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DISCUSSION PAPER SERIES

IZA DP No. 15561

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ABSTRACT

Assessing Australian Monetary Policy in the Twenty-First Century*

Using the Reserve Bank of Australia's MARTIN model we compare actual monetary policy decisions to a counterfactual in which the cash rate is set according to an optimal simple rule. We find that monetary policy played a crucial role in avoiding a potential recession in 2001 and mitigating the downturn in 2008-2009. By contrast we find that the cash rate was too high during 2016-2019, keeping inflation below the Reserve Bank's target band. Optimal monetary policy in 2016-2019 would have involved a substantially lower cash rate and would have produced significantly better employment outcomes.

JEL Classification: E47, E52, E58
Keywords: optimal monetary policy, unemployment, output gap, inflation

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I Introduction

For almost three decades, from 1992 to 2019, the Australian economy grew continuously year on year. However, from 2016-2021 inflation was consistently been below the 2-3 per cent target band. Some have argued that the Reserve Bank has been too slow to respond to economic crises (eg. Keating 2020) or overly focused on asset prices (eg. Wright 2021). Still others have critiqued the RBA for its relative lack of transparency, its tendency to make in-house appointments, and the lack of monetary policy expertise on its governing board (Tulip 2021).

These critiques raise the question as to whether this remarkable run of growth owed more to good fortune than to well calibrated monetary policy. Donald Horne famously wrote that 'Australia is a lucky country run mainly by second rate people who share its luck.' Does Horne's observation apply to the nation's central bankers?

Our paper informs this debate by analysing the role of monetary policy across three twenty-first century episodes: the 2001 slowdown, the Global Financial Crisis of 2008-2009, and the pre-pandemic period of low inflation from 2016 to 2019. Using the RBA's own macroeconometric models, we estimate the extent to which monetary policy contributed to the Australian economy's performance (by comparing it to a 'Do Nothing' counterfactual in which the cash rate is held constant), and how close monetary policy in this period was to the optimal path (by comparing it to an 'Optimal Simple Rule' counterfactual).

Our analysis adds to a broad literature evaluating historical monetary policy decisions. These analyses are a common and important tool in ensuring that past policy mistakes are not repeated. The Bank of Canada reviews its monetary policy strategy and framework every five years (Bank of Canada 2016). Both the Federal Reserve (Powell 2020) and the European Central Bank (European Central Bank 2021) have recently conducted reviews of monetary policy which evaluated the conduct of monetary policy in their respective jurisdictions and proposed changes to their ongoing policy frameworks as a result.

We find that monetary policy did indeed play an important role in stabilising the Australian economy and preventing recessions. We show that relative to a counterfactual in which the cash rate was held constant, the RBA was critical to avoiding recessions in 2001 and 2008-2009. Our results also demonstrate the costs of fixed, backwards-looking policy rules. In both these periods, we find that RBA policy decisions were better than the decisions that would have been made by mechanically following the macroeconomic model's optimal simple rule. The gap between the two is non-trivial, with actual policy decisions producing substantially better employment outcomes. This difference is due to the policy rule's inability to react to large, sudden shocks to the economy that only impact inflation and unemployment with a substantial lag.

However, with the benefit of hindsight, it is clear that monetary policy was sub-optimal in the period 2016-2019. The cash rate was held too high for too long, leading to inflation undershooting the Reserve Bank of Australia's inflation target band and a large unemployment gap opening up.

The remainder of the paper is structured as follows. In section II, we briefly outline the history of Australian independent monetary policy, and discuss the relevant literature. In section III, we outline the macroeconometric model, MARTIN, that will be the workhorse of our analysis. In section IV, we discuss each historical episode in turn, outlining how monetary policy contributed to the macroeconomic outcomes, and exploring the outcomes that optimal policy might have delivered. In section V, we discuss how our results are affected by alternative measures of welfare or by using a different model. The final section concludes.

II Australian Monetary Policy

A key policy tool for macroeconomic stabilisation, monetary policy aims to keep inflation low and counteract fluctuations in the output gap. While the Global Financial Crisis showed that fiscal policy may play a significant role in responding to large economic contractions – a point underscored by the COVID-19 Crisis – monetary policy is a much nimbler policy tool and is thus largely responsible for the short-term stabilisation of aggregate demand. Monetary policy's scope to stabilise aggregate demand has been further boosted by several policy innovations that enable further stimulus even when interest rates are close to zero. These include bank lending subsidises, quantitative easing, yield curve control and even negative interest rates (Tenreyro 2021).

The RBA's charter is set out in the *Reserve Bank Act 1959* (Cth) and has three objectives:

a) the stability of the currency of Australia;
b) the maintenance of full employment in Australia; and
c) the economic prosperity and welfare of the people of Australia.

The RBA seeks to meet these objectives by using monetary policy to achieve a flexible inflation target that keeps consumer price inflation between 2 and 3 per cent on average, over time. In practice the RBA follows this flexible target by placing weight on both keeping inflation within this band and keeping the labour market close to full employment (Otto and Voss 2011).

The RBA's individual programs and policies have been frequently evaluated in isolation. Examples include the RBA's quantitative easing program (Debelle 2021), forecasting performance (Tulip and Wallace 2012, Pagan and Wilcox 2016), communication and transparency (Preston 2020) and payments system (Chang, Evans and Swartz 2005). However holistic evaluations about the overall stance of money have only previously been done qualitatively (Kirchner 2021b, Tulip 2021). This paper aims to fill that gap and add to the literature by quantifying the overall performance of monetary policy in the 21st century.

Perhaps the study that is most similar to ours is Blanchard and Summers (2020), who use the US Federal Reserve's FRB/US model to estimate counterfactual unemployment paths for three recessions: 1990, 2001 and 2008-2009. In each downturn, they find that monetary policy saved a considerable number of jobs. Expressing the total effect in terms of percentage point-years of unemployment (where one percentage point-year reflects unemployment being 1 percentage point lower for 12 months), monetary policy saved 15 percentage point-years of unemployment in the 1990 recession, 10 percentage point-years of unemployment in the 2001 recession, and 26 percentage point-years of unemployment in the 2008-2009 recession.

III The MARTIN Model

To estimate the impact of monetary policy in Australia we use the RBA's large scale macroeconometric model of the economy, MARTIN (Ballantyne et al 2020).[1] MARTIN is a large model containing 150 equations and covers the household sector, housing market, trade sector, labour market, commodity sector, financial markets and non-financial private corporations. Figure 1 shows the core components and relationships within the model.

We update the version of MARTIN published as Ballantyne et al. (2020) by re-estimating the model up until the end of 2019 and substituting three data series that are not publicly available with publicly released counterparts as described by Stephan (2019). Specifically, we use US variables for World GDP and export prices, and a G3 average (the average of the United States, Japan and the Eurozone) for interest rates. We also have slightly different outcomes for

[1] More formally the model is named 'MAcroeconomic Relationships for Targeting INflation'.

businesses and government investment due to the lack of public data on net asset transfers between the private and public sectors. Details of the data series used and other minor modifications are outlined further in Appendix A.

Figure 1: Overview of Core Components of the MARTIN Model (Source: Ballantyne et al. 2020)

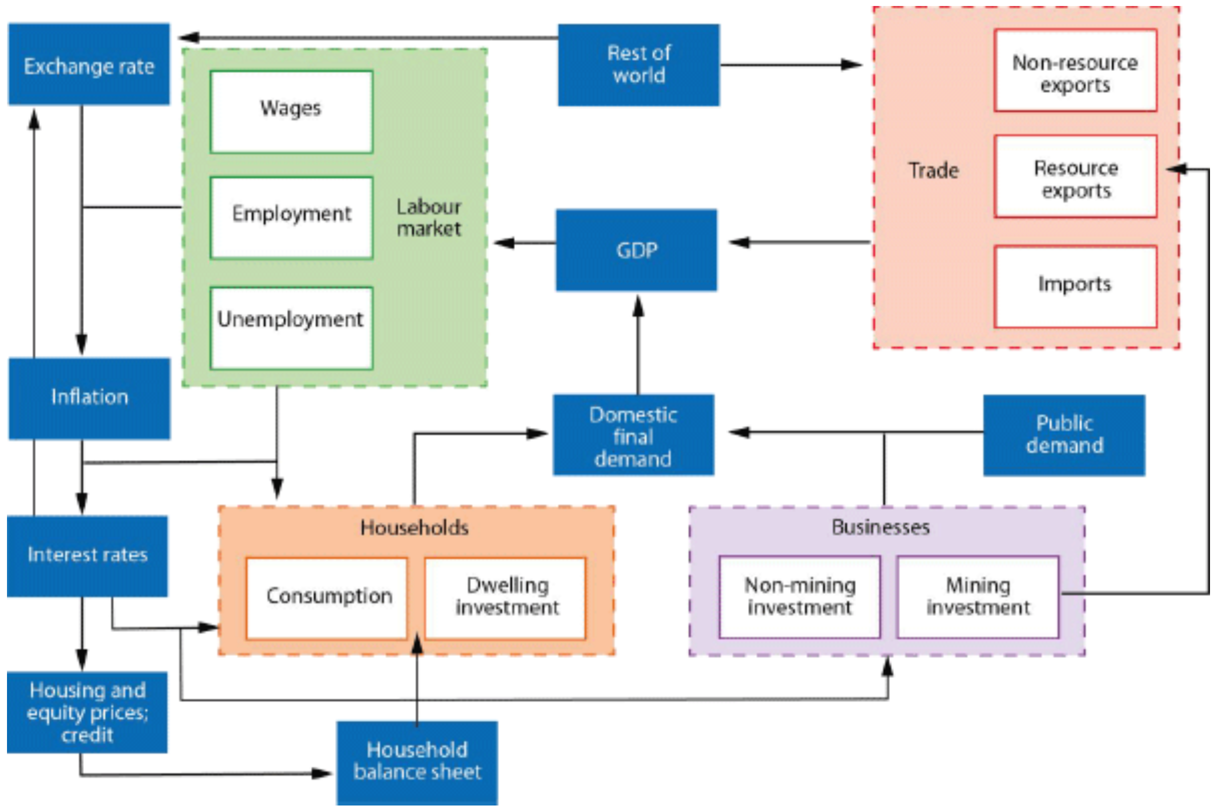
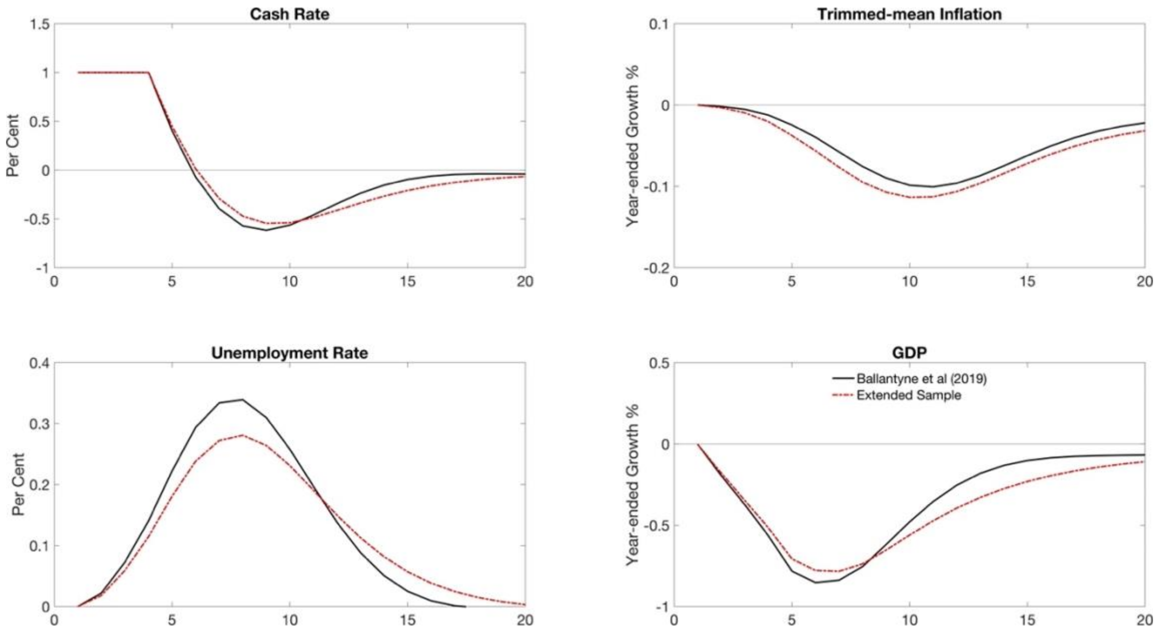


Figure 2 shows the impulse response functions from a persistent 1 per cent shock to the cash rate from MARTIN as estimated by the RBA's published version of the model as described in Ballantyne et al. (2020) and our updated estimates. Across all variables the two models produce quantitatively similar results with a rise in the cash rate causing lower trimmed-mean inflation, higher unemployment and a decrease in GDP.

