Monetary Policy with Phillips Curve: Lessons from Disinflation in New Zealand

Debasis Bandyopadhyay[*]

University of Auckland[†]

Abstract

Despite the transparency and independent operations of the central bank, the costly disinflation in the early nineties and the apparent lack of contemporaneous correlation between inflation and unemployment in the subsequent periods brings into question the validity of the Phillips curve hypothesis for the New Zealand economy. Nevertheless, drawing on an empirical exercise built on a narrative history, I argue that the hypothesis remains a valid view of the interaction between the real and nominal sides of the economy if we interpret that history with theories of credibility to account for the dynamics of inflation expectations. Between 1987 and 2015, the survey data of inflation expectations identifies, through either a new classical or a new Keynesian representation, the changing location of the Phillips curve, illustrating how inflation expectations directly affect both inflation and unemployment, without undermining their theoretical relationship. Findings suggest that a credible regime between 1993 and 1999 precipitated a stable manifold of relatively flat Phillips curves. However, probably the loss of credibility in the post-1999 era left the policymakers with a steeper Phillips curve with unstable locations. Use of the nontradable component of the consumer price index (CPI) rather than the CPI as a whole strengthens the policy conclusions based on the Phillips curve hypothesis.

Keywords: Rational Expectations, Phillips Curve, Time Consistency, Credibility, Natural Rate of Unemployment, Lucas' Supply Curve.

JEL: A22, B22, E31

1   Introduction

Inflation and unemployment no longer seem to correspond to each other. This message comes from a casual reading of New Zealand's history of disinflation, especially for the last twenty-five years. According to a growing body of literature (see, for example, Ball and Mazumder, 2011) such lack of contemporaneous correlation between the two variables constitutes a puzzle for the conventional Phillips curve paradigm. A question arises naturally: is the Phillips curve hypothesis no longer relevant for understanding the dynamics of inflation and unemployment as a part of conducting a monetary policy analysis?

Surprisingly, a careful reading of the history of disinflation in New Zealand uncovers a unique lesson: once we account for how the rational expectations of inflation shift in the economy, the Phillips curve hypothesis remains valid. This validation comes in a unified theoretical framework that assigns a critical role for time consistency of the monetary policy objective in building credibility which anchors the rational expectations of inflation. A narrative history of the economic environment in New Zealand and its interpretation within the above theoretical framework helps us identify the relevant model of the Phillips curve, its location and its slope as well as provide a clear answer to the key policy question stated above. The narrative approach focusses, in particular, on the credibility of the monetary policy objective in the overall politicio-economic environment to divide New Zealand's history of disinflation into three distinct eras.

The first is the era of low credibility (1987 - 1992), during which the Reserve Bank of New Zealand (RBNZ) began its journey toward the conquest of inflation and confronted friction in lowering the inflation expectations. In this period, a sharp decline in the inflation rate was accompanied by a sharp increase in the unemployment rate. I consider this period an era of low credibility in the RBNZ's ability to decrease inflation to its targeted level. In the absence of supportive labour market and fiscal reforms ahead of the monetary reforms, I argue, the RBNZ lacked the credibility in its ability to sustain its low inflation target in the long run. Consequently, the rational mind resisted in lowering their inflation expectation at the same pace as disinflation. Yet, the disinflation came swiftly and decisively as a surprise to most people. From that disinflation surprise came a large increase in unemployment and that induced a substantial cost to the economy as a whole in terms of lost income and lost tax revenue. Was that cost an inevitable dictum of the Phillips curve paradigm? Could the policymakers reduce the human and output cost significantly, by correctly identifying the shifting locations of the Phillips curves, with relevant theories that help trace the dynamics of the rational expectations of inflation? I also explore these questions as I investigate the validity of the Phillips curve hypothesis.

The second is the era of increased credibility (1993 - 1999) in the RBNZ's ability to succeed in its low inflation targeting objective. This increased credibility accompanied by a steady decline of inflation expectations. During this period an outcome of low inflation as well as low unemployment seemed achievable. The completion of all reforms

provided the critical support to complement the low inflation targeting objective of the RBNZ. Consequently, I consider this era to be one of increased credibility that brought inflation expectations down. Also, contrary to the sceptics who find this period to be inconsistent with the Phillips curve hypothesis, I argue that the lack of contemporaneous correlation between unemployment and inflation in this period can be explained by a gradual decrease of expected inflations over time. Thus, it allowed the New Zealand economy to enjoy low inflation and low unemployment simultaneously, without a rejection of the Phillips curve hypothesis.

Third and finally is the era of an apparent loss of credibility (2000 - 2015). The era began with the political defeat of the Shipley National government in 1999. According to Quiggin (1999), the election result "marked the end of a fifteen-year experiment" with "radical free market reforms". He also noted that the newly elected Labour government represented a significantly different political perspective on the economy and that led to the undoing of economic reforms for the first time since the Reserve Bank of New Zealand Act of 1989 (RBNZ ACT 1989). Those reforms upheld the low inflation target as a sustainable outcome. Therefore, when the newly elected government revised them, arguably with different political objectives, the credibility of the inflation targeting was also arguably compromised. Soon afterwards, the economy plunged into a period of uncertainty and confusion generating heated debates in the Parliament and controversial news headlines regarding the very objective of the monetary policy. Those confusions conceivably undermined the credibility of a sustainably low inflation target and coincided with an increased volatility of inflation expectations.

Also, in the post-1999 era, a seemingly vertical relationship between contemporaneous inflation and unemployment raised the question of whether or not the Phillips curve hypothesis holds any longer. In particular, following the global financial crisis (GFC), which began in 2007, this era offered a puzzle of "missing disinflation" amidst persistently high unemployment in New Zealand. Perhaps this phenomenon too can have a plausible explanation within the Phillips curve paradigm. In particular, I propose that the decreased credibility in the RBNZ's strict commitment and ability to ensure a low inflation rate in the long run could be attributed to the increased volatility of inflation expectations and that, in turn, could provide an empirically plausible explanation for the above phenomenon.

Guided by theory and a narrative history of the three distinct eras, I formulate hypotheses regarding various specifications of the Phillips curve, conduct empirical tests of those hypotheses, and report my findings. From these tests, I conclude that the expectation-augmented Phillips curve hypothesis, irrespective of its new Keynesian and new classical origin, cannot be rejected. Theories of rational expectations, time consistency, credibility governing the dynamics of inflation expectations and theoretical explanations of the slope of the Phillips curve turn out to be critical for discovering clear results, despite the apparent confusion due to the absence of a contemporaneous correlation between unemployment and inflation.

Also, empirical tests seem to suggest that, following the increased activism of the

Labour government since 1999, consistent with the observations made in Lucas (1973), the Phillips curve might have become steeper. At the same time, reduced credibility coincided with an increased average level of inflation expectations, even during the first few years of the GFC. Consequently, the low inflation targeting policy, prior to bringing the inflation expectations down, would ironically prolong the persistence of high unemployment, according to the expectation-augmented Phiilips curve paradigm. Thus, a careful analysis of New Zealand's disinflation experience validates the Phillips curve paradigm rather than writing its obituary.

Section 2 discusses literature on relevant ideas that can help explain the New Zealand experience. Section 3 provides an account of what happened in New Zealand's history of disinflation and identifies three distinct periods of inflation expectations. Section 4 describes the data and empirical methodology by relating them to earlier work, prior to presenting the key empirical findings of the paper. Section 5 includes a few concluding remarks.

2   Brief Literature Survey

The original Phillips (1958) hypothesis as well as subsequent modification by Samuelson and Solow (1960) missed the critical role of "inflation expectations". Friedman (1968) augmented the hypothesis by incorporating the inflation expectation as a shift parameter. In his model, it identifies the location of the Phillips curve along which a tradeoff between inflation and unemployment exists. A change in the inflation expectation causes a parallel shift of the Phillips curve to a different location. Consequently, understanding the theory behind the dynamics of inflation expectations holds the key to locating the Phillips curves in the data. That is the essence of the expectation augmented Phillips curve hypothesis.

Subsequently a new classical reformulation in Lucas (1972) and a new Keynesian renovation in Clarida, Gertler, and Gali (1999) and Woodford (2003) embraced Friedman's key insight behind the expectation augmented Phillips curve hypothesis. Irrespective of the differences in their underlying microfoundations, theoretically in both models, the following three general results hold:

(1) An unmet or an unfulfilled inflation expectations, where inflation or deflation comes as a surprise, generates a negative tradeoff between inflation and unemployment.

(2) A decreased expectation implies a downward shift of the Phillips curve, which reduces the cost of disinflation.

(3) If the inflation expectation is anchored at any level then the demand shocks generate a negative correlation and the supply shocks generate a positive correlation, between the inflation rate and the unemployment rate.

However, a discrepancy in the pace of change between inflation and its expectation could potentially generate an apparently puzzling relationship between inflation and

unemployment within the generalised Phillips curve paradigm.[1]

In what follows, I expand on three important ideas that uphold the essential wisdom behind the conquest of inflation in New Zealand within a generalised Phillips curve paradigm.

I do it with two critical objectives. The first is to present systematically the theoretical tools necessary for interpreting the slope of the Phillips curve and the dynamics of inflation expectations, which I utilise later to interpret three very distinct episodes of New Zealand's history. The second is to design an empirically relevant theoretical model of the Phillips curve to span the New Zealand data on inflation and unemployment between 1987 and 2015, by allowing for a change in its slope and history specific supply shocks.

2.1 The Slope of the Phillips Curve

The slope of the Phillips curve informs the policy maker as to the impact of a real demand shock or a monetary policy shock on inflation and unemployment. In particular, a flatter Phillips curve implies that a shock to demand or money would cause a relatively large change in unemployment with little associated change in inflation. A steeper Phillips curve implies a large change in inflation with little change in unemployment in response to the same shock.

2.1.1 New Classical Phillips Curve

The simplified new classical Phillips curve (NCPC) follows Lucas (1972) so that the date t inflation rate, π_t, can be written as the function of the last period's expectation of the current inflation rate, $E_{t-1}\pi_t$, and a measure of economic slackness. A less controversial and straightforward measure of that slackness is the *unemployment-gap*, given by the difference between the date t unemployment rate, u_t, and its natural rate, u_n. In addition, allowing for a time variant supply shock, v_t, I write the equation for the NCPC as follows:

$$\pi_t = E_{t-1}\pi_t - a(u_t - u_n) + v_t, \tag{1}$$

where the slope a increases with the relative frequency of demand management policies.

