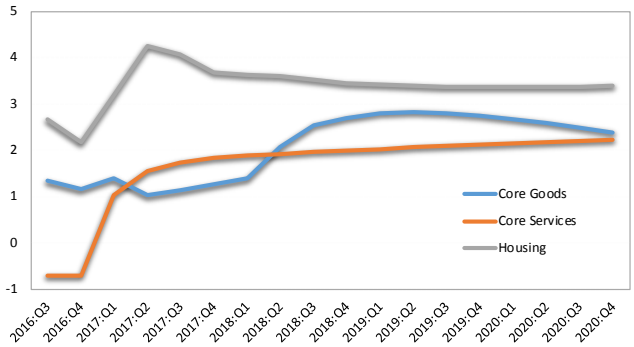


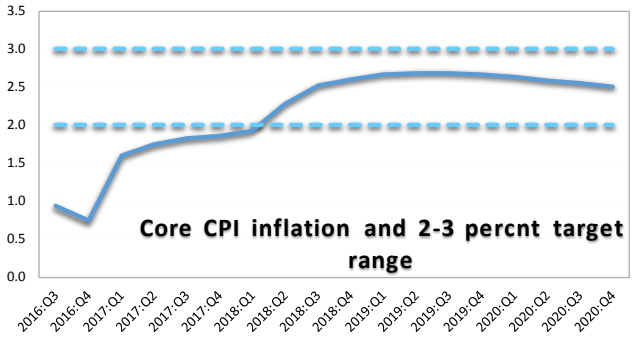
Alternative Scenario I





Alternative Scenario II





Alternative Scenario III