Figure 2: MARTIN Impulse Response Functions



As a macroeconometric model MARTIN differs from conventional New Keynesian macroeconomic models. It does not contain any forward-looking terms or measures of expectations. Nor is it derived using 'micro-foundations' in which agents optimising their choices across a range of markets define the aggregate economic relationships.

Instead, MARTIN combines a large number of individually estimated relationships, calibrated equations and economic identities to model the Australian economy. This framework focuses on replicating the empirical relationships in the macroeconomy and combining them in a way that is internally consistent. However, unlike purely empirical VAR models, it also allows for counterfactual analysis with an extremely large number of variables and consequently a more granular picture of the economy. This modelling approach involves important tradeoffs. Blanchard (2018) and Wren-Lewis (2018) outline how the macroeconometric approach allows a modeller to focus on a more granular and empirically-focused picture of the economy, potentially capturing aspects that cannot be explained with a micro-founded model. This approach comes at the cost of less clarity on the causal mechanisms at play, and the inability to change deep structural parameters within the model.

For example, in MARTIN, there is no well-defined measure of household time preferences: a core component of an Euler equation which usually defines the optimal path for household consumption. Instead, household consumption is modelled by an estimated error correction model in which the long-run level of real consumption is driven by the level of household income, net wealth and the real cash rate, while short-run fluctuations are the result of changes in labour and non-labour income, the unemployment rate, and the trend growth rate.[2] For a survey of the major macroeconometric models that have been constructed in Australia, see Pagan (2019).

Macroeconometric models generally fail the 'Lucas critique' which posits that policy changes may alter the structure of econometric models (Lucas 1976). Using MARTIN to estimate a counterfactual thus requires some degree of judgement as to its suitability. MARTIN would not be appropriate for conducting counterfactuals involving large scale structural changes in the economy, such as changing the RBA's inflation target or closing the nation's borders.[3] Since such counterfactuals exist far outside the historical experience of the Australian economy, one cannot have confidence that MARTIN's approach of using aggregated historical data would be well suited to accurately estimating their impact. For this reason, we do not analyse the COVID-induced downturn in our study.

[2] MARTIN's error correction model for household consumption also includes two dummy variables for outlier quarters.

[3] Notwithstanding this, Guttman, Lawson and Rickards (2020) use MARTIN to study the implications of a constrained cash rate and explore the impact of unconventional monetary policy.

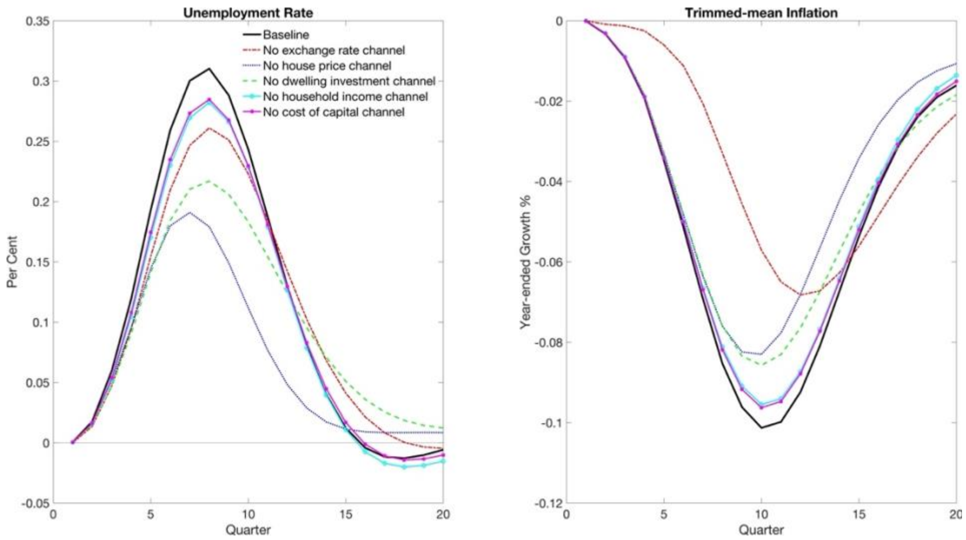
However, MARTIN is better suited to estimating the impact of counterfactuals for which the historical data is more informative. For example, small changes in the cash rate occur relatively frequently in the Australian economy and their impact on macroeconomic aggregates has been extensively modelled. Consequently, we can have more confidence that counterfactuals for different paths for the cash rate will be accurately modelled by MARTIN. Indeed, that is the main purpose for which it has been designed (Ballantyne et al. 2020).

In Section V we repeat the analysis with a micro-founded, forward looking dynamic stochastic general equilibrium (DSGE) model published by the RBA (Rees, Hall and Smith 2016) and show that the results are broadly consistent with those from MARTIN.

MARTIN models the impact of monetary policy through several channels of transmission. A lower nominal cash rate increases household consumption via a wealth effect from both housing and financial assets, and via an income effect on both labour and non-labour income. It also boosts investment by increasing the demand for housing and lowering the cost of capital for firms. Finally, a decrease in the cash rate will depreciate the exchange rate thus increasing net exports.

These channels all affect aggregate output which drives changes in the unemployment rate. The inflation rate is in turn driven by changes in the unemployment gap according to MARTIN's Phillips curve. One way to understand the transmission mechanisms in MARTIN is to systematically shut down each channel one by one. Figure 3 shows the impact of shutting down each of these channels in turn on the impulse response function of the unemployment rate and the inflation rate in response to a sustained increase in the cash rate. All of these channels are economically meaningful with the peak of the unemployment response being reduced by between 8 and 38 per cent and the trough of the inflation response being reduced by between 5 and 32 per cent.

Figure 3: Monetary policy channels of transmission in MARTIN



Note: Alternative IRFs simulate a 100 basis point, 4 quarter increase in the nominal cash rate. Each scenario holds the respective channel fixed at its steady state.

We use the MARTIN model to estimate four counterfactuals for each historical episode.

1. A 'Do Nothing' scenario in which the cash rate is kept constant across the entirety of the counterfactual scenario.[4]
2. An 'Optimal Simple Rule' counterfactual in which the cash rate is set by the model's Taylor rule but where the parameters have been chosen to minimise a quadratic loss function over the length of the counterfactual. This optimal simple rule approach allows the counterfactual policymaker to respond to changes in the economy as it evolves over time.
3. A 'Zero Lower Bound' counterfactual in which the cash rate is fixed at 0 per cent for a period of time, before returning to the model's Taylor rule. Similar to the optimal simple rule, the length of the time spent at the zero lower bound is chosen to minimise

[4] Given the lack of any forward-looking expectation terms it is not necessary to take a stance on whether this policy is expected or not.

a quadratic loss function. This counterfactual is only estimated in periods in which the optimal simple rule initially calls for a negative cash rate.

4. A 'Full Sample Optimal Simple Rule' counterfactual in which the policy rule parameters have been chosen to minimise a quadratic loss function over the entire sample from 2000Q4 to 2019Q4.

In each counterfactual the model is estimated using current data, since real-time data do not exist for many of the series. Consequently, the model potentially provides insights that were not available to decision makers in the moment. This should be borne in mind when interpreting our results. The only difference between the three counterfactual periods is the path for the nominal cash rate. Each optimal simple rule follows the functional form of the calibrated policy rule set out in Ballantyne et al. (2020)

$$ncr_t = \phi^i ncr_{t-1} + \left(1 - \phi^i\right)\left({r^*}_t + \pi_t + \phi^\pi(\pi_t - 2.5) - \phi^u(u_t - u_t^*)\right) - \phi^d(u_t - u_{t-2}) \qquad (1)$$

Where ncr_t is the nominal cash rate, ${r^*}_t$ is the neutral real interest rate, π_t is the annual trimmed-mean inflation rate, u_t is the unemployment rate and u_t^* is the non-accelerating inflation rate of unemployment (NAIRU).[5] $\phi^\pi, \phi^u, \phi^d, \phi^i$ are parameters which govern the weight placed on inflation, the unemployment gap, the change in the unemployment rate and interest rate smoothing respectively. We assume that no exogenous monetary policy shocks occur across each counterfactual.[6]

How do we model the loss function given that MARTIN does not contain an internal measure of household welfare? To approximate welfare across the different counterfactuals, and to

[5] The NAIRU for Australia is estimated as an unobservable input into a wage and price Phillips Curve as outlined by Cusbert (2017).

[6] Since MARTIN lacks any forward-looking terms it is only the path of the cash rate that affects the macroeconomy. Whether changes to the cash rate are due to an exogenous shock or a change in the policy rule's calibration has no direct effect on macroeconomic outcomes.

select the parameters in the optimal simple rule, we assume a quadratic loss function of the deviations of inflation from target, the unemployment rate from the NAIRU and the quarterly change in the nominal cash rate

$$L_t = \lambda^{\pi}(\pi_t - 2.5)^2 + \lambda^{u}(u_t - u_t^{*})^2 + \lambda^{i}(ncr_t - ncr_{t-1})^2 \qquad (2)$$

where π_t is the annual trimmed-mean inflation rate and is measured relative to the midpoint of the RBA's target band of 2 to 3 per cent. $u_t - u_t{}^*$ is the unemployment gap (the difference between the unemployment rate and the NAIRU). The final term allows for an interest rate smoothing term in the loss function which penalises large changes in the nominal cash rate, ncr_t. $\lambda^{\pi}, \lambda^{u}$ and λ^{i} are the relative penalties attached to deviations from the midpoint of the inflation band, the NAIRU and the previous cash rate respectively.[7] Woodford (2003) shows that a quadratic loss function is a second order accurate approximation of household welfare in a broad class of New Keynesian models. In our baseline results we assume an equal weight of 1 on deviations in inflation and unemployment from their respective optimums while the weight on interest rate smoothing is 0.5.[8] However, we relax these assumptions when conducting robustness checks in Section V.

IV Three Macroeconomic Counterfactuals

We focus on three key historical episodes – the global slumps of 2001 and 2008-2009, plus the period of below target inflation in 2016-2019.[9] In each case, we analyse the counterfactuals to

[7] In practice we normalise λ^{π} to 1 as the ranking of policy choices will not be affected by scaling the loss function by a constant.

[8] Minimising a loss function consisting of inflation, unemployment (equally weighted) and changes in the nominal cash rate is also how the Federal Reserve interprets its dual mandate (Yellen 2012).