From Lucas (1973) we infer that countries which would try to exploit the Phillips curve relationship more frequently would end up making the Phillips curve steeper. Also, the absence of demand management would make the curve flatter. Based on the insights of the original new classical Phillips curve of Lucas (1973) and the subsequent literature on time consistency one conclusion regarding the slope of the Phillips curve follows in a straightforward way. The slope becomes steeper (i.e., a increases)

---

[1]Lacker and Weinberg (2006) provide a useful layperson's guide to the Phillips curve paradigm.

if people perceive that the monetary policy objective is to manage unemployment by accommodating wider variation in the inflation rate rather than the stated objective. Based on the Lucas (1973) supply curve, with a few simplifying assumptions, Romer (1996) derived an explicit formula, connecting the variance of money (a proxy for the frequency of the use of monetary policy) and the slope of the Phillips curve as follows:

$$a = (\gamma - 1)\frac{V_z + V_m}{V_z}, \ \gamma > 1, \tag{2}$$

where, γ, V_z and V_m denote, respectively, an index of disutility from work (as well as the intertemporal elasticity of labour supply) and the two variances of shocks from real demand (z) and money (m) or, by implication, from the variation in the monetary policy instrument. Evidently, a decreases to its minimum if the monetary policy instrument is not used at all and increases with the frequency of its usage.[2]

2.1.2 New Keynesian Phillips Curve

A different variation, popularly known as the new Keynesian Phillips curve (NKPC), follows the influential work of Clarida, Gali and Gertler (1999), Woodford (2003) and Gali (2008). In the spirit of those models, in the NKPC, the date t inflation rate, π_t, is a function of currently expected future inflation rate, $E_t\pi_{t+1}$, (where the future is discounted at a rate $0 < \beta < 1$), the *unemployment-gap,* $(u - u_n)$, and the time varying supply shock v_t at date t as follows:

$$\pi_t = \beta E_t \pi_{t+1} - a(u_t - u_n) + v_t. \tag{3}$$

The above relationship has a micro-foundation that arises through the presence of rigidities in price-setting decisions. The higher the inflation expectation prior to the next period for price adjustment, the higher the current price the firms will set. Such price setting behaviour implies that the current inflation depends on the real cost of production and expected future inflation and that, in turn, implies a negative relationship between inflation and unemployment.

According to proponents of the new Keynesian Phillips curve (e.g., Gali, 2008), the slope of the Phillips curve is given by

$$a = -\ \alpha \left(\frac{(1 - \lambda)(1 - \beta\lambda)}{\lambda} \right) \left(\frac{\alpha}{\alpha + (1 - \alpha)\epsilon} \right) \left(\sigma + \frac{\phi + 1 - \alpha}{\alpha} \right), \tag{4}$$

where, λ denotes the frequency of price changes, α denotes the elasticity of output with respect to the labour's share (which positively affects the labour's share of income), β denotes the factor for discounting future, ϵ denotes the Dixit-Stiglitz elasticity of

---

[2]See, for example, chapter 6 of Romer (1996), pages 246-250.

substitution across varieties (which positively impacts on the markup or the profit share in sales), σ denotes the intertemporal elasticity of substitution and ϕ denotes the Frisch labour supply elasticity ϕ.[3]

Thus, there is a clear distinction between the new classical and new Keynesian theories regarding how to explain any significant change in the slope of the Phillips curve between any two periods. The new classical theory points toward a change in the frequency of the monetary policy shocks while the new Keynesian theory points toward a change in the deep fundamental parameters of the economy.

I now briefly discuss the ideas of rational expectations, time consistency and credibility which offer critical insights for the policymakers to understand the dynamics of inflation expectations.

2.2   Inflation expectations: Some Theoretical Insights

To understand the dynamics of inflation expectations, atheoretical econometric methods of extracting information from the past proved to be problematic due to a basic conceptual flaw: economic policies influence data and hence past data lose relevance in forecasting the future under new policies. In the literature, we know this problem with econometric forecasting as the *Lucas Critique* (see, Lucas, 1976). From that critique emerged the concept of rational expectations of inflation which, by definition, coincides with the model's equilibrium inflation outcome, which can plausibly and significantly differ from the past trend.

2.2.1   Rational expectations of Inflation

Since Phelps (1967) and Friedman (1968), economists have realised that monetary policy not only determines inflation but that it also determines the inflation expectation and that, in turn, pins down the location of the entire Phillips curve. Afterwards, the focus turned to modelling expectations and its specification in the equation for the Phillips curve. Two distinct routes emerged subsequently. One involves econometric forecasting techniques while the other follows Friedman's tradition of using theory as a guide to understanding the behaviour of inflation expectations.

A noteworthy illustration of the first route (see, e.g., Roberts, 2006) involves conventional econometric techniques where the lags of inflation serve as a proxy for inflation expectations, capturing the presumed inertia of inflation in the data. The alternative route follows the seminal work of Lucas (1972), which interprets the rational expectation of inflation as the model consistent expectation. The model consistency of inflation expectations requires that the rational agent expects the inflation rate to be the same as the equilibrium outcome of the relevant economic environment which includes, in particular, the agent's belief about the nature of the monetary policy objective.

---

[3]By assumption, labour is perfectly mobile and fixed capital have been normalised to one.

Despite subsequent differences in modelling the economy, both new classical and new Keynesian formulations of the Phillips curve incorporate that idea of rational expectations so that the agent's forecast of inflation affects the equilibrium outcome of inflation itself.[4]

In addition, from the work of Kydland and Prescott (1977) and Calvo (1978), we know that if the policy objective is not time consistent then the equilibrium outcome and hence the rational expectation of inflation would change. Consequently, one important key to bringing the rational inflation expectation down is to ensure the time consistency of the objective of a low inflation target.

2.2.2 Time Consistency

According to the rational expectations paradigm, when forming their expectations of future inflation, people optimally use all the information they consider relevant to determine if the monetary policy objective is time consistent. Therefore, to understand the behaviour of inflation expectations in New Zealand, we must examine how important changes in the political environment may tamper with public perception of the time consistency of the monetary policy objective. To keep our focus on the essential details, I assume that the government policy reflects the political preference of a clearly identifiable interest group.

Suppose that the objective of one group is to minimise the long-run inflation rate while the objective of the opposing group is to pursue activist policies to reduce fluctuations in unemployment and nominal exchange rates even if that requires accepting greater short term fluctuations in the inflation rate. A large fluctuation in the nominal exchange rate may be undesirable to a political group which prefers a fixed exchange rate regime. Similarly, a powerful interest group representing labour may push for lower unemployment following a deep recession with an easy monetary policy.

Assuming the common knowledge that the real exchange rate is independent of monetary policy, changes in the nominal exchange rate in percentage can be simply attributed to the difference between the domestic and foreign inflation rate.[5] Depending upon the institutional set up for separating political influence of the interest groups and the monetary authority, the two separate objectives could be described as to minimise, respectively, the following two cost (C) functions:

---

[4]The original idea of rational expectation follows from two articles by John Muth: "Optimal Properties of Exponentially Weighted Forecasts", 1960, and "Rational Expectations and the Theory of Price Movements", 1961.

[5]By definition, the following relationship involving the nominal (e) and the real (q) exchange rates and the domestic (π) and the foreign (π^*) inflation rates holds:

$$\frac{\triangle q}{q} = \frac{\triangle e}{e} - (\pi - \pi^*).$$

Following a domestic or foreign monetary policy shock the real exchange rate q remains unchanged (i.e., $\triangle q = 0$) and, therefore, the nominal rate e changes as follows: $\frac{\triangle e}{e} = (\pi - \pi^*)$.

$$C_1 = \frac{b}{2}\pi^2, \tag{5}$$

or

$$C_2 = \frac{b}{2}\left(\pi - \pi^*\right)^2 + au_c, \tag{6}$$

where π and π^* denote, respectively, the domestic and the foreign inflation rates, $u_c = (u - u_n)$ measures the cyclical unemployment rate. For expositional simplicity, I drop the subscript t and assume that the parameter a measuring the disliking of unemployment equals the slope of the Phillips curve in (1) - (4) and the common parameter $b > 0$ measures, respectively, group one's disliking of inflation and its opposition's disliking of inflation differentials with the country's trading partners. After simplifying the notation for the expected inflation to $E\pi$, it follows from (1): $u_c = -\frac{1}{a}(\pi - E\pi)$ and, in turn, from (6):

$$C_2 = \frac{b}{2}\left(\pi - \pi^*\right)^2 - (\pi - E\pi). \tag{7}$$

It is straightforward to conclude that the first group's objective is time consistent while the second group's objective is not. Next, I provide a brief outline of that argument.[6]

Suppose initially the economy is at a state of a long-run equilibrium with $\pi = 0$ and, therefore, the rational expectation of inflation $E\pi = 0$. The cost of the two policy objectives under the above economic condition are as follows: $C_1 = 0$ and $C_2(initial) = \frac{b}{2}\pi^{*2} > 0$. Clearly, for the first group the policy cost equals the minimum possible value. However, for the second group that is not the case. The optimal inflation rate that minimises the policy cost for the second group satisfies

$$\pi_{OPT} = \frac{1}{b} + \pi^* > 0. \tag{8}$$

If the government reneges its promise to set $\pi = \pi_{OPT}$ while the inflation expectation $\pi^e = 0$ then the new cyclical unemployment rate u_c would be :

$$u_c = -\frac{1}{ab} - \frac{\pi^*}{a},$$

and by reneging as above it can bring down its cost C_2 to a lower level so that:

$$C_{2OPT} = -\left(\frac{1}{2b} + \pi^*\right) < 0 < \frac{b}{2}\pi^{*2}.$$

<hr>

[6]See Box 1, page 24 of Grimes (2014) for a similar illustration of a time inconsistent policy objective without involving the international sector.

In other words, once the inflation rate is anchored at $E\pi = 0$ possibly through a decade of hard work to increase credibility, the objective function of the second group provides the government an incentive to cheat. Not only their political preference would encourage their representative government to renege on its promise but the key idea of time consistency is that, even if it does not, rational agents would expect the government to do just that. Consequently, the rational expectations of inflation would be revised upward so that $E\pi = \pi_{OPT} > 0$ and that would imply $u_c = 0$ and the new value of $C_2(new) = \frac{1}{2b} > C_2(initial) = \frac{b}{2}\pi^{*2} > 0$ (for all $b < 1$).

Worse still, if the second group fails to understand the inherent time consistency problem with the objective indicated by their publicly declared political preference and nonetheless pursues a policy of zero inflation rate dictated by a law, then the rational expectations of inflation would be above zero, being equal to the optimal inflation rate. Consequently, it would cause an increase in the unemployment rate so that $u_c = \frac{1}{a}\left(\frac{1}{b} + \pi^*\right) > 0$ and the policy cost would increase further: $C_2(\pi = 0) = \frac{b}{2}\pi^{*2} + \frac{1}{b} + \pi^*$.

No amount of transparency and vigorous pursuit of zero inflation policy would bring the expectations down, until and unless the public's perception of the very policy objective is changed. In other words, as long as people believe that the government dislikes "undesirable fluctuations" in unemployment and exchange rates they would rationally expect the government to renege from the promise of a zero inflation target. It would be true especially if, in a situation like the global financial crisis, foreign governments follow a lax monetary policy which may increase π^*, causing appreciation of the nominal currency. The rational agents would expect the government, which tries to minimise C_2, to increase the inflation rate.

Clearly, the first group's policy objective of minimising C_1 is time consistent. Therefore, to overcome the problem of time consistency, it is necessary that people believe that the government reflects the preference of the first group. An independent central bank can help but is not sufficient.

The Minister of Finance, who is a political person, appoints the Governor and influences the Governor's objective by changing the Policy Targets Agreements (PTA) between them. Sometimes, a close relative of the Minister serves as an adviser to the Governor.[7] Irrespective of the integrity and the professionalism of the individuals concerned, such close association could tamper with the public perception or the credibility of the monetary policy objective. Similarly, the public expressions of the uneasiness with the tight inflation targetting objective by the Minister of Finance could also undermine the credibility of inflation targeting.

Passing a law to increase credibility like the RBNZ Act of 1989 certainly helps but the rational expectations of inflation ultimately depends on the public perception of the political influence of the government as a whole. Therefore, the political character of the whole government is at stake here for increasing credibility which, in turn, enhances

---

[7]Rutherford (2015) reported that the brother of the Minister of Finance had been appointed to advise the Governor of the RBNZ on monetary policy.

monetary policy effectiveness.

2.2.3 Credibility

A large volume of theoretical literature on reputation and credibility of the policymaker emerged from the seminal work of Barro and Gordon (1983) and the influential work of Goodfriend and King (2005). The idea of credibility helped to build a consensus among economists around the world that not only does the central bank need to enjoy full autonomy over all its instruments to implement its objective but the public's perception of this objective also should not differ from the officially stated one.

With reference to the two policy objectives discussed above, if people believe that with a probability p the government's objective is to minimise C_1 while with probability $(1-p)$ it is to minimise C_2 then their perception of the government's monetary policy objective becomes to minimise $C = pC_1 + (1-p)C_2$. Consequently, irrespective of a transparently written legislation, if a newly elected government undertakes specific decisions that make $p < 1$ then such a policy would also suffer from a time consistency problem. In essence, the condition $p < 1$ is sufficient to cause a loss of credibility. Consequently, a zero inflation target would ironically yield the worst possible outcome in that environment. The work of Goodfriend and King (2005) supports the conjecture that the public uncertainty about p could easily add avoidable cost of pursuing a low inflation policy, implying the importance of credibility of the monetary regime in ensuring without any confusion that $p = 1$.

It follows, therefore, that setting up a fixed inflation target and a clear rule for meeting that target, however transparently followed, is not sufficient to anchor inflation expectations. The overall commitment of the whole government and its politics must be consistent with a stable inflation outcome in the economy. To ensure such an outcome, economic literacy of the majority of the electorate would be critically important as well. Failure to do such preparation prior to introducing a policy of sharp disinflation would rationally force an economy to sacrifice valuable output, causing avoidable suffering among the people.

The disinflation decision in New Zealand in the late 1980s and the experience of the country afterwards provides a salient illustration of that point.

3 A Narrative History of Inflation Expectations in New Zealand

In the late 1980s, the RBNZ faced the prospect of reducing inflation from its peak of about fifteen percent to a zone between zero to two per cent as specified by the RBNZ Act 1989. The conventional wisdom, based on Samuelson and Solow (1960), described a rigid trade off between inflation and unemployment. Dalziel (1989) and others warned about the inevitable cost of disinflation in terms of lost output due to

increased unemployment from such a sudden and drastic disinflation.[8] Bollard (1992) made a reference to "a rather naive view" of "a relatively painless outcome" (see page 5, second paragraph) and suggested that the new monetary policy incorporated "the new classical view of expectations" (see page 11, second paragraph). The new classical hypothesis of short-run neutrality of money with rational expectations and the consequent zero sacrifice ratio was considered more radical than the monetarists' view of the temporary cost of disinflation. Coleman's (1992) survey of opinions reveal that contemporary economists in New Zealand largely supported or opposed the disinflation decision of the late 1980s based primarily on their views regarding the monetarist's neutrality proposition and its implication for unemployment, ignoring the new classical view of rational expectations altogether.[9]

Prior to 1989, none of the RBNZ publications explicitly referred to the contemporary theories of rational expectations following Lucas (1972). The novelty of the idea of rational expectations is that it identifies inflation expectations with the sustainable outcome of inflation which is a function of the overall policy framework of the government, not to be equated with a temporary inflation outcome. Reddell and Heppleston (1988) stood out as an exception to this rule. They emphasised the importance of bringing the inflation expectations down by taking a broader range of mutually consistent policies rather than merely focussing on the monetary aggregates alone. Consequently, the perils of bringing inflation down prior to lowering its expectations were ignored and, ironically, celebrated. The February 1992 Monetary Policy Statement (MPS) noted without warning that in 1991 the CPI inflation rate reached a thirty year low of one percent which was significantly below its stated forecast made in MPS (1991). Considering high inflation expectations, on 19 December 1990, the Minister of Finance issued a new Policy Targets Agreement (PTA) to postpone the target date for achieving the zero inflation target by one full year (see, page 18, MPS, 1991). Moreover, the MPS 1992 included its assessment that the inflation expectations for 1992 to exceed three percent but it offered no warning against pursuing an inflation target below its expectations. What happened afterwards offered clear insights for the policy makers.

Figure 1 below displays a spectacular graph apparently mimicking the Phillips-Samuelson-Solow hypothesis of a rigid inflation-unemployment trade-off between 1987 and 1992. It plots the inflation rate using the GDP deflator because of its natural link

---

[8]Dalziel (1998) provides a comprehensive summary of the contemporary thoughts regarding the conventional wisdom on the likely adverse impact of disinflation.

[9]Coleman's (1992) survey of opinions among the economists concluded that a considerable majority of economists believed that there is no long run trade off between inflation and unemployment (see page 52) and that "the younger economists are ... less likely to disagree with the money-neutrality thesis" (see, page 56) which implies a relatively costless disinflation. The survey result shows that about a quarter of the respondents generally agreed with the premise (32) of monetarism that short-term cost in the economy through the "liquidity-effect", presumably following a disinflation, would be negligible (see footnote 7, page 52).

to the underlying theory of the Phillips curve without inflation expectations.[10]

Evidently, the disinflation in the early 1990s came with a sharp and significant increase in unemployment. However, the data since 1993 poses a puzzle to the original Phillips hypothesis where inflation expectations play no role.

If, instead, we follow Friedman's (1968) insight to consider the expectation augmented generalised paradigm for the Phillips curve, then we can potentially explain such a sharp increase in unemployment by a rapid disinflation that surpassed the public expectations between 1987 and 1992. Also, the steady decline of the unemployment rate afterwards without a corresponding increase in the inflation rate can be explained by a steady decline in the inflation expectations till 1999. Finally, the increased volatility of inflation and unemployment since the 2000s may be explained by the increased volatility of the rational inflation expectation itself.

Figure 1
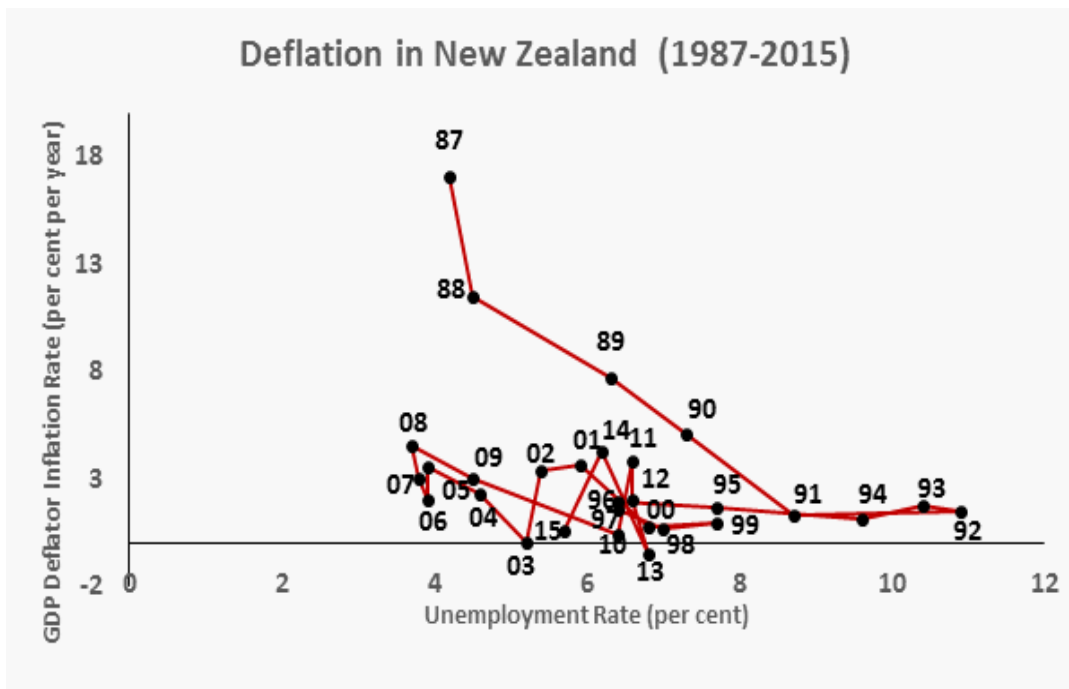
A question arises naturally: can we find evidence from the data on inflation expectations or present theories relevant to the narrative history to support those hypotheses? To answer this question we begin with the application of the the theory of credibility and its impact on the rational expectations of inflation followed by an empirical analysis of the data on inflation expectations.

---

[10]For the empirical exercises, presented later, I use the expectation augmented model for the Phillips curve and the survey data on the CPI inflation expectations. Therefore, for consistency, I also use the inflation rate measured by the CPI and not by the GDP deflator for doing those exercises.

3.1 Rational Inertia of Expectation: 1987-1992

During the period 1987-1992 the Reserve Bank of New Zealand brought down the inflation rate drastically. Yet, the real product wages, calculated as mean nominal hourly earnings deflated by the Producers Price Index (PPI), which measures the labour cost of employers, rose between 1984 and 1994—by about 4 percent (see, Dixon, 1996, page 53, first paragraph), implying downward nominal wage rigidity. The data of commercial forecasting firms on inflation expectations show that expected inflation remained higher than inflation justifying this wage rigidity. Between the end of 1987 and the end of 1992, the inflation expectations remained two to seven percent higher than the actual inflation rate, except for the four consecutive quarters around the period when the RBNZ Act 1989 was passed.

One can explain such a staggering decline of inflation expectations along the line of Mankiw and Reis (2002) by arguing that learning about the new policy regime typically requires costly reallocation of resources and hence, during the time of big changes, people update expectations at a relatively slow pace. One can also refer to Gordon (1997) to suggest that, believing in the inherent "inflation inertia", firms and workers may sign contracts expecting high rates of inflation in the future. Such contracts raise the labour cost unexpectedly to cause a sharp increase in unemployment. However, those explanations appear lame for making sense of the data after 1993. This is because, in the post 1993 era New Zealand witnessed a steady decline of the unemployment rate till 1997 without any significant change in the inflation rate, suggesting that the pace of adujustment for inflation expectation was much faster than the theories based on costly adjustment of expectation would allow.

The rational expectations view, contrary to Gordon (1997), denies that there is any inherent momentum to the present process of inflation. Instead, this view insists that people expect high rates of inflation in the future precisely because the labour market condition along with the government's prospective monetary and fiscal policies warrant those expectations. In particular, the rational expectation of inflation coincides with the long-run inflation outcome of the underlying economy and not necessarily with the current inflation. It also assumes that the cost of processing information in a transparent environment is negligible.

Consequently, according to the rational expectation view, the independence and transparency of the central bank's operative procedure was not enough to convince people that the low inflation target would be sustainable in the long-run. Several political and economic factors stood in its way.

First, according to Evans et al., (1996), those reforms were quite drastic, which arguably changed "a closed and centrally controlled economy to one of the most open countries in the OECD." Those drastic institutional changes raised sharp political controversies offering serious challenges to their long-term viability.

Second, Evans et al., (1996) concluded that the sequencing of those reforms were "suboptimal" for the intended outcome of low inflation (see page 1871, 2nd column, 2nd

paragraph). The labour market and fiscal reforms should have preceded the monetary reform.