[9] In principle, we could have included other episodes, but we focus on these three periods in which downturns occurred for expositional clarity, and because they have drawn considerable attention from outside commentators. Another episode that might be of interest is the mining boom years of 2005-2008, when unemployment rate fell to almost 4 per cent and trimmed-

test how effectively monetary policy has been used to stabilise the Australian economy. Table 1 shows the estimated parameters from the optimal simple rule for each of the three periods (the 'Optimal Simple Rule', where the parameters are chosen to minimize the loss function in each specific period), and for the entire 2000-2019 period (the 'Full Sample Optimal Simple Rule', where the parameters are chosen to minimise the loss function over the entire time span).[10]

Table 1 Parameters from the Optimal Simple Rule

Sample	Inflation Coefficient	Unemployment Gap Coefficient	Unemployment Change Coefficient	Interest Rate Smoothing Coefficient
2000Q4-2003Q4	0.0	2.4	0.0	0.5
2008Q3-2011Q3	0.0	0.1	0.6	0.3
2016Q4-2019Q4	0.1	1.6	0.0	0.5
Full Sample (2000Q4-2019Q4)	0.1	2.1	0.0	0.4

For each episode, we show the counterfactuals for six variables: the nominal cash rate, trimmed-mean inflation, real GDP, the unemployment gap, the wage price index and the nominal trade-weighted exchange rate. Counterfactuals for an extended set of variables are depicted in Appendix C.

(i) 2000-2003 – A Recession Avoided

In the early 2000s several major economies experienced a downturn, with the United States, Germany and Japan falling into recession. Australia avoided a significant downturn. Our

mean CPI peaked at nearly 5 per cent. In this episode, MARTIN's optimal simple rule called for higher interest rates than the RBA actually delivered.

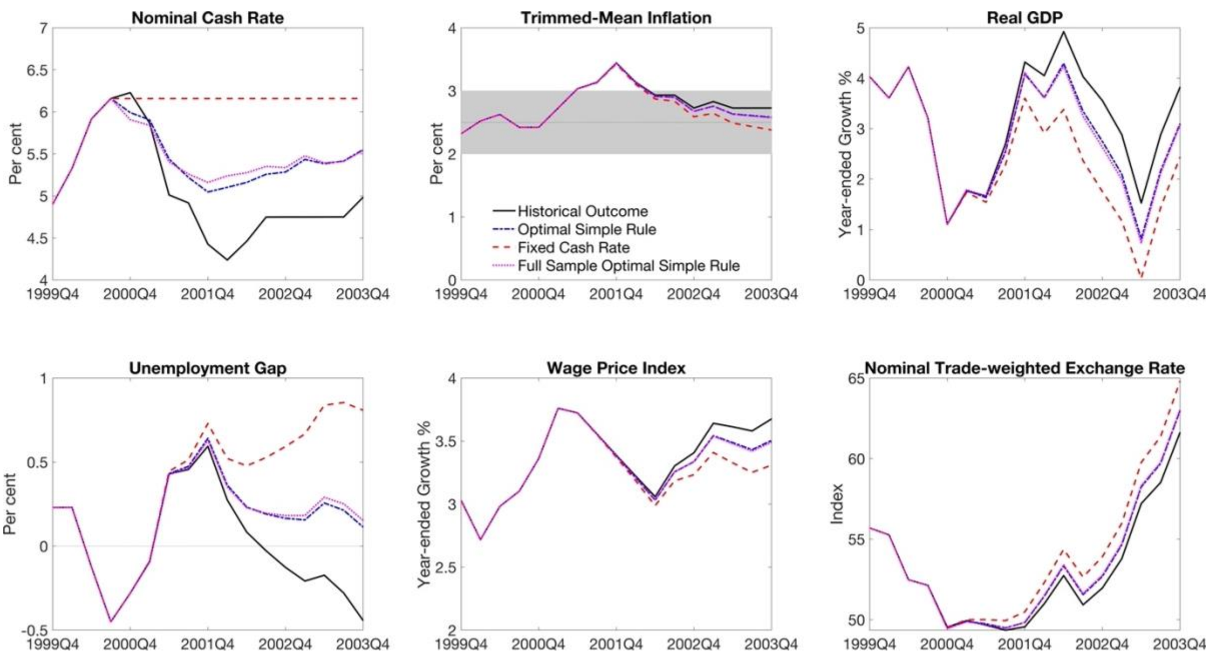
[10] The coefficient on inflation is constrained to be equal to or greater than zero, ensuring that the RBA does not violate the Taylor principle (which implies that when inflation rises, the real interest rate should be increased).

counterfactual analysis – presented in Figure 4 – finds that this economic success can be attributed in large part to the RBA's decision to cut the cash rate.

From the peak in the fourth quarter of 2000, the cash rate was lowered by 2 percentage points over the next five quarters. This decrease in the cash rate limited the impact of the global recession in Australia with the unemployment gap peaking at only 0.5 percentage points before quickly returning to zero, while keeping trimmed-mean inflation only just above the target band.

Our counterfactual shows that this monetary easing played a large role in offsetting the global weakness. If the RBA had not decreased the cash rate the unemployment rate would have remained at an elevated level, over 6.5 per cent, approximately 0.75 percentage points above the NAIRU for an extended period.

Figure 4: 2000-2003 Counterfactuals



This labour market slack would have consequently driven trimmed-mean inflation lower within the target band. However, the impact that the decline in the cash rate had on inflation is relatively small – only 0.3 percentage points. The main deviation between actual and optimal rates are the declines in the cash rate associated with the September 11 terror attacks. A purely backwards looking Taylor rule is unable to adjust to the event in a timely manner, a demonstration of the downside of following a strict data-based policy rule.

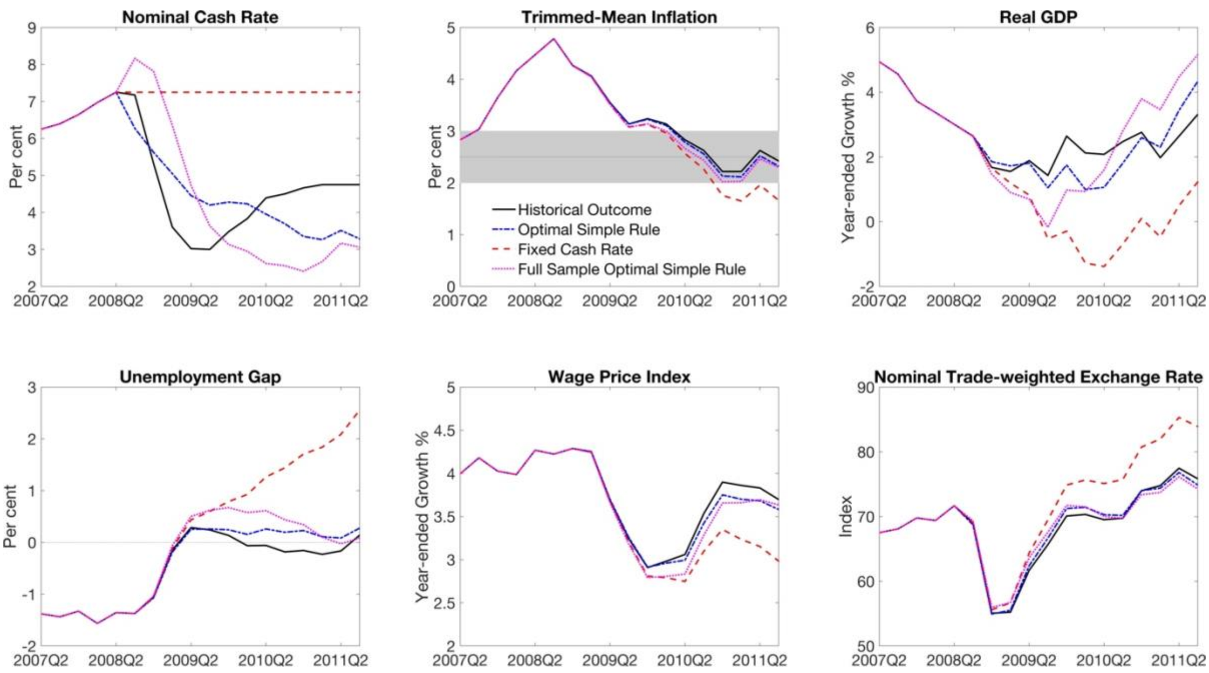
Compared with the hypothetical in which the cash rate was kept unchanged, MARTIN estimates that in the 2000-2003 period (spanning the 2001 downturn), the decreases in the RBA's cash rate reduced the unemployment rate by 1.3 percentage point-years. If the RBA had implemented MARTIN's 'optimal' path for the cash rate, the unemployment rate would have only declined by 0.8 percentage point-years of unemployment (0.5 percentage point-years worse than monetary policymakers actually delivered) and would have remained above the NAIRU. Since the average size of the labour market in 2001 was 9.7 million, the policymakers' improved performance over the simple rule translates to nearly 50,000 jobs for a year. MARTIN estimates that actual policy decisions pushed the unemployment rate below the estimated NAIRU with only moderate effects on trimmed-mean inflation.

This historical episode is a prime example of monetary policy being actively used to ward off a recession that hit other advanced economies.

(ii) 2008-2011 – A Downturn Mitigated

In the Global Financial Crisis, the Australian economy experienced a moderate downturn with the unemployment rate increasing by more than 1 percentage point from peak to trough. This relatively mild outcome was in part the result of aggressive countercyclical policy deployed by both monetary and fiscal authorities.

Figure 5: 2008-2011 Counterfactuals



Over the course of 9 months the RBA reduced the cash rate from a high of 7.25 per cent in August 2008 to only 3 per cent by April 2009. This easing of monetary policy had a substantial impact on the macroeconomy. At the same time, the budget swung from a surplus of almost 2 per cent of GDP to a deficit of over 4 per cent.

As Figure 5 depicts, MARTIN calculates that if the RBA had not reacted at all, and kept the cash rate constant, then the unemployment rate would have risen to over 7 per cent – more than 2 percentage points above the level consistent with full employment. Moreover trimmed-mean inflation would have fallen below the RBA's target band. The combination of a large unemployment gap and a trimmed-mean inflation rate below the target band produces very large welfare costs as measured by our quadratic loss function.

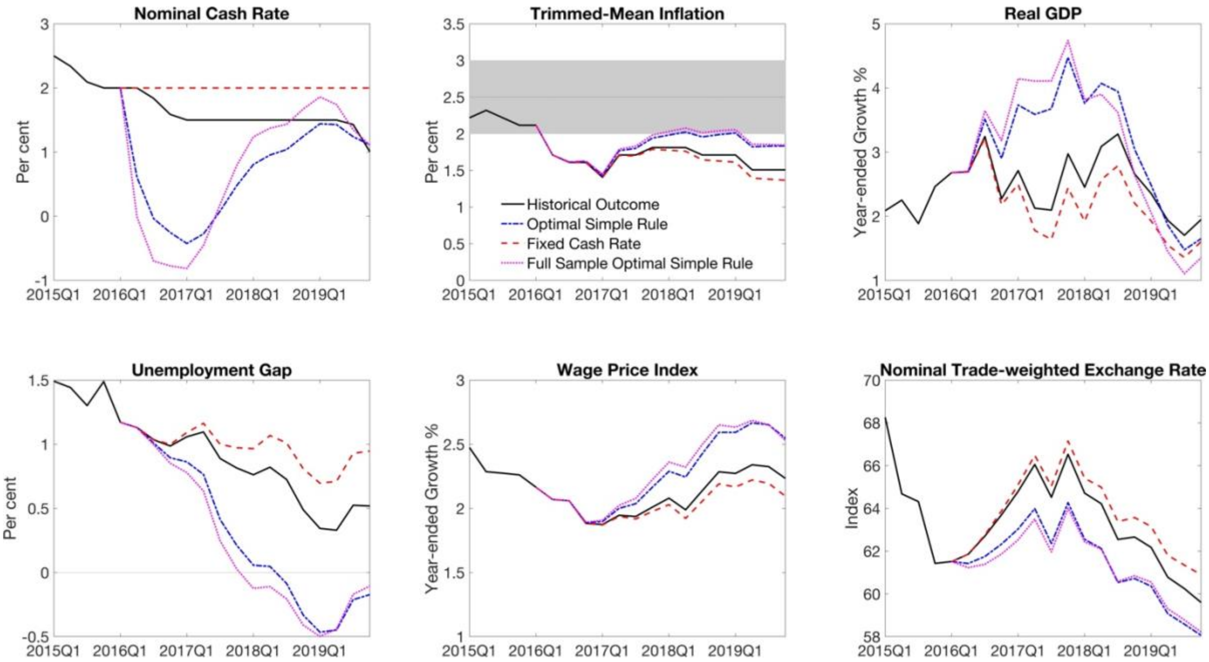
There are some differences between the historical path of the cash rate and the estimated optimal simple rule over the counterfactual scenario. These are largely due to the backwards looking nature of the Taylor rule and its lack of fast-moving financial market variables. While the RBA could observe events unfolding overseas and in financial markets and react in real time, the Taylor rule embedded in MARTIN relies solely on changes to inflation and unemployment which only adjust to external shocks slowly – even if there is zero weight placed on interest weight smoothing. This effect is even larger with the optimal simple rule estimated over the entire sample which places more weight on slow-moving inflation and consequently takes longer to call for the cash rate to decline. The loss function for the optimal simple rule is actually higher than the historical baseline which highlights the benefits from monetary policy being forward-looking. This is especially true of the 2008-2009 crisis, since the events that precipitated the slump occurred in the United States, and the effects took some time to propagate across the globe.

Compared with a hypothetical in which the cash rate was kept unchanged, we estimate that in the 2008-2011 period (spanning the 2008-2009 downturn), monetary policy saved 2.8 percentage point-years of unemployment, while the simple optimal policy rule would have saved only 2.3 percentage point-years of unemployment. Again, actual policy decisions were superior to the policy decisions that would have been implemented by mechanically following the macroeconomic model's optimal simple rule. With the labour force averaging 11.3 million people in 2008-2009, the additional insights of monetary policymakers added over 50,000 full-year jobs.

(iii) 2016-2019 – An Economy Run Too Slow

The third historical episode we examine is the period of below target inflation that occurred from 2016 up until the end of 2019. Over this period trimmed-mean inflation was consistently below the RBA's target band averaging only 1.7 per cent. At the same time a significant unemployment gap opened up starting at over 1 percentage point before falling to 0.5 percentage points at the end of 2019.

Figure 6: 2016-2019 Counterfactuals



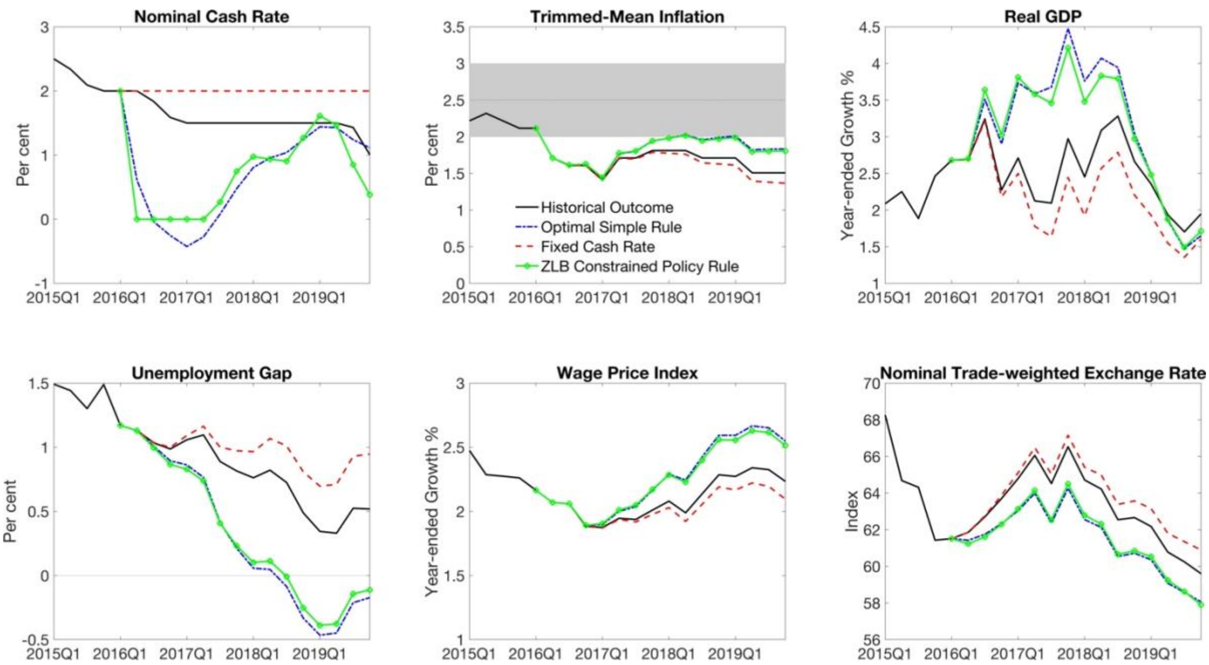
In response to this period of low inflation and high unemployment the cash rate was kept largely constant with the cash rate decreasing only 50 basis points until the middle of 2019, when it was lowered a further 75 basis points. As Figure 6 shows, because of the comparatively stable path of the cash rate, the 'No Change' counterfactual has fairly small differences with the actual outcomes.

By contrast the 'Optimal Simple Rule' counterfactual (whether optimised over the counterfactual period or the full sample) outlines a radically different path for the cash rate. The optimal simple rule calls for a large decline in the cash rate over the sample period. This is because the combination of low inflation and a large unemployment gap can both be simultaneously ameliorated by easing monetary policy. Interest rates remain low until the unemployment gap is reduced and inflation returns towards the mid-point of the RBA's target band. Because the quadratic loss function heavily penalises large deviations from the model's steady state, the optimal simple rule prescribes an aggressive response, followed by a period of overshooting as the unemployment rate dips below full employment.

However, the cash rate target is generally not able to be set at negative values and is instead subject to an effective lower bound of zero per cent. While a negative cash rate could be interpreted as the use of unconventional monetary policy measures, such as quantitative easing, we also estimate a counterfactual in which the zero lower bound is a binding constraint. In this counterfactual the RBA chooses the optimal number of periods to hold the cash rate at 0 per cent before reverting to the policy rule.

In the zero lower bound counterfactual the cash rate is optimally set at 0 per cent for 5 quarters before lifting off. Under this scenario the unemployment gap diminishes at a similar rate relative to when we allow the cash rate to be negative.

Figure 7: 2016-2019 Period, Constraining Optimal Counterfactual to Zero Lower Bound



Compared with a hypothetical in which the cash rate was kept unchanged, we estimate that monetary policy led to 0.9 fewer percentage point-years of unemployment. However, had monetary policy followed the optimal simple rule it would have saved 3.0 percentage point-years of unemployment. If we use a counterfactual in which the zero lower bound operates as a binding constraint we find that optimal monetary policy would have saved 2.9 percentage point-years of unemployment. In either case, this translates into a significant number of jobs. The average size of the labour force in 2016-2019 was 13.1 million people, and the difference between actual outcomes and the optimal simple rule was 2.1 percentage point years of unemployment (or 2.0 if the zero lower bound was a binding constraint). The failure to implement optimal monetary policy thus cost the equivalent of approximately 270,000 people being out of work for a year.

Recall that actual RBA decisions outperformed the optimal simple rule in both 2000-2003 and 2008-2011, producing outcomes in each instance that equated to 0.5 percentage point-years less of unemployment. However, in 2016-2019, the optimal simple rule more than squared the ledger, outperforming monetary policymakers by 2.0 to 2.1 percentage point-years of unemployment.

Given the difference in unemployment outcomes between the 'Optimal Simple Rule' counterfactual and actual policy, and given that inflation remained steadfastly below the target band, many would regard the monetary policies pursued in 2016-2019 as reflecting a substantial error by the RBA. What caused it?

We can reject the explanation that monetary policy was optimally responding to changes in fiscal policy. In fact, fiscal policy tightened over this period, with federal payments falling from 25.5 per cent of GDP in 2015-16 to 24.9 per cent in 2016-17 and 24.5 per cent in 2017-18 and

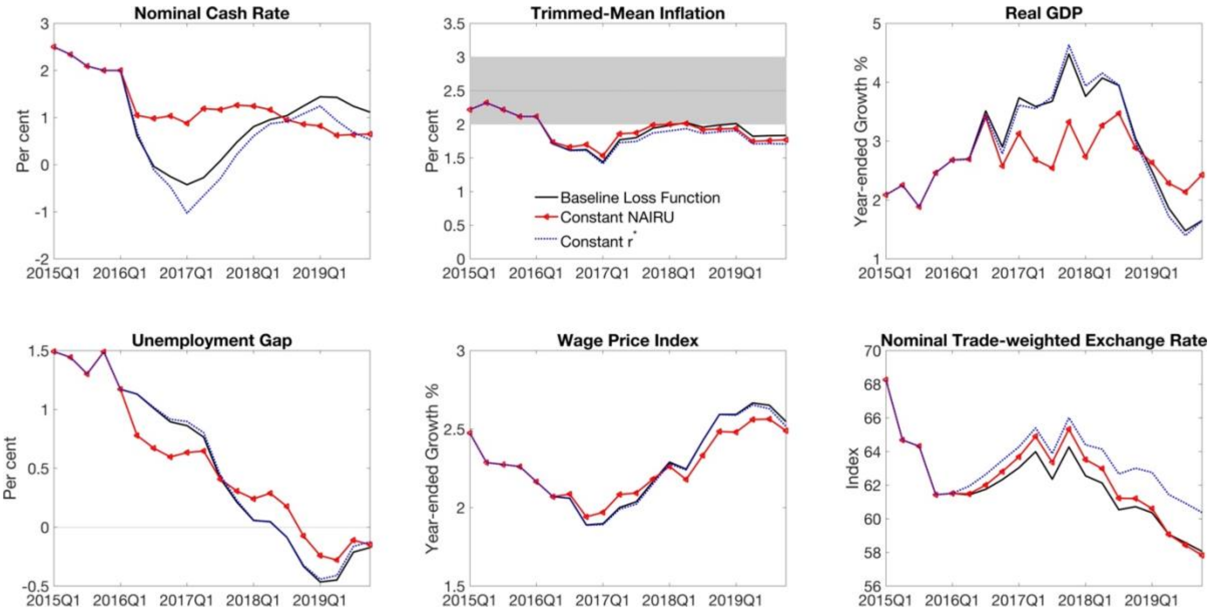
2018-19. This contraction in fiscal policy should, if anything, have encouraged looser monetary policy.

Another explanation is that the central bank was overly optimistic about wage growth.[11] In every year from 2011 to 2019, the RBA forecast a higher level of wage growth than actually occurred. Over a one-year forecast horizon, the error was around one quarter of a percentage point. Over a two-year forecast horizon, the error was around one half a percentage point (see Bishop and Cassidy 2017; Lowe 2021). RBA forecasts for inflation over this period also tended to overestimate the actual level of inflation, although the errors were not as large (Cassidy et al. 2019).