Hall (1996) concluded that deregulation of labour markets prior to the introduction of the RBNZ ACT of 1989 would have reduced the cost of disinflation (see chapter 2 in Silverstone et al., page 61, third para, lines 2-4). Presumably, the rational mind believed that an economy with strong labour market frictions due to the close link between the award wages and the negotiated Metal Trades Award would make it hard for the RBNZ to sustain low inflation for a long-period of time.[11]

The much celebrated "Growth Agreement" between the New Zealand Government and the Council of Trade Unions to limit the growth of nomimal wage to two percent plus productivity growth was only indicative, for the lack of a centralized implementation mechanism. By reflecting on the official monetary policy statements, Johnson (1990) noted such limited control over wage inflation and mounting external debt as two important policy challenges.

By 1987, the public debt rose to seventy-six per cent of the GDP with almost half of it held by the non-taxpaying foreigners. Only after the completion of all major fiscal reforms, both numbers fell by more than fifty per cent. Prior to that change, a sudden reduction of inflation could risk increasing the real burden of that debt beyond feasibility. Therefore, following Sargent and Wallace (1981), one could not rule out this perceived fiscal risk for high inflation without the necessary fiscal reform. I find an implicit support for the above argument in Wheeler's (2014) comment that "there are limits to what monetary policy can do: supportive structural and fiscal policies are also needed".

Third, the financial crisis of 1984 led to a sudden and significant depreciation of the New Zealand dollar which was severe enough to make news even for the farmers in Iowa whose exports compete with their New Zealand counterpart.[12] The panic that followed afterwards continued to provide a reason for the public's concern for an uncertain future for the value of the New Zealand dollar and the expectation of a higher inflation due to a higher expected price for imports.

Fourth, in 1989, the introduction of the Goods and Services Tax (GST) for the first time ever in New Zealand's history did not help to lower inflation expectations either.

Therefore, the sluggish decline of inflation expectations in this era seems rational, if we consider the specific economic environment in which the RBNZ's ability (not just the declared intent) to sustain a low inflation target lacked credibility.
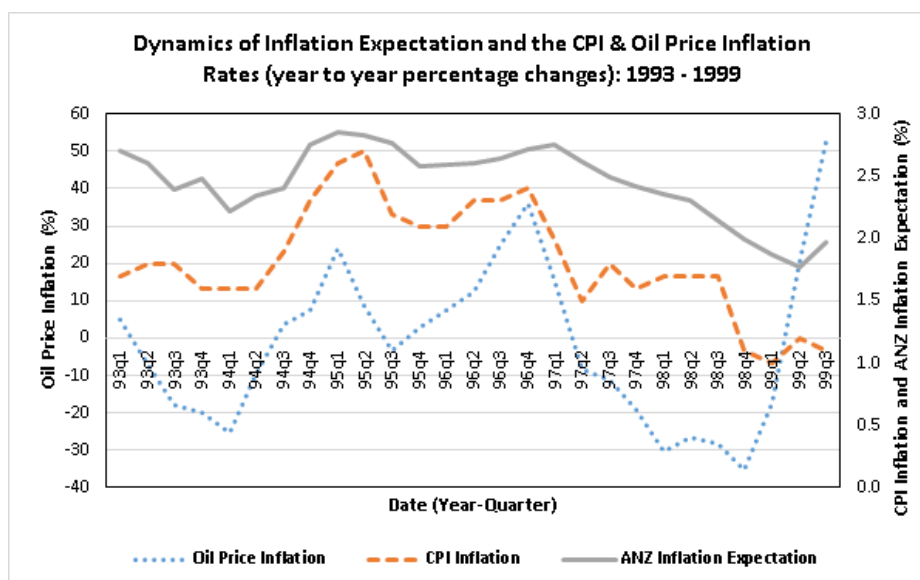
---

[11]Bradford (1983) documented that in the early 1980s, about 90 percent of the wage settlements were within one percent of the Metal Trades Award (see, page19).

[12]Associated Press (1984) reported in *The Daily Reporter* on July 18 that the incoming government devalued currency by twenty per cent and abolished all controls over interest rates.

3.2 A Period of Increased Credibility: 1993-1999

Even to the sceptics, the conquest of inflation appeared decisive by the end of 1993. By that time reforms, complementary to inflation targeting, were all but completed. Then unemployment began returning home to its natural rate of four per cent (see Figure 1).[13] Presumably, as Figure 2 below suggests, a gradual decrease of the inflation expectations over time allowed the economy to enjoy lower unemployment without any increase in inflation, consistent with the models (1) and (3).

Figure 2

Dynamics of Inflation Expectation and the CPI & Oil Price Inflation Rates (year to year percentage changes): 1993 - 1999

Thus, this outcome was possible without a rejection of the Phillips curve. A narrative history helps us here with potential reasons for such steady decline of inflation expectations.[14]

In particular, the Employment Contracts Act (ECA) of 1991 reduced labour market frictions which helped to generate disinflation in wages.[15] The Fiscal Responsibility Act (FRA) of 1994 reassured the employers and the workers about no implicit pressure on the RBNZ arising from any future burden of debt to be financed via inflation.

---

[13]Razzak (2014) concluded that the measured long-term unemployment rate has been around four percent. The unemployment rate did sharply increase after the RBNZ ACT of 1989 and came down eventually to its original state of about four percent and stayed there till the global financial crisis (GFC) hit in 2007.

[14]In Figure 2, I plot the quarterly data on one-year-ahead inflation forecast from the ANZ Business Outlook Survey of firms.

[15]Rosenberg (2010) concluded that wage disinflation accelerated in the post ECA era to reduce the elasticity of the wage rate relative to labour productivity significantly from 0.37 (1990 - 1997) to 0.14 (1997-2000).

Trade liberalisation facilitated global competition and that too put downward pressure on inflation. Also, Evans et al, (1996) noted that successful applications of modern microeconomic theories into various policy designs augmented overall efficiency as well as labour productivity. They reported about an eighty per cent increase in the hours based on the average productivity growth between the period 1984 - 1991 and 1991 - 1995 (see page 1881, Table 2). Those productivity gains were likely to lower the cost of production and increased the credibility of a sustainable low inflation target in the long run.

Afterwards, the increased credibility, achieved through the supportive economic reforms, caused inflation expectations to decline steadily till September 1999. Figure 2 shows that this steady decline in the inflation expectations occured despite a sharp increase in the oil price inflation between 1998 and 1999. More importantly, Figure 2 suggests that throughout this period inflation expections were much less succeptible to oil price inflation than the actual inflation. The correlation of the oil price inflation was only 0.26 with the ANZ inflation expectations compared to 0.36 with the CPI inflation during the period 1993 -1999. This apparent divorce between the oil price inflation and inflation expectations supports Bernanke's (2010) conclusion that a successful anchoring of inflation expectations, achieved through a credible low inflation targeting objective, causes the death of high inflation or deflation.

With inflation expectations anchored, according to the Phillips curve hypothesis, shocks to supply and demand would respectively generate a positive and negative trade-off between inflation and unemployment in the short run. However, as long as the monetary policy regime remains credible, the inflation rate would return to the same rate as its anchored expectation, while the unemployment rate returns to its natural rate.

3.3 Loss of Credibility and Missing Disinflation: 1999-2015

Yet, the absence of a contemporaneous correlation between inflation and unemployment in the post 1999 period, especially in response to a demand shock such as the one during the recent GFC, poses a puzzle for the hypothesis of anchored expectation within the context of the Phillips curve paradigm.

Moreover, a comparison of Figure 2 (above) and Figure 3 (below) suggests a greater volatility of inflation expectations and its stronger comovements with the oil price inflation, compared to the previous era of increased credibility between 1993 and 1999.

In particular, the coefficient of variation (measured by the ratio of variance to the square of the mean) for the inflation expectations and inflation increased by more than two hundred per cent and one thousand per cent, respectively, while the same for the oil price inflation increased only by about seventy-three per cent. Also, the corelation of the oil price inflation with the ANZ inflation expectations increased sharpy by about 50% from only 0.26 during the previous era between 1993 and 1999 to about 0.39 in the post-1999 era. Interestingly, during the same time period, the correlation between the

oil price inflation and the CPI inflation remained about the same as before, indicating a significant increase in the succeptibility of the inflation expectations to external shocks in the latter period. More interestingly, the sharp increase in the inflation expectations in 2001 and 2002 despite a steady decline in the oil price between 2000 and 2002 suggests a separate cause for this increased inflation expectation and poses an apparent puzzle to Bernanke's (2010) anchored inflation expectation hypothesis and hence its relevance to the New Zealand economy in the post-1999 era.

Figure 3
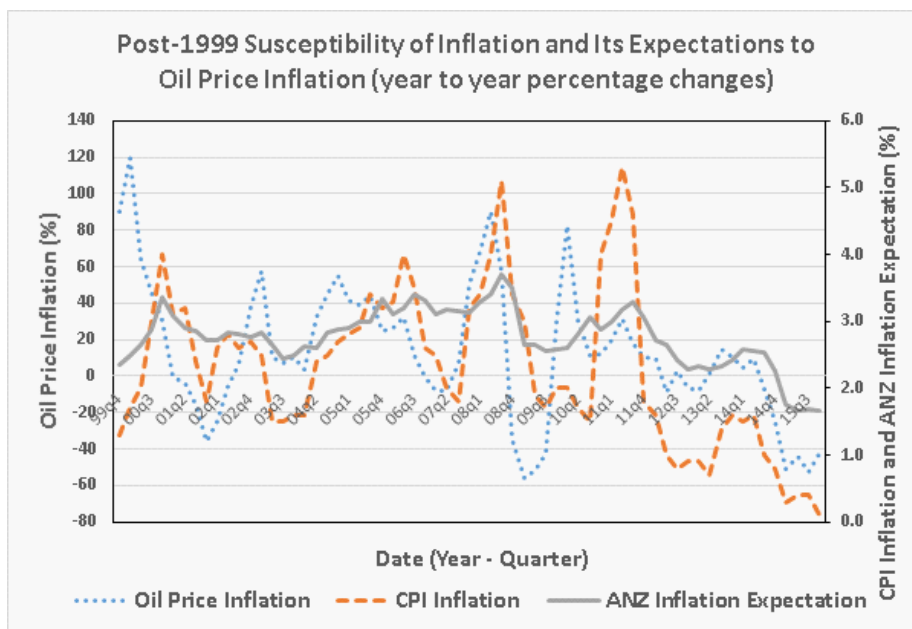
It seems that there are two ways to rationalise this puzzle. One way would be to hypothesise that the loss of credibility in the post 1999 era unanchored inflation expectations. An alternative way would be to assume that the Phillips curve has flattened (see, e.g., IMF 2013 and McDormet, 2014) or has lost its relevance along the line of Ball and Mazumder (2011).

A flatter Phillips curve does indeed help explain the phenomenon of "missing disinflation" but not the puzzle of increased volatility of inflation and its expectation. Besides, Coibion and Gorodnichenko (2013) argued that a theoretical explanation for a flattening of the Phillips curve is problematic, especially in the new Keynesian model. It requires specific structural changes implied by (4) in a way that I find inconsistent with New Zealand's history during this era. More importantly, empirical evidence, presented later, suggests that the the slope of the Phillips curves became steeper (not flatter) during this era, compared to the previous era of increased credibility. Also, Lucas's (1973) rationale for the slope, given by (2), provides a plausible explanation.