Alternatively, the error may have been caused by an over-estimation of either the NAIRU or natural rate of interest either of which may have caused the RBA to keep interest rates too high. Re-estimating the optimal path for monetary policy holding the NAIRU fixed at its 2015 level does increase the optimal path for interest rates, though it is still lower than the actual path for the cash rate (Figure 8). However, Cusbert (2017) shows that even when using historical data, it was clear there was a substantial unemployment gap as early as 2015, so it is unlikely that this error would have persisted throughout the four-year period.

[11] A related explanation is that we use historical data rather than real-time data, and may therefore have insights that were not available to the RBA at the time.

Figure 8: 2016-2019 Counterfactual with fixed NAIRU and r*



In both alternative counterfactuals the NAIRU and r* respectively are held constant at their 2015 Q4 level rather than decreasing as assumed by MARTIN in the baseline calibration.

Revaluating the optimal path for the cash rate with the natural rate of interest held constant actually leads to a marginally lower path for the cash rate. Historical estimates of the natural rate of interest are not available, but McCririck and Rees (2017) show that the natural rate of interest was known to be falling at the time so it seems unlikely that over-estimation is an explanatory factor for the undershooting.

Another potential explanation was a concern that a lower cash rate would send a signal that the RBA expected demand to remain weak and would thus lead to a decline in business and consumer confidence. This concern was specifically cited by the RBA as a reason why the bank did not decrease nominal interest rates in 2019.[12] However, this view conflicts with RBA

[12] The RBA's July 2019 board minutes state that 'members recognised the negative confidence effects for some parts of the community arising from lower interest rates'.

research (He 2021) which concludes there is little evidence for such an "information effect" being caused by changes in the RBA's cash rate.

While these explanations cannot be fully rejected as plausible causes of the policy error, we believe that a more likely answer is that the RBA was concerned about financial stability, and accordingly set interest rates higher than inflation and unemployment alone would warrant. Since 1996, the high-level objectives of Australian monetary policy have been set out by the Treasurer and the RBA in seven *Statements on the Conduct of Monetary Policy*, published in August 1996, July 2003, September 2006, December 2007, September 2010, October 2013 and September 2016.[13]

The 2010 statement, following the Global Financial Crisis, included for the first time a mandate on financial stability. However, financial stability was made subordinate to the price stability objective. The 2016 statement revised this approach, allowing flexibility in achieving the inflation objective in order to pursue other aims, including financial stability.

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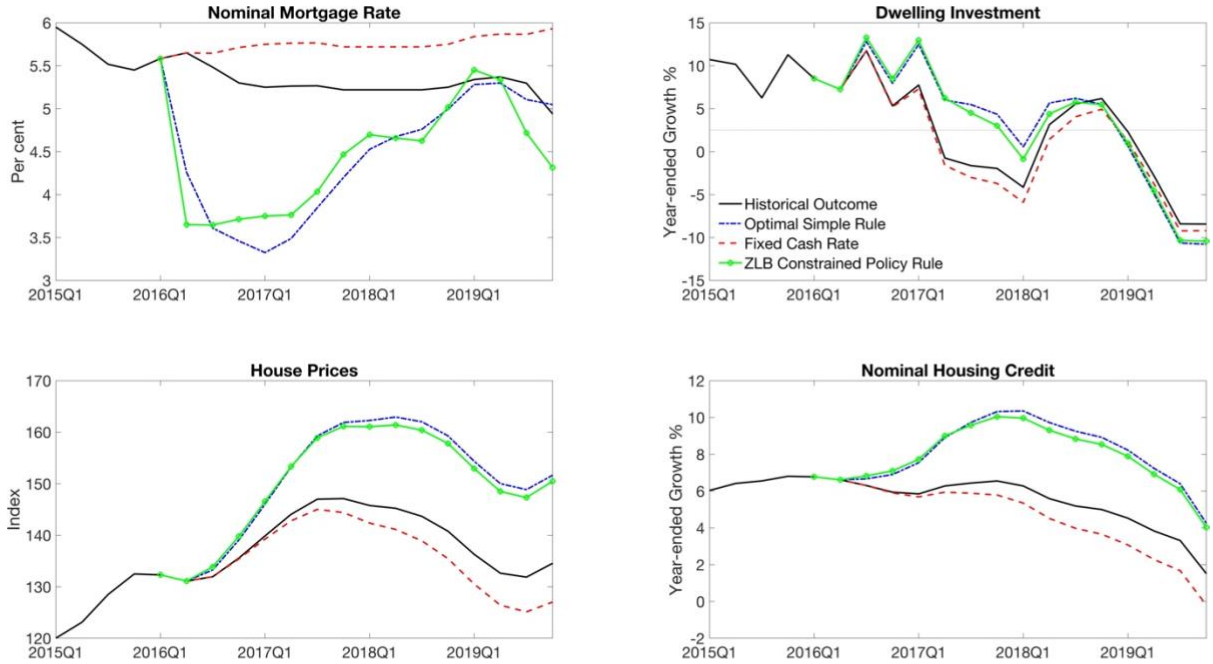
[13] In November 2019, following that year's federal election, Treasurer Frydenberg announced that no new Statement on the Conduct of Monetary Policy would be issued, noting that he was comfortable with the 2016 statement, and observing that past statements had typically coincided with either a change of government or the appointment of a new RBA Governor, neither of which had occurred.

Figure 9: 2016-2019, Housing Market



The following year, statements from the RBA made clear that house prices were a significant factor in shaping their decisions. As Kirchner (2021a) notes, the September 2017 RBA board minutes stated 'Taking into account all of the available information, and the need to balance the risks associated with high household debt in a low-inflation environment, the Board judged that holding the stance of monetary policy unchanged would be consistent with sustainable growth in the economy and achieving the inflation target over time.' Similarly, Governor Philip Lowe stated in a 2017 speech, 'We would like the economy to grow a bit more. If we were to try to achieve that through monetary policy that would encourage people to borrow more and it would probably put upward pressure on housing prices. At the moment I don't think those two things are in the national interest.' (quoted in Martin 2017).

Other commentators (eg. Evans 2018; Tulip 2021) have also noted that the RBA's focus on financial stability – in particular, their concerns over dwelling prices and household debt – led to higher interest rates during this period compared to if the RBA had focused only on achieving price stability and full employment. Despite the low inflation rate the RBA also created an expectation that the next move in interest rates would likely be up (Kirchner 2021a).

There is no doubt that Australian house price growth has indeed been rapid. From 2000 to 2020, real dwelling prices rose by 122 per cent (Economist 2021), with a corresponding increase in household debt ratios. As expected, we find that that a lower path for the nominal cash rate would have boosted the housing market with an increase in house prices, dwelling investment and household credit (Figure 9). These are all standard channels of monetary policy and a key driver of the rise in employment that typically flows from a cash rate reduction. Notably the 2018-2019 house price slowdown still occurs under all counterfactuals. Indeed, by the end of the scenario house prices under the zero lower bound counterfactual are roughly at the same level that actually occurred in 2017.

However, there are a range of policies that can affect house prices, including construction of social housing, zoning laws, state and federal tax policies, and macroprudential rules (for a recent discussion, see Cho, Li and Uren 2021). Whether monetary policy should be used to dampen house price growth therefore depends on weighing the gains and losses of such an approach.

On this point, the literature is remarkably clear cut. A strategy of using monetary policy to constrain asset price growth, dubbed ‘leaning against the wind’, has generally been found to fail any reasonable cost-benefit test (Svensson 2017; Habermeier et al 2015, Gorea, Kryvtsov and Takamura 2016; Kockerols and Kok 2019).

Indeed, the RBA’s own researchers have estimated that the costs of leaning against the wind are three to eight times larger than the benefit of avoiding financial crises (Saunders and Tulip 2019). Importantly, Saunders and Tulip (2019) do not rely on hindsight, opting instead to use published forecasts from 2016 to show that, in expectation, leaning against the wind has small benefits and large costs. Nonetheless, the RBA appears to have opted to pursue such a strategy in 2016 to 2019, with the result that the cash rate was kept at a level higher than the inflation and unemployment rates alone would have warranted. As late as February 2020, Governor Lowe stated 'There is a risk that further cuts in interest rates could encourage further borrowing. If people borrow more, then perhaps down the track we have problems.'

V Robustness

(i) Alternative Specifications

In this section we explore the effect of altering the assumptions on our quadratic loss function. We calculate the optimal simple rule under four alternative parameterisations. The first is a loss function derived from the welfare function from the DSGE model in Woodford (2003). Woodford (2003) derives a loss function with a relatively small weight on output and no weight on interest rate smoothing. As Table 2 shows, this alternative specification places a much lower weight on unemployment gap stabilisation compared to the baseline results. The second loss function we consider is one derived from Debortoli et al (2019) who estimate the optimal simple loss function to approximate social welfare in larger, more complex DSGE models. They find that the optimal weight on the output gap is approximately 20 times larger compared with Woodford (2003) which translates into a weight on the unemployment gap roughly 4 times that of our baseline results.

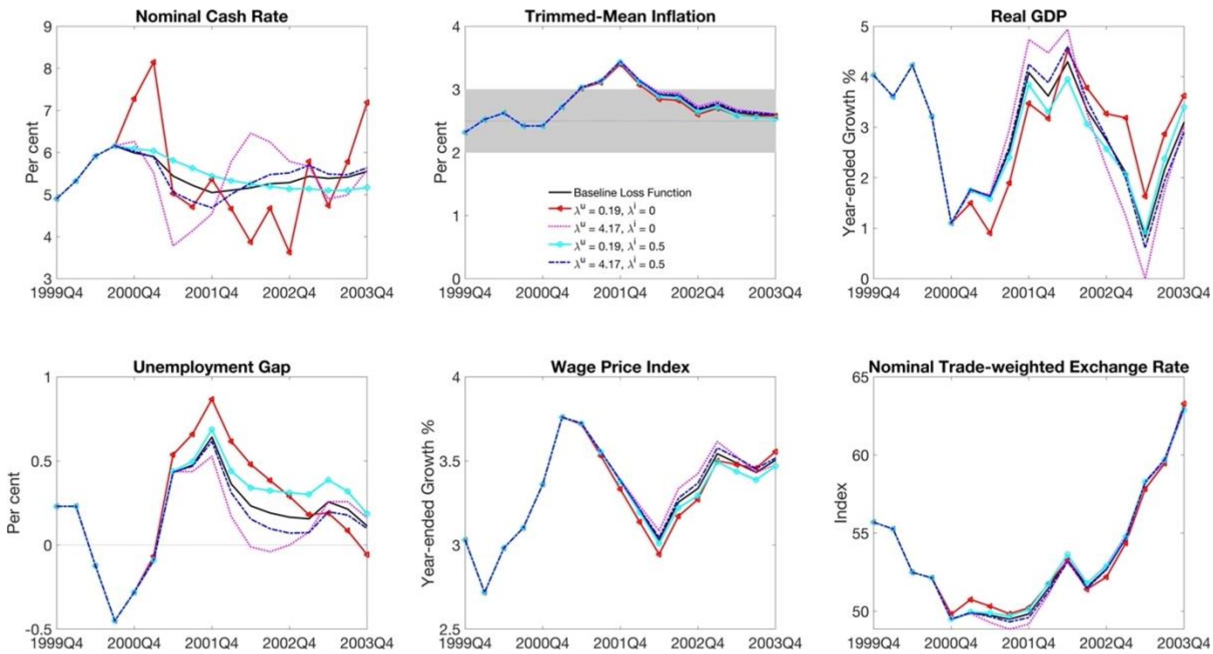
Table 2 Parameters for Alternative Loss Functions

Sample	Inflation Weight	Unemployment Gap Weight	Interest Rate Smoothing
Baseline	1.00	1.00	0.50
Woodford (2003)	1.00	0.19	0.00

Debortoli et al (2019)	1.00	4.17	0.00
Smoothed Woodford (2003)	1.00	0.19	0.50
Smoothed Debortoli et al (2019)	1.00	4.17	0.50

We consider both alternative calibrations with and without a positive weight on the interest rate smoothing term.