18

It involves the public perception of an increased frequency of monetary policy shocks relative to non-monetary demand shocks.

However, the sudden and significant increase in the frequency of monetary shocks in the decade after 1999, despite a decade of successful anchoring of the inflation expectations earlier, calls for an explanation. A careful study of Quiggin (2000) and Reddell (2016) suggests that there is an obvious explanation for this change; but it is not economic but political.

Perhaps due to a lagged political response to the costly disinflation which resulted immediately after the RBNZ Act 1989, coupled with the lack of complete understanding of the deeper theoretical ideas involving rational expectations, time consistency and credibility that produced an economy with low inflation and low unemployment, in 1999 the electorate demanded revisions of the "radical free market reforms" and the newly elected government pledged to roll back some of them.[16]

Tampering with the original reforms also tampered with credibility of the low inflation target, because together those reforms ensured the credibility of the RBNZ's ability to sustain its low inflation target. For example, the new Employment Relations Act of 2002 which replaced ECA 1991 to give labour unions more bargaining power arguably created more wage frictions in the labour market.[17] Also, immediately after the election victory, the Minister of Finance revealed his not so strict preference for the exclusive pursuit of a low inflation target at the cost of a higher volatility of unemployment and output. In particular, the December 1999 PTA made explicit the requirement for the RBNZ to seek to avoid "unnecessary instability in output, interest rates and exchange rate" in the pursuit of a low inflation target. Also, to support that change in focus, the Minister lifted the upper limit of the targeted zone for inflation by one full percentage point while keeping the lower limit unchanged. This asymmetry in tampering with the targeted zone arguably revealed a new upward bias in the preferred inflation target.[18]

It did not stop there. In September 2002, even the lower limit for the inflation target was raised from zero to one per cent. Reddell (2016) reported that "the Minister of Finance, Michael Cullen, had been uneasy for a long time as to whether the target framework was too restrictive." He also recalled that the new Governor chosen by the

---

[16]Quiggin (2000) cited Bean (1999) to note that the RBNZ's "exclusive focus on an inflation targets have led to excessively restrictive policy" and 1999 election result was a verdict against such "radical free market reforms" and "the Labour government pledged to roll back" some of those reforms. (see, page 35).

[17]Rosenberg (2010) found that the elasticity of real wage growth relative to labour productivity growth increased by more than fifty per cent during the period 2000 - 2006 compared to the period 1997 - 2000. He attributed this increase to the ERA 2002.

[18]Bean (1999) argued that a policy that limits itself to inflation targeting alone must accept a greater volatility of output and unemployment. Therefore, to reduce volatility of unemployment, the policymakers must allow for "ample fluctuations in inflation" and accept a longer lasting divergence of inflation from its target. The 1999 changes in the PTA seem consistent with Bean's (1999) recommendations.

new Minister of Finance "had much the same unease about how the Bank had been run - and about the anti-inflation inclinations of key personnel - as the Beehive did." He argued that possibly because of such "continuing unease" the Minister added to the PTA the explicit requirement for the Governor to mind output and exchange rate stabilizations.

The RBNZ Memo (2005) provides evidence of this shift in monetary policy preference toward including a desire to stabilise the value of the NZD.[19] Cheng, et al. (2006), in a New Zealand Herald article with a title: "Avoid kiwi dollar, Government tells Japanese", wrote that a spokesman for the Minister of Finance confirmed that a joint delegation from the RBNZ and the Treasury had been to Japan in late 2005 to dissuade them from using the New Zealand dollar denominated Uridashi bonds as a part of their portfolio of savings. The article also reported that "Federated Farmers board-member Hugh Ritchie was concerned about the Government intervening to influence the dollar."

More importantly, as Reddell (2016) noted, the rationale behind the first few OCR decisions appeared confusing. In a large economy like the United States, an interest rate hike is likely to reduce inflation and its expectation; but it is also likely to increase the value of its currency. In a small open economy like New Zealand, an interest rate hike may also ironically boost liquidity significantly by attracting NZD from the international market via Uridashi or other NZD denominated bonds. Therefore, the OCR decisions, which also started since 1999, contributed to confusions regarding the monetary policy objectives, especially when their rationale appeared incosistent with inflation targeting.

The direct evidence of such confusion comes from a question put to the Minister of Finance by the opposition leader at that time, Honourable John Key, regarding the RBNZ Governor's description of the exchange rate "as exceptionally and unjustifiably high" at a time when his own policy of raising interest rates was likely to attract "billions of dollars of hot money" via "Uridashi and Eurokiwi" bonds into the country (see, New Zealand Parliament Speeches, 2005, Dec 8). Key (2005) argued that such a scenario was also likely to fuel inflation rate because a higher interest rate would attract more liquidity from abroad. Other political leaders such as the United Future leader Peter Dunne and the ACT party leader Rodney Hide expressed similar concern related to a confusing monetary policy stance. Three years later the Governor of the RBNZ and the Treasury Head went on a roadshow around the world with an opposite mission to encourage inflow of New Zealand dollars from abroad (see, Fallow, 2009). It was soon after the Governor lowered the interest rate sharply at home, plausibly to combat recession, which ironically undermined that effort, creating additional confusion.[20] As

---

[19]The December 2005 Uridashi memo includes a graph suggesting that the RBNZ is concerned about high value of the NZD. Yet, a high NZD is ironically good for keeping inflation low. The root of this concern must be a new objective and there lies the evidence of a policy trade-off between the volatility of the NZD versus the inflation rate.

[20]Sanderson, et al. (2007) wrote a memo on behalf of the Business and Economic Research Limited

the confusion regarding the monetary policy objective grew, its credibility suffered. Consequently, the rational expectations of inflation became more volatile.

Lewis and McDermott (2016) report econometric evidence of a clear increase in inflation expectations immediately after the explicit changes in the inflation targets in the PTA of 1999. Also, in a recent speech, Wheeler (2014) noted that the global stimulus package and New Zealand's loose fiscal policy, and the latest PTAs guideline for the Governor of the RBNZ to seek inflation in the medium term rather than short term made the inflation rate more volatile and prone to supply shocks. However, he concluded that policy credibility achieved through increased transparency has stabilised (or anchored) inflation expectations at a low level and that anchoring of expectations enhanced "the ability of monetary policy to help offset short-term shocks to output and employment".

Yet, Figure 3 above casts some doubt over the hypothesis of an anchored expectation. Instead, it seems that the volatility of oil price inflation contaminated its volatility to inflation expectations more prominently in the post 1999 era than in the nineties. Conceivably, significant changes in the PTAs in 1999 and afterwards might have undermined the very credibility of the monetary policy objective to make inflation expectations more sensitive to external shocks. Ironically, credibility is necessary for anchoring the inflation expectations at a low level but any attempt to exploit the inflation-unemployment trade-off for demand management following the original Phillips-Samuelson-Solow hypothesis may adversely affect the policy trade-off by making the Phillips curve itself steeper. That is the essence of the *Lucas Critique.* Also, if inflation expectations are no longer anchored due to lost credibility and are susceptible to external shocks then a temporary period of low inflation expectations due to an external shock provides little assurance of credibility, contrary to Wheeler's (2014) conjecture. Ironically, the Governor's recent stance on monetary policy "to help offset" the demand shock from the GFC may cause stagflation by raising inflation expectation.

Moreover, the average inflation expectation might have already increased in the last few years as the survey data of firms in New Zealand reported in Coibion, Gorodnichenko and Kumar (2014) indicated. According to Coibion and Gorodnichenko (2015) the possible explanation for such an increase could be the rise in oil prices, the recent growth of China and the unprecedented volume of quantitative easing following the global financial crisis. However, it seems reasonable to conclude that had the monetary policy of low inflation targeting remained credible, then those outside influences would not have raised the rational expectations of inflation so easily.

In the following section I report results from my estimation of the Phillips curve and tests of relevant hypotheses to examine if the insights offered by the narrative history of events are compatible with those empirics.

(BERL) expressing concern about the RBNZ's conduct of monetary policy. The memo noted that the high interest rate policy may ironically fuel inflation by attracting "foreign funds into New Zealand Dollar deposits," and thereby "increasing New Zealand's domestic money supply."

4 The Phillips Curve Empirics for New Zealand

From the earlier discussions, I make four conjectures: (i) credibility matters for understanding the pace and direction of changes in the rational inflation expectations; (ii) within a credible regime with anchored inflation expectations demand shocks generate a contemporaneous negative tradeoff between inflation and unemployment as predicted by the generalised Phillips curve paradigm; (iii) supply shocks and changes in inflation expectations shift the location of the Phillips curve without changing its slope; and (iv) the loss of credibility leaves the policymaker with a steeper Phillips curve whose location shifts more frequently.

I follow a new style advocated by Leeper et al. (2008) in which the narrative history interpreted by relevant theory can be used to partition the available data to discern insightful facts from regression based exercises. The findings from this exercise uncover the inflation-unemployment dynamics through a generalised Phillips curve paradigm, despite the puzzling lack of evidence for such a relationship (see, for example, Hargreaves et al., 2006, and McDermott, 2015).

4.1 Data

The empirical work includes data and research assistance from various people. Together, we consider two alternative sources for the survey data on expectations but primarily rely on the longer and clearer data series from the Australia and New Zealand Banking Group (ANZ). In particular, we use the data generated by the monthly ANZ Business Outlook Survey of firms from the answer to the following question: *what does the survey respondent expect the annual inflation rate (as measured by the consumer price index) to be in the next twelve months' time*? In order to obtain the quarterly data required for this research, we take the average of the values for the three corresponding months belonging to each quarter, beginning from June 1986 through December 2015. The RBNZ M14 data series provides an alternative source for the quarterly data on inflation expectations from September 1987 onwards. We examine the one year out expected inflation data for our study. The RBNZ M13 data series for the household expectations provides another source for inflation expectations but it represents a much shorter series as it begins from March 1995 and, therefore, turns out to be unsuitable for answering questions of this paper.

We note that even though the ANZ survey data is collected monthly, the inflation expectations variable is defined as the expectation of the annual CPI inflation rate for the year ahead. The RBNZ, on the other hand, provides the CPI data on a quarterly basis. To create a larger dataset for our regression analysis, we use the annual inflation expectations data on a quarterly basis and calculate the annual inflation rate for each quarter q using the RBNZ data.

In particular, for the period ranging between June 1986 and December 2015, we use the quarterly data on the CPI for each quarter q to calculate the year to year inflation

rate $\pi_{t,q}$, by measuring the percentage change in the value of the CPI between the year $t-1$ and t, beginning and ending at that quarter q such that

$$\pi_{t,q} \equiv \left(\frac{CPI_{t},q \ - \ CPI_{t-1,q}}{CPI_{t-1,q}} \right) \ \times \ 100. \tag{9}$$

We also examine the non-tradable component of the CPI inflation rate for which I found June 1999 through December 2015 quarterly data from the "CPI Non-Standard Tradable & Non-tradable Component Series," provided by Statistics New Zealand. Additional data from March 1993 through March 1999 came from the RBNZ statistician Ian McIlraith, as the best estimates available for that period.

The quarterly data for the oil price inflation rate is also generated in the same way to ensure the consistency of the model. We compile the oil price data from the series "DCOILWTICO" provided by the United States Energy Information Administration from the beginning of the year 1986. The units of the figures are US dollars per barrel. We first compute the quarterly average to determine the mean oil price for the quarter and then for each quarter we take the previous year to current year annual percentage changes to determine the oil price inflation rate for the year ended with that quarter.

For data on unemployment, we use the seasonally adjusted unemployment rate for that quarter q from the June 2015 and December 2015 publications of Statistics New Zealand.[21]

4.2   Empirical Methodology

First, I describe how my methodology relates to a few relevant earlier works on the estimation of the Phillips curve. Second, I present key findings from selected regressions which are most useful for answering the key questions for this paper.

Hargreaves et al. (2006) used quarterly data from 1992 to 2005 and estimated the inflation rate on alternative models of the Phillips curve involving the survey data on inflation expectations, the lagged inflation rate and a combination of output gap and its lags as key explanatory variables. They also separately reviewed tradable and non-tradable inflation rates and reported a reasonable fit for their Phillips curve with inflation measured by the non-tradable component of the CPI. The work of Paloviita (2005, 2008), Kuttnerner and Robinson (2010), Koop and Onorante (2012) and Coibion and Gorodnichenko (2015) included equations similar to (1) and (3).

As a measure of economic slackness Hargreaves et al.(2006), Paloviita (2005, 2008) and Kuttnerner and Robinson (2010) used the GDP gap, while Coibion and Gorod-

---

[21]Statistics New Zealand revised the unemployment rate in the second half of 2015 due to redevelopment of the Household Labour Force Survey. After using both sets of data I conclude that the key results of this paper are robust to these data revisions. However, considering the prospect of a comparison with the previous work, I report results that use data from the June 2015 publication and incorporate data for the last two quarters of 2015 from the December 2015 publication.

nichenko (2015) used the unemployment gap. Both gaps are unobservable. Yet, the theory behind the natural rate of unemployment (NRU) is relatively intuitive and straightforward to estimate from the data.[22] The GDP gap, on the other hand, may be an artefact of detrending the data and hence may be ill-suited for estimating the Phillips curve. This is because the model requires an estimate of the GDP gap relative to the flexible price output, which has no theoretical link with the popularly used low pass filter without a theoretically specified trend for the flexible price output.[23]

I limit my focus to the Ordinary Least Square (OLS) regressions. Estimates with a lagged inflation rate (as a proxy for inflation expectations) were insignificant and hence I do not report them. Besides, the use of past data as a proxy for expectations of the future is subject to the *Lucas Critique*.

I use a quarterly model for all the variables but the annual measure of inflation. I do that to generate a large number of data while, at the same time, to ensure the consistency of the time periods covered by the expected inflation term relative to that covered by the actual inflation. The temporal aggregation gives us the empirical models of analysis based on the original specifications (1) and (3) of the new classical and new Keynesian specifications, respectively, as follows:

$$\pi_{t,q} = E_{t-1,q}\left[\pi_{t,q}\right] - a(u_q - u_n) + v_q, \tag{10}$$

and

$$\pi_{t,q} = \beta E_{t,q}\left[\pi_{t+1,q}\right] - a(u_q - u_n) + v_q, \tag{11}$$

where, (9) gives the definition of the annual inflation rate $\pi_{t,q}$ for the year 't' ending in the quarter 'q'.

Clearly such temporal aggregation induces moving average errors (at least, depending on the properties of the original errors) and this impacts the regression via serial dependence but no endogeneity effects since there are no lags in the system for generating data. So the use of HAC estimators like Newey West addresses the complications due to serial dependent errors.[24] A standard Breusch Godfrey autocorrelation test supported the use the Newey West standard errors with a bandwidth set to 3 for determining significance.[25]

---

[22]The mid-point of Razzak's (2014) estimates for the NRU is four per cent which I use for this study but allow a possible change in it due to the GFC, since December 2007.

[23]Kuttner and Robinson (2010) had a similar concern and cited the work of Neiss and Nelson (2005) in this regard.

[24]Hansen and Hodrick (1980) proposed a method for accounting for this induced serial dependence in the error term. Their method was the precursor to Newey and West (1987).

[25]An alternative approach would be to annualize the quarterly inflation rate by quadrupling it but that would create an obvious inconsistency betwen this measure of the inflation rate and the measure of the inflation expectations compiled from the ANZ survey data. In any case, the key finding is robust to this alternative measure and I provide additional information in the Appendix to support that claim.

4.3 Regression Results

Next, I present robust evidence for (a) the existence of the new classical Phillips curve modelled by (1), (b) a plausible rational expectation hypothesis for the Phillips curve with a constant slope, and (c) a steeper slope of the Phillips curve in the post 1999 era, especially if we consider the nontradable component of the CPI inflation rate. Surprisingly, I also find that the use of the nontradable component of the CPI for calculating the inflation rates yields a stronger support for the conclusions (a) - (c) and provides new insights on the plausible increase in the natural rate of unemployment (NRU).

4.3.1   *Evidence for the Phillips Curve in New Zealand*

Following the recent work of Coibion and Gorodnichenko (2015), I use the two popular specifications described by (1) and (3) but without assuming that the data of inflation expectations reflects rational expectations.[26] Instead, I use the ANZ's survey data of inflation expectations that directly affects inflation. Table 1 summarises the findings. In each quarter q, the term $E_{t-1}\pi_{t,q}$ in (10) refers to the one year lagged expectation of the annual inflation rate $\pi_{t,q}$ measured for that quarter q while the term $E_{t,q}\left[\pi_{t+1,q}\right]$ in (11) refers to the expectation in quarter q about the one-year-ahead annual inflation rate $\pi_{t+1,q}$. The difference between the unemployment rate u_q in quarter q and the natural rate of unemployment u_n measures the unemployment gap in quarter q.

---

[26]Such an assumption would restrict the coefficient of inflation expectation to unity under the new classical set-up and to $\beta < 1$ under the new Keynesian set-up.

Table 1

These regressions use quarterly data for the year to year CPI inflation rate								
	New Classical Model				New Keynesian Model			
Dependent Variable	**1987-2015**	**1987-1992**	**1993-1999**	**2000-2015**	**1987-2015**	**1987-1992**	**1993-1999**	**2000-2015**
Inflation Rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unemployment Gap $(u_{t,q} - u_n)$	-0.297***	-1.929***	-0.160***	-0.324	-0.130**	-0.156	-0.067*	0.0532
	(0.108)	(0.555)	(0.0527)	(0.202)	(0.0522)	(0.483)	(0.0325)	(0.148)
Expected Inflation $\mathbf{E}_{t-1,q}[\pi_{t,q}]$	0.711***	-0.383	0.726	0.446				
	(0.189)	(0.309)	(0.608)	(0.499)				
Expected Inflation $E_{t,q}[\pi_{t+1,q}]$					1.100***	1.322***	1.256***	2.315***
					(0.145)	(0.441)	(0.131)	(0.309)
Intercept	0.869*	16.89***	0.521	1.462	-0.566	-3.330	-1.030***	-4.175***
	(0.498)	(4.329)	(1.674)	(1.508)	(0.412)	(4.584)	(0.322)	(0.952)
N	115	23	28	64	115	23	28	64
F-stat	7.24	7.62	5.56	1.84	28.75	16.51	47.86	48.91
Prob>F	0.001	0.003	0.010	0.168	0.000	0.000	0.000	0.000
Testing whether the coefficient of the unemployment gap is equal to 0								
F-stat	7.54	12.09	9.22	2.56	6.21	0.1	4.21	0.13
Prob>F	0.001	0.002	0.006	0.115	0.014	0.751	0.051	0.721
Newey West standard errors with a bandwidth set to 3 reported inside the parentheses: ***p<0.01,p<0.05, *p<0.1**								

In the regressions based on the full sample of data, the relatively high significance of the estimates for the unemployment gap and their theoretically correct sign in (1) and (5) validates the Phillip's curve under both the new classical model (NCM) and the new Keynesian model (NKM). However, in the sub-samples the NCM provides a stronger support than the NKM for the Phillips curve hypothesis.

In Table 1, the columns (1) - (4) show that under the new classical specification, the estimates for the slope of the Phillips curve are unambiguously negative, consistent with the Phillips curve hypothesis. They are also significant at the one percent level in the full sample as well as in all subsamples but (4). However, the columns (5) - (8) reveal that under the new Keynesian specification the same conclusion holds only for the full sample period and for the subsample period 1993-1999 of increased credibility. Therefore, I conclude that strong empirical support for the Phillips curve hypothesis arises primarily through the new classical specification.

4.3.2 *Plausibility of the Rational Expectation Based Phillips Curve*

Next, following the new classical specification (1), I restrict the co-efficient of the inflation expectation $E_{t-1,q}[\pi_{t,q}]$ variable to be one, assuming that it reflects the rational expectation equilibrium inflation rate for the economic environment which includes the public's perception regarding the monetary policy objective function. I do that because such a formulation closely resembles the original Lucas (1973) representation

of a relationship between the "inflation surprise" $(\pi_{t,q} - E_{t-1,q}[\pi_{t,q}])$ and the economic slackness which I measure by the "unemployment gap", $(u_{t,q} - u_n)$.[27]

In Table 2 below, I present the estimates with the above restriction. I also include at the bottom of Table 2, the results from testing the validity of the above restriction, based on the rational expectation assumption, using the output related to the estimates presented in columns (1) - (4) of Table 1. I conclude that, except for the period 1987-1992, I cannot reject, at the one per cent level of significance, the hypothesis that slope of the inflation expectation is equal to one.

Table 2

These regressions use the Phillips curve specification of Lucas (1972) which is the same as (1) but without the supply shock.				
Dependent Variable:	1987-2015	1987-1992	1993-1999	2000-2015
Inflation Surprise $(\pi_{t,q} - \mathbf{E}_{t-1,q}[\pi_{t,q}])$	(1)	(2)	(3)	(4)
Unemployment Gap $(u_{t,q} - u_n)$	-0.330***	-0.205	-0.173***	-0.282
	(0.104)	(0.446)	(0.0579)	(0.212)
Intercept	-0.156	-1.663	-0.131	-0.107
	(0.388)	(2.707)	(0.294)	(0.247)
N	115	23	28	64
F-stat	10.060	0.210	8.920	1.770
Prob>F	0.002	0.651	0.006	0.188
Newey West Standard Errors (3 lags) inside the parentheses	***p<0.01,**p<0.05, *p<0.1			
F-stats below are for the null hypothesis that the co-efficient of the inflation expectations variable is equal to one.				
F-stat	4.07	52.60	0.5	2.25
Prob>F	0.046	0.000	0.485	0.139

The estimated co-efficients of the unemployment gap have the theoretically correct sign and, except for column 4, show a high level of significance and the F-test reveals that we cannot reject the null that the coefficient of the expected inflation rate is unity, except during the period of transition (column 2) marked by declining inflation expectations.

Surprisingly, as Table 2 illustrates, contrary to popular belief, the Lucas (1973) type specification generates robust evidence for the existence of the (rational) expectation augmented Phillips curve, except for the sub period 1987 - 1992, which is arguably a costly period of learning due to a rapid economic transition.[28] These results are comparable with what was reported in Coibion and Gorodnichenko (2015). Therefore, I conclude that the New Zealand data supports the Lucas (1973) specification of the Phillips curve with the rational expectation hypothesis.

---

[27] The rational agent assumes that policy lags, short term contracts and menu costs may not be responsible for any gap between their one year ahead forecast and the actual inflation a year later.