Figure 10: 2000-2003 Alternative Loss Functions

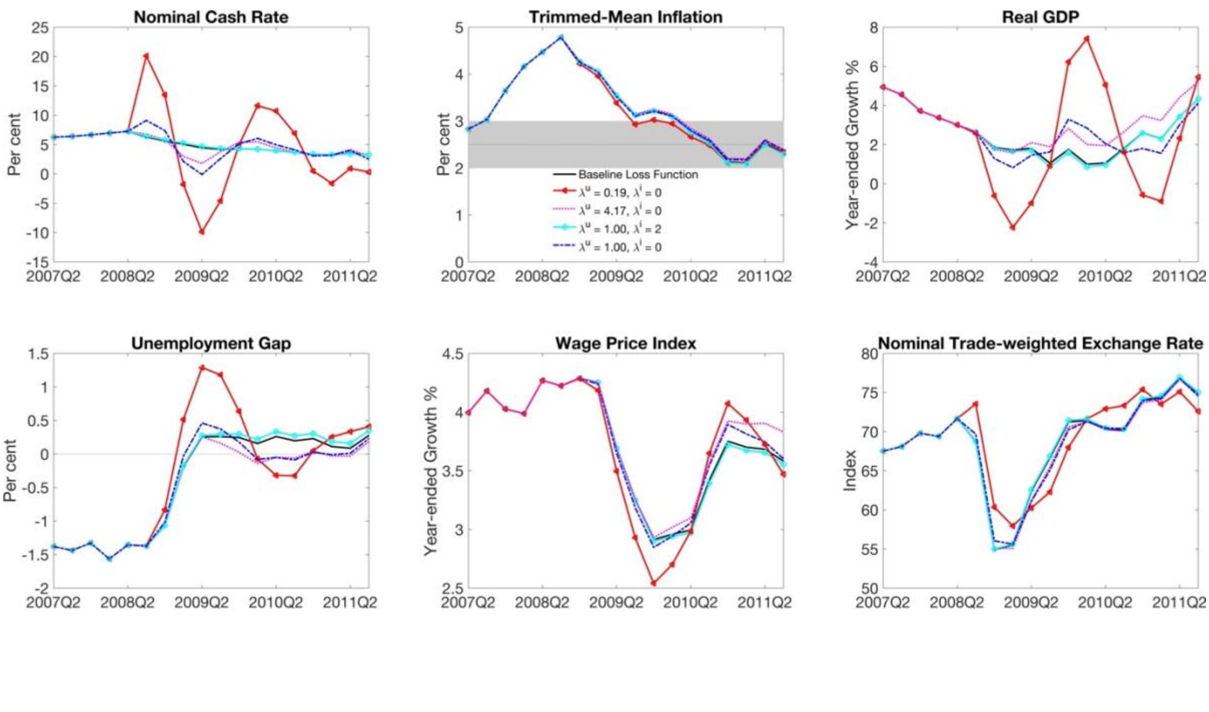


As Figures 10 to 12 show, eliminating the weight placed on the interest rate smoothing term leads to significantly higher volatility in the nominal cash rate with interest rates changing by up to 10 percentage points in a single year and a pattern of overshooting with interest rates moving significantly above and below their initial levels in each of the four scenarios.

Abstracting from the volatility in the nominal cash rate, changing the parameterisation of the loss function generally does not materially change the optimal path of macroeconomic variables. In 2000-2003 a higher weight on the unemployment gap would have led to a somewhat faster rate of interest rate cuts, while a lower weight would have resulted in a slower decline. Decreasing the weight on interest rate smoothing increases the volatility of the nominal cash rate particularly when the weight on the unemployment gap is low. However, the differences in macroeconomic outcomes that arise from the different loss functions are small, with the unemployment gap differing at most by 0.5 percentage points and trimmed-mean inflation differing by 0.2 percentage points.

During the Global Financial Crisis, the various alternative loss functions do not meaningfully change the optimal path for trimmed-mean inflation. As Figure 11 shows, the main consequence of placing different weights on the two variables is the degree of overshooting in the unemployment gap.

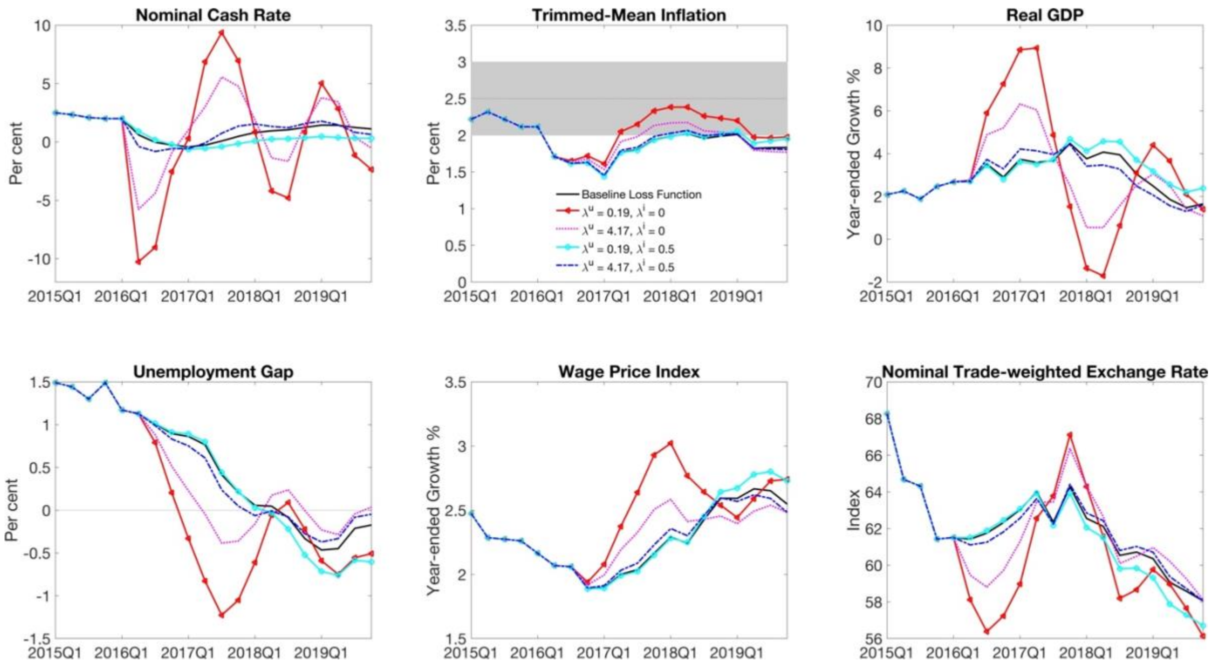
Figure 11: 2008-2011 Alternative Loss Functions



As Figure 12 illustrates, a similar result occurs for the 2016 period. Differing weights on inflation and the output gap do not materially change the direction of optimal policy or macroeconomic outcomes, but reducing the weight placed on interest rate smoothing leads to a faster fall in the cash rate and a significant degree of overshooting.

In short, varying the calibration of the loss function does affect the estimated path for monetary policy, but not our substantive findings. These alternative specifications still suggest that monetary policy was relatively well calibrated in 2000-2003 and 2008-2011 and the cash rate was kept too high in 2016-2019.

Figure 12: 2016-2019 Alternative Loss Functions



(ii) Alternative Model

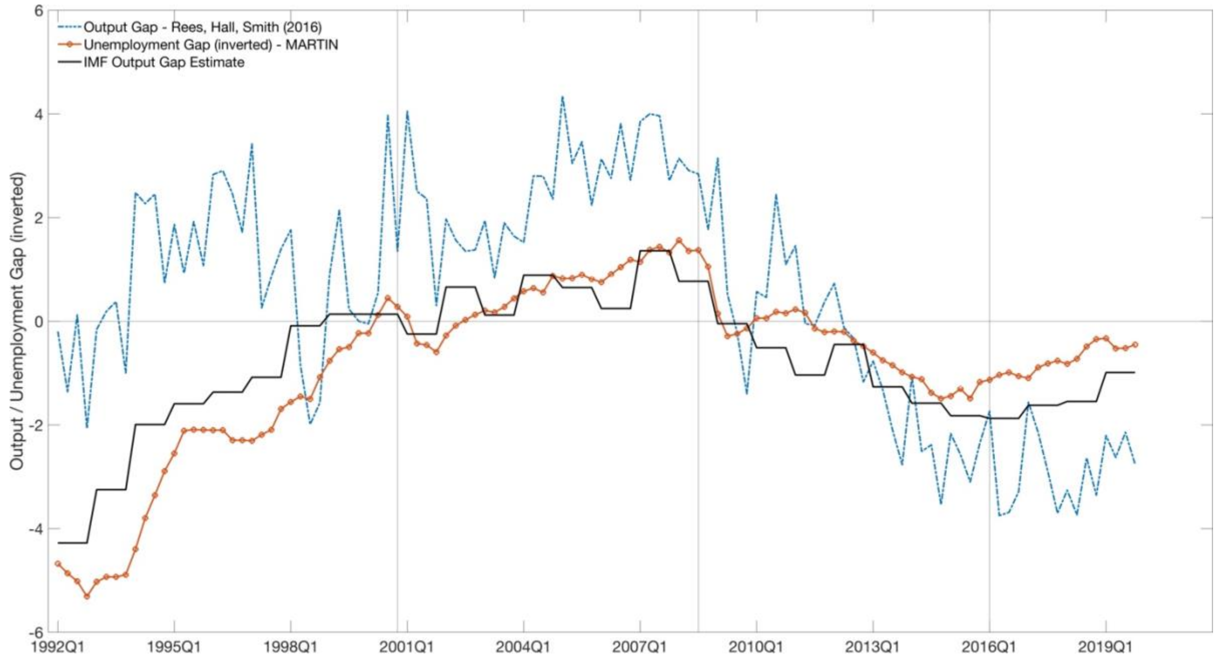
We also replicate our analysis using a DSGE model previously published by the RBA in Rees, Hall and Smith (2016), henceforth RHS.[14] RHS is a large scale, small open economy model

[14] We also considered an extension of this model that includes a housing sector as outlined by Gibbs, Hambur, and Nodari (2021). However, the estimated flexible-price output gap was so implausible as to render the results of the exercise nonsensical.

which includes a commodity sector. We re-estimate the model up to 2019 Q4 and calculate the output gap as the difference between aggregate output and the output level that would prevail if prices and wages were completely flexible and the standard deviations of all mark-up shocks were set to zero.

Debortoli et al (2019) show that even in large scale DSGE models with many nominal and real rigidities social welfare can be well approximated with a loss function consisting solely of inflation and the flexible price output gap. We thus use the flexible price output gap to substitute for the unemployment gap in the loss function when optimising the path for the cash rate in the RHS model.[15]

Figure 13: Activity Gaps from Alternative Models



[15] The weight on the output gap is decreased by a factor of 3.7 to account for differences between the two activity gap measures using estimates of Okun's Law from Lancaster and Tulip (2015).