[28] We get similar results, although with weaker level of significance, using the RBNZ data series M14 on the Survey of Professional Forecasters (SPF).

4.3.3 *Supply Shocks and Changes in the Natural Rate and the Slope of the Phillips Curve*

Next, I confine my focus exclusively on the post-reform period, 1993 - 2015, because it gives an impression of a sudden death of the Phillips curve, following the virtual completion of all economic reforms (see Figure 1). I consider supply shocks, a possible post-GFC increase in the natural rate and, following the rationale of Lucas (1973), a possible change in the slope of the Phillips curve due to an increased frequency of the monetary policy shocks since the introduction of the Official Cash Rate (OCR) in 1999.[29]

The factors affecting inflation from the demand side are already incorporated in the specification of the Phillips curve, because they represent a movement along the Phillips curve. However, the supply shock shifts the position of the Phillips curve but they do that exactly the same way as the changes in inflation expectations do. Thus, they are observationally equivalent. One question arises naturally: how well does the survey data on the inflation expectations captures all relevant supply shocks and, in particular, the oil price shock? Table 3 presents findings that shed some light on this issue.

Table 3		
	1993Q1 - 2015Q4	
Dependent Variable: ANZ Expected Inflation	(1)	(2)
Oil Price Inflation	0.002	
	(0.008)	
Oil Price		0.005***
		(0.001)
Intercept	2.675***	2.446***
	(0.045)	(0.068)
Observations	92	92
adj. R-sq	-0.009	0.106
F-stat	0.07	12.56
Prob>F	0.791	0.001

In determining the ANZ's inflation expectations variable, the estimated co-efficient for the oil price (and not its percentage change since the previous year) turns out to be positive and highly significant.

Clearly, regression results presented in Table 3 reveal that the oil price and the ANZ expectation are linearly dependant and hence should not be included together in the

---

[29] If the Governor's decision on the OCR does not agree with the public's understanding of the implied rationale for the inflation targeting, it constitutes a monetary policy shock.

same regression. However, the Phillips curve hypothesis dictates that the regression equation must include a measure of the inflation expectations such as the ANZ data. Therefore, we drop the oil price but not the oil price inflation from the regressions.

In other words, the data on inflation expectations assimilates information on the absolute value of the oil price quite well but the information surprise conveyed by the "oil price inflation" has no significant explanatory power and hence can be considered exogenous to the survey data.

However, it turns out that once the model is correctly specified, the oil price inflation turns out to be insignificant and does not alter any other conclusions. Therefore, I drop them from the best specification of the model and report results without oil price inflations.

Besides, our empirical tests show that there are two specific supply price shocks to the inflation rate which the ANZ data on inflation expectation apparently missed.

First is the sharp and swift increase in the oil price inflation to about two hundred per cent between mid 2007 and mid 2008, ironically at the outset of GFC. This particular shock, according to Coibion and Gorodnichenko (2015), was worldwide and contributed to the missing disinflation puzzle.

Second, is the positive inflation shock in 2011, representing the lagged cost-push effect from the GST, introduced in 2010.

Table 4 below presents results from the OLS regressions of the new classical Phillips curve, (1), with and without the assumption of rational expectations, but with suitable dummy variables to include the two idiosyncratic supply shocks and possible changes in the natural rate following the GFC shock in 2007. In particular, the modified equation for organising the data for the OLS estimations is as follows:

$$z_{t,q} = c + \beta x_{t,q} + a_1 D_1 (u_{t,q} - u_n) + a_2 D_2 (u_{t,q} - (u_n + a_3 D_3)) + a_4 D_4 + a_5 D_5, \quad (12)$$

where, either (i) $z_{t,q} = \pi_{t,q}$ and $x_{t,q} = E_{t-1,q}[\pi_{t,q}]$; or, (ii) $\beta = 1$ and $z_{t,q} = (\pi_{t,q} - E_{t-1,q}[\pi_{t,q}])$. Besides, D_1 and D_2 represent two slope dummies corresponding to the periods 1993 - 1999 and 2000 - 2015, respectively; $D_3 = 1$, if $t \geq 2007$, otherwise zero; and it denotes the post-GFC dummy for the natural rate of unemployment, which I set to equal four per cent, following Razzak (2010). The dummies D_4 and D_5 denote, respectively, the oil price inflation shock of 2008, which pushed inflation against the inertia of the GFC to constitute a genuine surprise, and the cost-push shock in 2011 from the GST increase in 2010.

The null hypothesis that the coefficients of both year dummies are zero is rejected for column (2) with an F-statistic of 9.22 to imply almost zero probability of error. Similar results hold also for columns (3) and (4). The inclusion of the natural rate

dummy significantly alters the conclusion regarding the change of the slope but its estimated coefficient implies the post-GFC natural rate to be fifteen per cent, which is theoretically unreasonable.[30]

<div align="center">

Table 4

</div>

These regressions use quarterly data for the year to year CPI inflation rate and builds on the model explored in Table 3.				
	Estimated Phillips Curves (1993-2015) with ANZ Survey Data on the Inflation Expectations			
Dependent Variable:	Inflation Surprise	Inflation Surprise	Inflation Surprise	Inflation Rate
	$(\pi_{t,q}-\mathbf{E}_{t-1,q}[\pi_{t,q}])$	$(\pi_{t,q}-\mathbf{E}_{t-1,q}[\pi_{t,q}])$	$(\pi_{t,q}-\mathbf{E}_{t-1,q}[\pi_{t,q}])$	$\pi_{t,q}$
	(1)	(2)	(3)	(4)
Expected Inflation rate $\mathbf{E}_{t-1,q}[\pi_{t,q}]$				0.063
				(0.322)
(1993 - 1999) * unemp_gap $(u_{t,q}-u_n)$	-0.179***	-0.153**	-0.152**	-0.131**
	(0.0615)	(0.060)	(0.061)	(0.063)
(2000 - 2015) * unemp_gap $(u_{t,q}-u_n)$	-0.281	-0.363**	0.092	-0.354***
	(0.206)	(0.162)	(0.204)	(0.126)
Natural Unemployment Rate Dummy from 2008			-1.382***	
			(0.439)	
Oil Price Inflation (last year to current year)				0.009**
				(0.004)
2008		1.101***	2.417***	1.570***
		(0.251)	(0.455)	(0.257)
2011		2.331***	2.579***	2.265***
		(0.560)	(0.501)	(0.453)
Intercept	-0.109	-0.211	-0.213	2.157***
	(0.225)	(0.222)	(0.226)	(0.942)
Observations	92	92	92	92
F-stat	4.23	18.39	23.78	22.66
Prob>F	0.018	0.000	0.000	0.000
Chow test results for the null hypothesis that the two slope coefficients are the same.				
Chow Test F-Stat	0.31	5.18	1.68	3.18
Chow Test Prob>F	0.577	0.025	0.198	0.078
Newey West standard errors with a bandwidth set to 3 reported inside the parentheses: ***p<0.01,**p<0.05, *p<0.1				

Under all four plausible specifications the slope of the unemployment gap (i) consistently reveals the theoretically correct sign, (ii) often with significance at a very high level and (iii) shows an increase after 1999 in all specifications but (3) which includes a dummy for the natural rate of unemployment (NRU) for the post GFC period beginning in 2008. However, (3) implies an unreasonably large increase in the NRU to fifteen percent during the GFC.

4.3.4 Nontradable Inflation and One Surprising Finding

Next, I repeat the exercise but this time measuring the inflation rate with only the *non-tradable component* of the CPI. Imported inflation is arguably exogenous to monetary policy in a small economy. The inflation expectations too reflect arguably by the monetary policy stance which has a relatively direct and immediate impact on the prices of the non-tradable goods. After all, they do not face global competition and hence

---

[30]To get the estimated change in the NRU, I set $a_2 D_2 (u_t - (u_n + a_3 D_3)) = a_2 D_2 (u_t - u_n) + a_6 D_6$ and identify a_6 as the estimate for the NRU dummy D_6 reported in Table 4. It follows, therefore, $a_3 = a_6/(-a_2)$.

absorb the monetary policy impact significantly more than the rest of the economy. So, I present below in Table 5 a set of results comparable to the same reported in Table 4 with the overall CPI inflation.

Table 5

These regressions repeat Table 4 but with the inflation rate calculated using only the *NONTRADABLE* component of the CPI.				
	Estimated Phillips Curves (1993-2015) with ANZ Survey Data on Inflation			
Dependent Variable:	Inflation Surprise	Inflation Surprise	Inflation Surprise	Inflation Rate
	$(\pi_{t,q}-\mathbf{E}_{t-1,q}[\pi_{t,q}])$	$(\pi_{t,q}-\mathbf{E}_{t-1,q}[\pi_{t,q}])$	$(\pi_{t,q}-\mathbf{E}_{t-1,q}[\pi_{t,q}])$	$\pi_{t,q}$
	(1)	(2)	(3)	(4)
Expected Inflation rate				0.134
				(0.305)
(1993 - 1999) * *unemp_gap* $(u_{t,q}-u_n)$	-0.181*	-0.210**	-0.211**	-0.323***
	(0.0921)	(0.0905)	(0.0918)	(0.0742)
(2000 - 2015) * *unemp_gap* $(u_{t,q}-u_n)$	-0.363***	-0.480***	-0.601***	-0.642***
	(0.127)	(0.104)	(0.167)	(0.0990)
Natural Unemployment Rate Dummy from 2008			0.369	
			(0.239)	
2008		-0.754***	-1.105***	-0.205
		(0.253)	(0.361)	(0.264)
2011		1.255**	1.189**	1.883***
		(0.601)	(0.491)	(0.502)
Intercept	1.045***	1.161***	1.162***	3.690***
	(0.214)	(0.131)	(0.223)	(0.870)
Observations	92	92	92	92
F-stat	4.45	7.17	5.49	13.87
Prob>F	0.014	0.000	0.000	0.000
Chow test results for the null hypothesis that the two slope coefficients are the same.				
Chow Test F-Stat	2.28	7.35	5.23	8.03
Chow Test Prob>F	0.134	0.008	0.025	0.006
Newey West standard errors with a bandwidth set to 3 reported inside the parentheses: ***p<0.01,**p<0.05, *p<0.1				

All specifications but (1) reject with high degree of significance the claim that the slope did not increase in the post-1999 era. Also, with non-tradable CPI data, (3) implies that the NRU estimate during the GFC increased only reasonably by half a percentage point.

As above, the test with the null hypothesis that all of the coefficients of the two year dummies are equal to zero in column (2) yields an F-statistic equal to 6.54. I reject that null hypothesis with 0.002 probability of error. Similar results hold for columns (3) and (4).

The natural rate dummy (when included) turns out to be insignificant but its inclusion changes no other conclusions, surprisingly unlike the case with the CPI inflation reported in column (3) of Table 4. Interestingly, also, the estimate of the natural rate dummy in column (3) of Table 5 implies a post-GFC increase to 4.6 per cent, which is a theoretically plausible estimate, unlike the case presented in Table 4 when the inflation rate calculation does not exclude the tradable component of the CPI.

Most importantly, from the results of the Chow tests reported above in Tables 4 and 5, the increase in slope turns out to be robust especially if we consider the nontradable component of the inflation rate but the result loses clarity if we consider the CPI inflation rate which, by construction, is contaminated by the imported inflation.