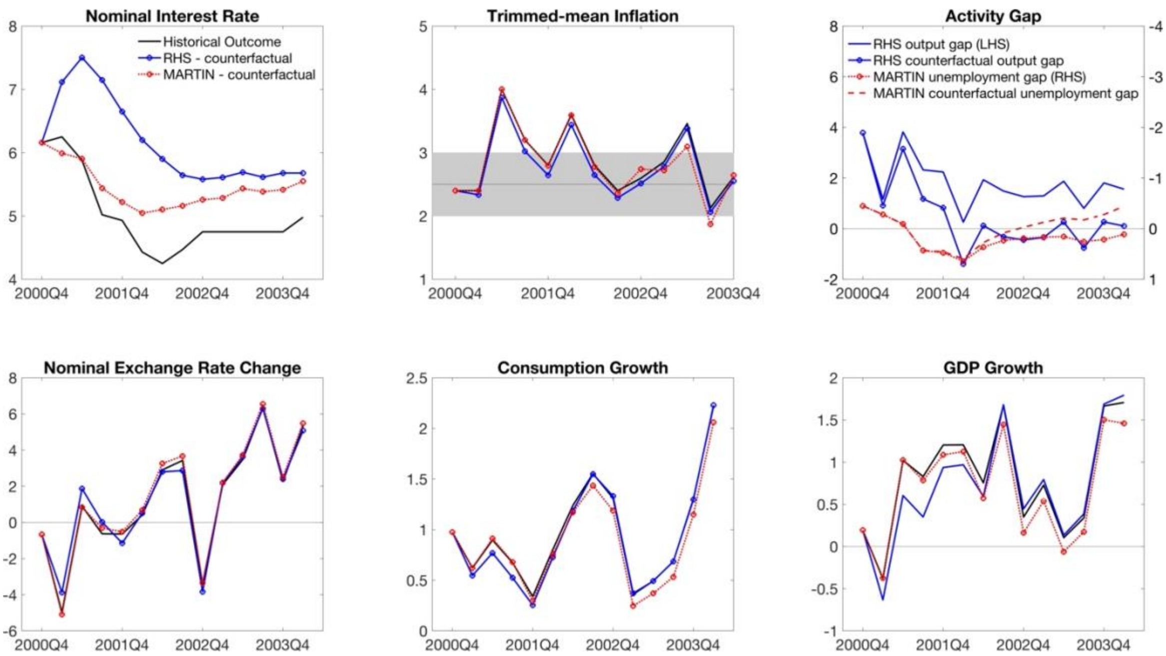
The flexible price output gap estimated by RHS is positively correlated with the IMF's measure of Australia's output gap, though not as closely as MARTIN's inverted unemployment gap (see Table 3). There are notable differences between RHS's measure of the activity gap and the other measures. In the early 2000s, RHS's output gap is positive (indicating a boom) while the alternative measures from the IMF and MARTIN are close to zero. RHS's output gap measure continues to be more positive than the other two models until the onset of the 2008-2009 Global Financial Crisis. Conversely, towards the end of the sample period, RHS's estimate is considerably *below* the measures from the IMF and MARTIN.

Table 3 Correlation between Activity Gap Measures

	IMF	MARTIN	RHS
IMF	1.00	0.88	0.54
MARTIN		1.00	0.30
RHS			1.00

The impact of these differences on optimal policy is most apparent during 2000-2003 when MARTIN and the IMF's estimate of a mildly negative activity gap (ie output was below potential) prompts a decrease in the optimal path for the RBA's cash rate. By contrast the DSGE model of RHS estimates that the output gap is consistently above zero during this period which, combined with an inflation rate that is mostly above the mid-point of the target, calls for a substantially higher path for the cash rate (Figure 14).

Figure 14: 2000-2003 Alternative Models



By contrast, during the Global Financial Crisis, the models are much more closely aligned, with similar paths for the estimated activity gaps and thus the optimal cash rate (Figure 15).

The output gap during the 2016-2019 period is estimated by the RHS model to be consistently and substantially below zero. This is somewhat at odds with the historical estimates from MARTIN and the IMF which are initially large but recover by approximately half over the subsequent four years. Accordingly, the optimal path for the cash rate in RHS is for a much quicker and sustained fall in the cash rate across the sample period (Figure 16).

In summary, conducting the same exercise with RHS, a large scale DSGE model of the Australian economy, generates broadly similar results when the two models agree on the size of the activity gap. However, predictably the results differ when the models' estimates of the activity gaps diverge.

Figure 15: 2008-2011 Alternative Models

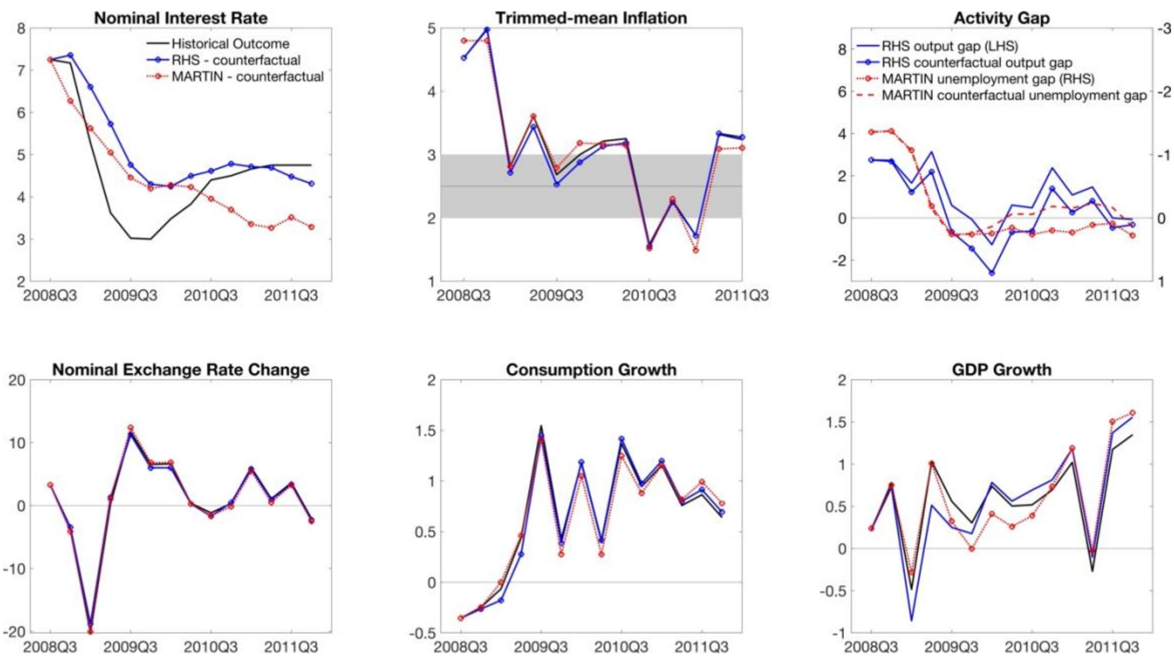
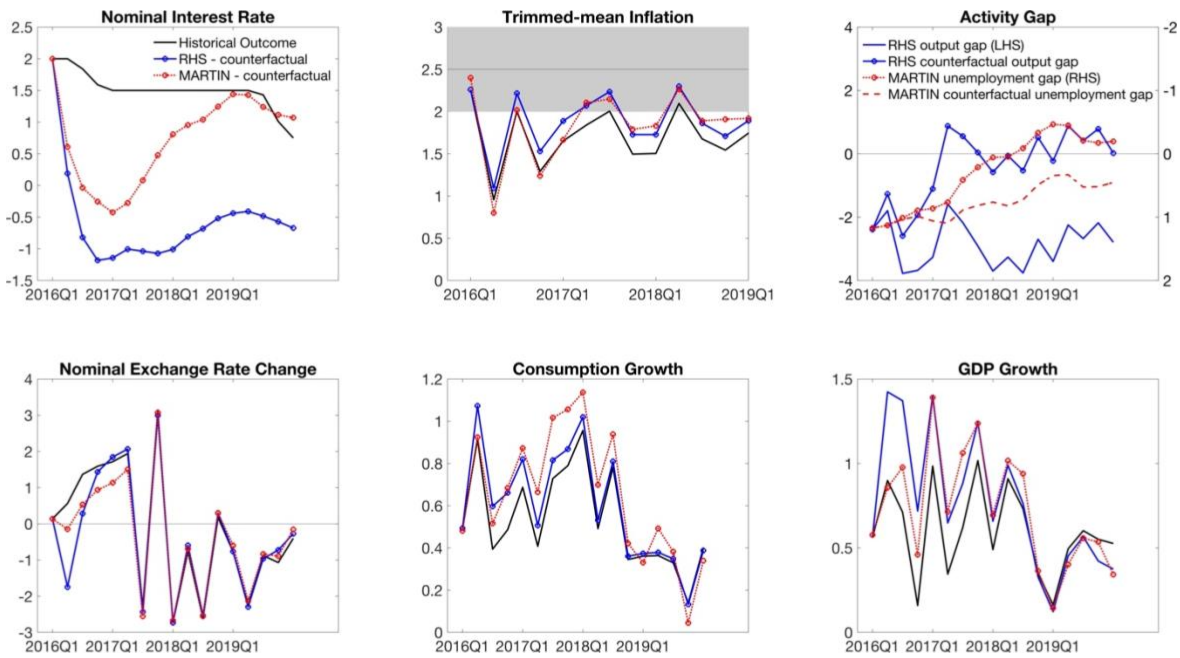


Figure 16: 2016-2019 Alternative Models



VI Conclusion

Keeping the labour market close to full employment, while maintaining price stability, is the core of the RBA's mandate. Evaluating a central bank's previous performance against its mandate is critical for its accountability to the public and its ability to avoid repeating the mistakes of the past.

The RBA's easing of monetary policy in response to global downturns was instrumental in avoiding a recession in 2001 and mitigating the impact of the Global Financial Crisis in 2008-2009.

However, while it performed well in responding to these crises, the RBA's relative inaction over the period 2016-2019 led to a substantial deviation of inflation from its target band and the creation of a large output and unemployment gap. This carried a high cost, equivalent to 2.0 to 2.1 percentage point-years of unemployment, relative to an optimal simple rule.

A plausible explanation is that the RBA's focus on financial stability – in particular, its concerns over dwelling prices and household debt – led to higher interest rates during this period than if the central bank had focused only on achieving price stability and full employment.

It is also worth noting that in the 2016-2019 episode, when our analysis suggests the cash rate was held too high for too long, Australia had a higher policy rate than the United States, Japan, Euro Area, the United Kingdom and Canada (Appendix C). This suggests that even if there were barriers to lower interest rates that are not well modelled by MARTIN, they did not pose a meaningful constraint for other central banks.

Our results suggest that in the past two decades the RBA has mostly, though not always, fulfilled its mandate. We hope our work helps inform the implementation of monetary policy by illuminating the trade-offs that central bankers must consider, the limitations of purely backwards looking policy rules, and the cost of focusing on objectives outside the RBA's core mandate.

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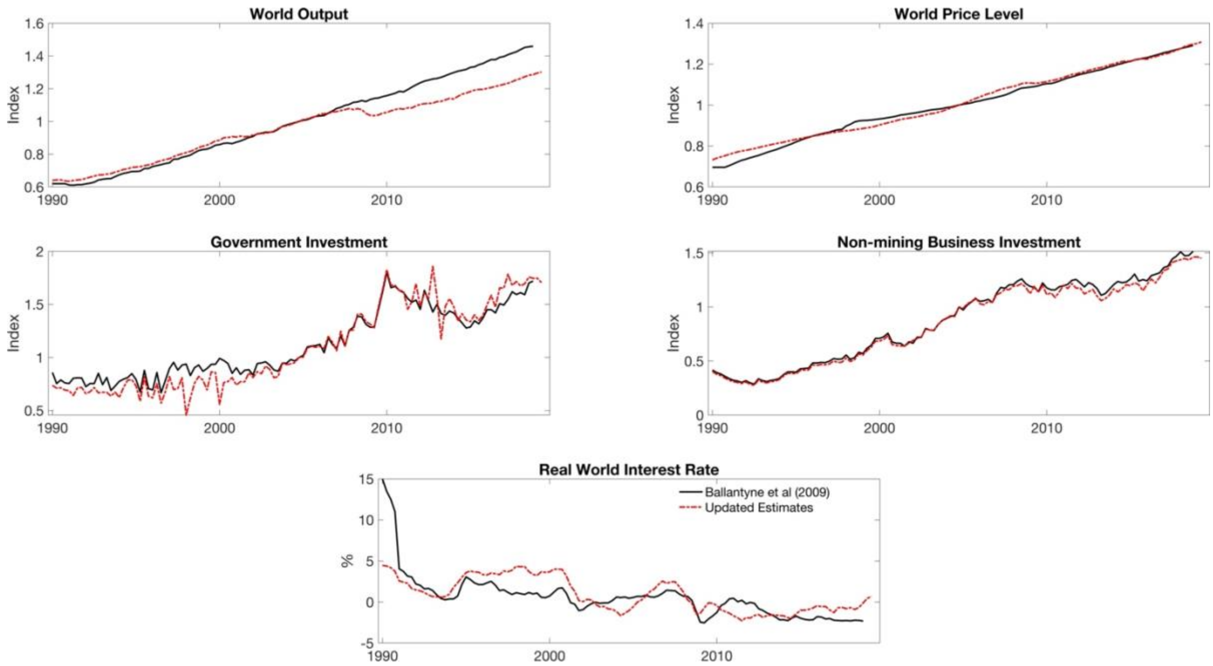
Appendix A: Data Issues

We use a version of MARTIN that closely follows that published by the RBA in Ballantyne et al. (2020). However, there are some series that had to be substituted because public versions of the data do not exist. This version of the MARTIN was developed by David Stephan and is available at https://github.com/MacroDave/MARTIN.

While the RBA model has data on net asset transfer between the public and private sectors, this is not publicly available which results in minor differences in non-mining business investment and government investment. Similarly, instead of calculating data on world GDP or weighting the overseas variables by major trading partner, we simply use US data for these series. This is primarily due to the lack of quarterly data from China.

Finally, we use a fixed time trend for the export sub-sector equations which cover mining, manufacturing and the service sectors. Figure A.1 shows the differences between Ballantyne et al (2020) and our version of MARTIN in five key series: world output, the world price level, government investment, non-mining business investment and the real world interest rate. In each case, we manage to replicate results from the original model fairly well.

Figure A.1 Data differences between Ballantyne et al. (2020) and our version of MARTIN.



Appendix B: Additional Counterfactuals

Figures B.1 to B.3 display the counterfactual results for an extended set of variables.

Figure B.1: 2000-2003 Counterfactuals for an Extended Set of Variables

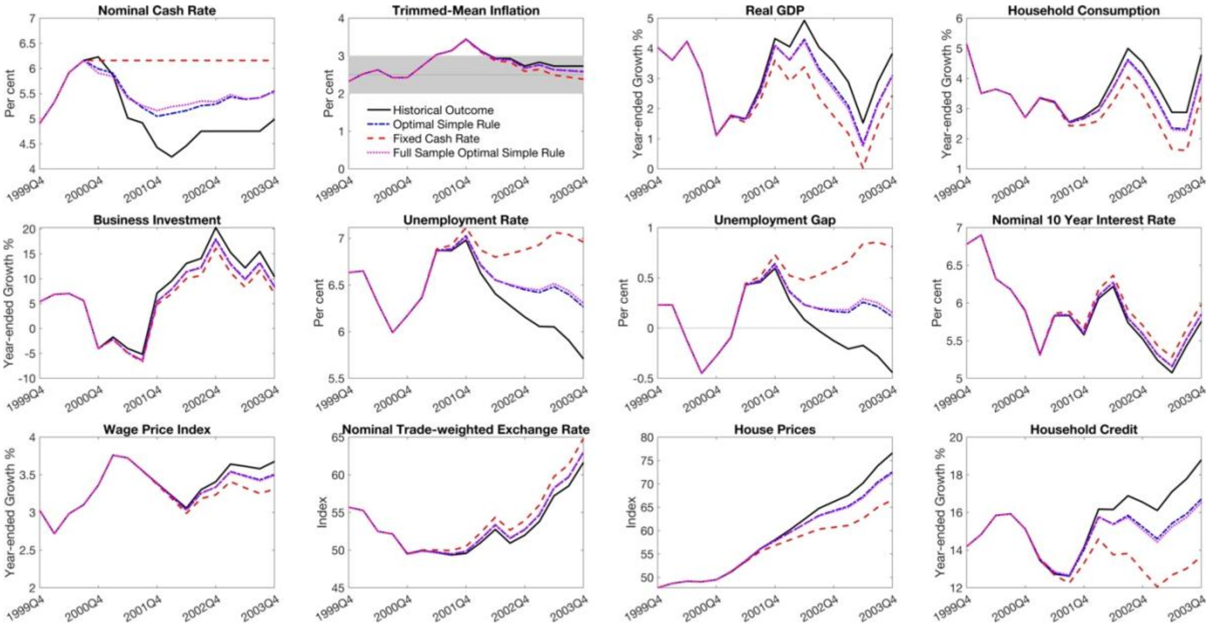


Figure B.2: 2008-2011 Counterfactuals for an Extended Set of Variables

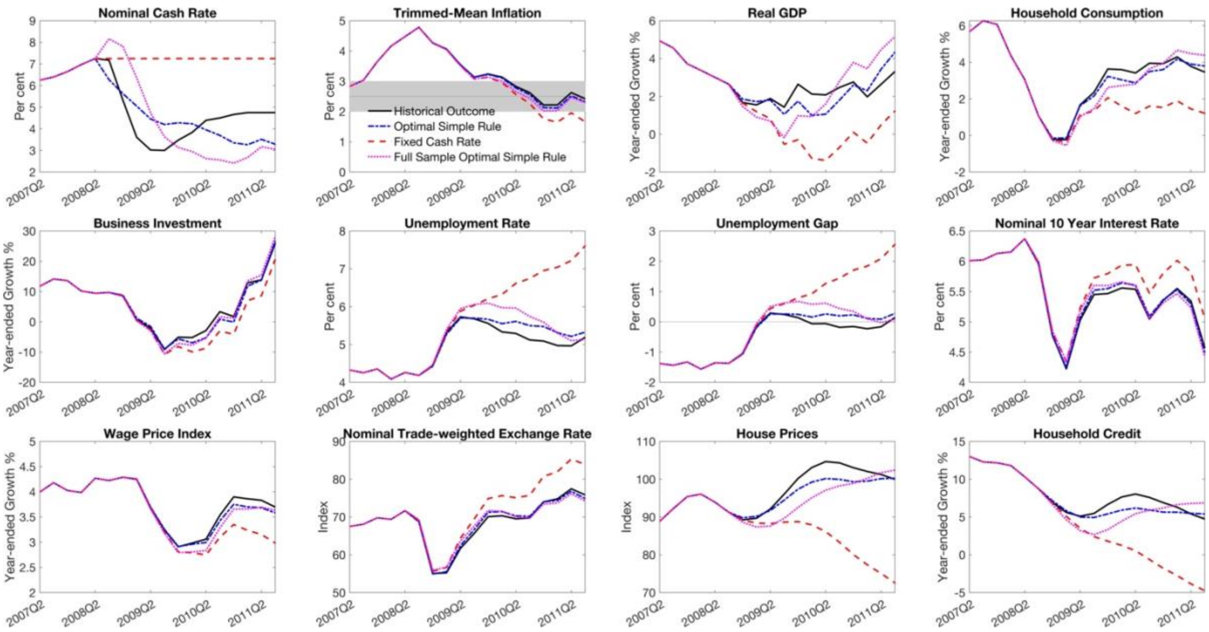
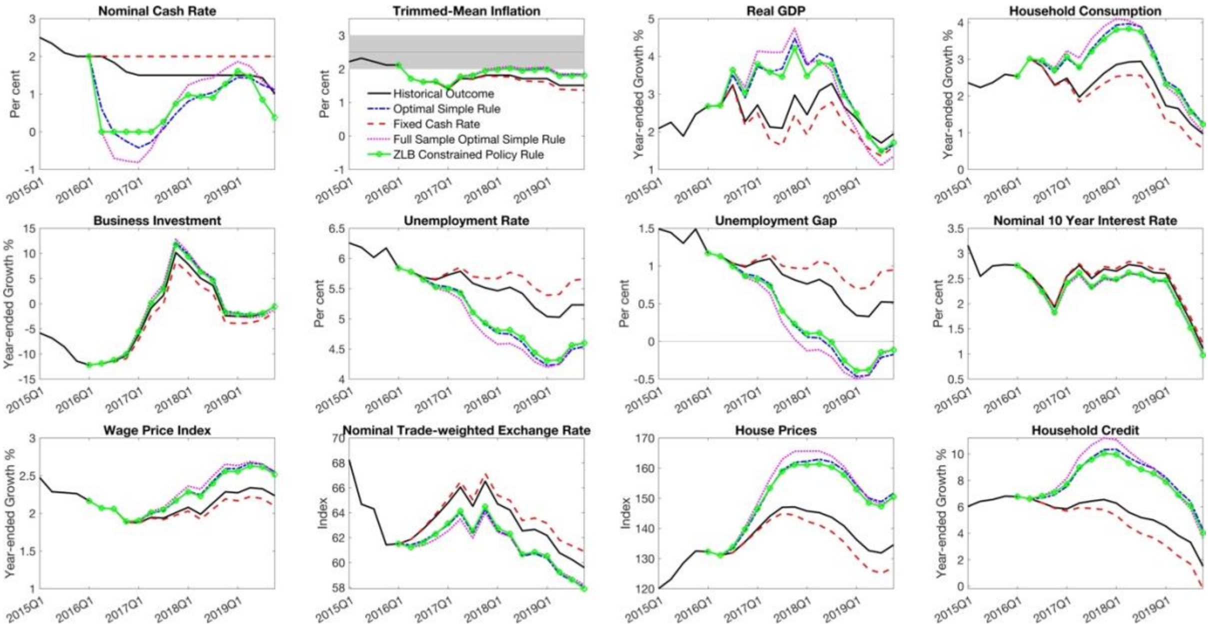


Figure B.3: 2016-2019 Counterfactuals for an Extended Set of Variables



Appendix C: International Comparisons

International comparisons of policy rates are complicated by differences in inflation targets, the underlying drivers of inflation and the neutral interest rate. Nonetheless, it is instructive to note that the Australian cash rate target has significantly exceeded the rate in other advanced economies. Figure C.1 compares Australia's average cash rate with the average policy rate in the United States, Japan, Euro Area, the United Kingdom and Canada. These other jurisdictions all have a 2 per cent inflation target, with the exception of Canada, which has a 1 to 3 per cent target band and the EU which had a target of 'below but close to' 2 per cent over this period.

In each of the three episodes, Australia had the highest or second-highest official interest rate. The gap is generally larger than the 0.5 percentage points by which the RBA's inflation target exceeds the other jurisdictions. Notably during the 2016-2019 episode, when our analysis suggests the cash rate was held too high for too long, Australia had the highest policy rate among its peers. This suggests that even if there were barriers to lower interest rates that are not well modelled by MARTIN, they did not pose a meaningful constraint for other central banks.

Figure C.1: Official Interest Rates in Selected Major Advanced Economies