Therefore, I conclude that by separating the component of the CPI over which the monetary policy of a small open economy can exert little influence we may discover insightful results. In particular, by measuring inflation with the non-tradable component of the CPI, we may not only find a reasonable estimate of the NRU in the post-GFC period but also a stronger support for the conclusion of this paper regarding the steepening of the Phillips curve.

Regressions using the annualized inflation rate (i.e., quarterly inflation x 4) generally yield lower significance but keep the two main conclusions intact:

(1) the Phillips Curve hypothesis holds and the new classical model exhibits this more significantly.

(2) the slope always shows an increase after 1999. This is a robust result. The only caveat is that the significance may vary depending on the model and the data used.

To sum up, regressions never yield a result where either the Chow test suggests no change in the slope in the post 1999 era coupled with a pair of estimates for the slopes that suggests the slope becomes flatter after 1999. This is a surprising finding contrary to conventional wisdom popularised in McDermott (2015) which suggests otherwise.

5   Concluding Remarks

I have examined New Zealand data on inflation and unemployment between 1987 and 2015 to conclude that it can be spanned by shifting an appropriately estimated Phillips curve with the survey data on inflation expectations. I have used the theories of rational expectations and time consistency to build the theory of credibility that is relevant for interpreting the narrative history of the disinflation experience in New Zealand. That theoretical interpretation of history has served as a guide in two important ways. It guided my design of the empirical exercises and, in particular, my idiosyncratic partitioning of the data for developing key hypotheses related to my research questions. Also, it guided my interpretations of the test results, including my evaluations of the theoretical plausibility of the econometric estimates of key parameters.

It turns out that people's perception of the policy making environment and the rational expectation of inflation that is consistent with the long-run equilibrium outcome of inflation in that environment plays the key role for our understanding of the changing positions and slopes of the Phillips curve. Overall, the Phillips curve hypothesis remains a valid view of the interaction between the real and nominal sides of an economy. The expected inflation can act as a shifter of the Phillips curve and affect both inflation and unemployment without undermining the relationship of the two, as predicted by the Phillips curve hypothesis. In other words, this hypothesis is

not to be rejected simply due to the lack of a contemporaneous correlation between unemployment and inflation during occasional periods in the New Zealand history of disinflation.

The above finding has implications for monetary policy, wage and price-setting behaviour and real activity. It also offers a unified theoretical explanation for three apparently distinct episodes of history concerning disinflation in New Zealand: (i) the disinflation and accompanying deep recession of the early 1990s; (ii) the decline of unemployment with little change in inflation, leading to a low inflation and low unemployment outcome in the late 1990s; and, (iii) volatile inflation with little change in unemployment between 2000 and 2007, coupled with the puzzle of missing disinflation despite an increase in unemployment, following the global financial crisis (GFC), between 2008 and 2015.

In particular, I conclude that the early 1990s deep recession seems to have been caused by an unmet expectation due to the lack of credibility of the RBNZ's ability to sustain the drastically reduced inflation without complementary fiscal and labour market reforms. However, once the labour market and fiscal reforms were completed, increased credibility of a low inflation target brought down the inflation expectation swiftly to its new equilibrium level and temporarily anchored it at that level.

Subsequently, since 1999, changes in the political climate led to revisions of the hallmarks of the earlier economic reforms. Also the explicit changes in the PTAs detracted the Governor's focus away from inflation targeting and his subsequent activities made news headlines that created confusion and controversies. Those developments might have compromised the credibility of inflation targeting and unanchored the inflation expectations. Arguably, afterwards, inflation expectations became more susceptible to external shocks and hence more volatile in the post-1999 era. In the expectation augmented Phillips curve paradigm, those behavioural changes in the inflation expectations, in turn, would cause relatively large fluctuations in the inflation rate without any significant changes in the unemployment rate as observed in this period.

I also note that, after an initial period of flattening in the late nineties, the Phillips curve has become steeper in the post-1999 era, apparently due to an increased frequency of the monetary policy shocks in the public's perception. From that discovery, I derive one policy conclusion: the implication of the public perception of the policy making environment plays a critical role in identifying the rational expectation of inflation which helps identify the exact location of the Phillips curve for the policymakers.

However, the finding of a steeper Phillips curve in the post 1999 era comes as a surprise and it carries with it an important policy implication. For example, an activist monetary policy, as manifested by the recent cut in the Official Cash Rate (OCR) at a time of a historically high house price inflation, may cause a relatively large increase in inflation without causing any significant change in unemployment.[31] If, in addition, it

---

[31]However, the monetary laxity signalled by the rate cut may bypass the goods-price inflation to show up as an asset-price inflation as postulated by Bordo and Landon-Lane (2015).

adds fuel to the rise in the average expectation regarding non-tradable inflation, then a time-inconsistent and hence less credible policy of a low inflation regime may ironically bring about stagflation due to unmet inflation expectations. I leave the verification of that conjecture for future research.

I end this paper by noting a very crucial policy lesson from the theories of inflation dynamics. A good understanding of the direct effect of the expected inflation on the current realizations of unemployment and inflation helps construct better economic policies as well as better monetary policies. The overall political stance of the government and not just a law, which politics can overturn, determines the rational expectations of inflation in the economy. Therefore, the outcome of a specifc monetary policy objective, in general, depends on the consistency of the overal objective of the government and not just on the transparency and independence of the Governor's operative procedures.

6   Bibliography

Associated Press (1984): "Dollar devaluation is announced", in *The Daily Reporter*, Spencer, Iowa, July 18, (The Second Front Page), page 3A:
https://news.google.com/newspapers?id=r18rAAAAIBAJ&sjid=9dgEAAAAIBAJ&pg=5909,1337552&dq=zealand+dollar+devalued+20&hl=en

Ball, L., & Mazumder, S. (2011). "Inflation Dynamics and the Great Recession," *Brookings Papers on Economic Activity* (Spring), Pages 337-381.

Barro, R. J., & Gordon, D. B. (1983). "Rules, Discretion and Reputation in a Model of Monetary Policy." *Journal of Monetary Economics* 12 (1):101-21. doi:10.1016/0304-3932(83)90051-X.

Bean, C. (1999). "Australasian monetary policy: a comparative perspective", *The Australian Economic Review* 32(1), 64-73.

Bernanke, B. (2010). "The economic outlook and monetary policy", speech delivered at the *Federal Reserve Bank of Kansas City Economic Symposium*, Jackson Hole, Wyoming.

Bollard, A. (1992). *New Zealand: Economic Reforms, 1984 - 1991*: San Fransisco, International Center for Economic Growth, CS Press.

Bordo, M. & Landon-Lane, J. (2012). "Does Expansionary Monetary Policy Cause Asset Price Booms: Some Historical and Empirical Evidence", paper presented at the *Macroeconomic and Financial Stability: Challenges for Monetary Policy*, Chile: Central Bank of Chile.

Bradford, M. (1982). "Real wages, inflation, unemployment and the New Zealand wage determination system," paper presented at the *New Zealand Association of Economists Conference*, February.

Bradford, M. (1983). "Issues of concern to employers", in R. Harbridge (ed.) *Industrial relations: issues of concern*: Wellington, Industrial Relations Centre, Victoria

University of Wellington.

Calvo, G. A. (1978). "On the Time Consistency of Optimal Policy in a Monetary Economy." *Econometrica,* 46 (6): 1411-28.

Cheng, D., Bennett, A., & Berry, R. (2006). "Avoid kiwi dollar, Government tells Japanese", *The New Zealand Herald*, January 20, Economy: Auckland: http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10364573.

Clarida, R., Gertler, M., & Gali, J. (1999). "The science of monetary policy: a new Keynesian perspective", *Journal of Economic Literature*, 37, 1661-1707.

Coibion, O., & Gorodnichenko, Y. (2015). "Is the Phillips curve alive and well after all? Inflation expectations and the missing disinflation", *American Economic Journal - Macroeconomics,* 7, 197-232.

Coibion, O., Gorodnichenko Y., & Saten Kumar. (2015). How do firms form their expectations? New survey evidence, (NBER Working Paper, 21092: http://www.nber.org/papers/w21092).

Coleman, W. (1992). "Concord and discord amongst New Zealand economists: The results of an opinion survey", *New Zealand Economic Papers*, 26 (1), 47-81: http://dx.doi.org/10.1080/00779959209544184.

Dalziel, P. (1989). "An independent Reserve Bank: the case against," paper presented at the *Summer Conference of the New Zealand Association of Economists*, Victoria University of Wellington.

Dalziel, P. (1998). "New Zealand's experience with an independent central bank since 1989" in P. Arestis and M. Sawyer (Eds.), The Political Economy of Central Banking, Cheltenham, U.K., Edward Elgar, pages 199 - 216.

Dixon, S. (1996). "The distribution of earnings in New Zealand 1984 - 1994", *Labour Market Bulletin*, Department of Labour, New Zealand,1, 45-100.

Evans, L., Grimes, A., Wilkinson, B., & Teece, D. (1996). Economic reform in New Zealand 1984-95: the pursuit of efficiency. *Journal of Economic Literature*, 34,1996, 1856-1902.

Fallow, B. (2009). "Brian Fellow: Good doctors seek injection", *The New Zealand Herald,* February 5, Auckland.

Friedman, M. (1968). "The Role of Monetary Policy," *American Economic Review* 58, 1–17.

Gali, J. (2008). *Monetary policy, inflation and the business cycle: an introduction to the New Keynesian framework*, Princton: Princeton University Press.

Goodfriend, M., & King, R. (2005). "The incredible Volcker disinflation" Journal of Monetary Economics, 52, 981-1015.

Gordon, R. J. (1997). "The Time-Varying Nairu and Its Implications for Economic Policy," *Journal of Economic Perspectives*, 11, 11-32.

Grimes, A. (2014). "Four Lectures on Central Banking' especially Chapter 2 'Inflation Targeting: 25 Year' Experience of the Pioneer', *MOTU Working Paper 14-02*, February.

Hargreaves, D., Hannah, K., & Hodgetts, B. (2006). "Modelling New Zealand Inflation in a Phillips Curve", *RBNZ Bulletin*, 69, September.

Hall, V. B. (1996). "Economic Growth" in Silverstone, B., Bollard, A., & Lattimore, R. (eds.) *A Study of Economic Reform: The Case of New Zealand, Chapter 2, 31-71.*

International Monetary Fund (IMF). (2013). "The dog that didn't bark: has inflation been muzzled or was it just sleeping", *World Economic Outlook*, Chapter 3.

Johnson, S. (1990). "Monetary Conditions and Policy," *Reserve Bank Bulletin*, the Reserve Bank of New Zealand publications, 53, (4), 345 - 357.

Kuttner, K., & Robinson, T. (2010). "Understanding the Flattening Phillips Curve", *North American Journal of Economics and Finance* 21, August (Special Issue on the Phillips Curve).

Kydland, F. E., & Prescott, E. C. (1977). "Rules Rather Than Discretion: The Inconsistency of Optimal Plans", *Journal of Political Economy* 85 (3): 473-91.

Leeper, E., Walker, T., & Yang, S-C. S. (2008). Fiscal foresight: analytics and econometrics, NBER Working Paper, 14028: http://www.nber.org/papers/w14028).

Lewis, M., & McDermott, J. (2016). "New Zealand's experience with changing its inflation target and the impact on inflation expectations," *New Zealand Economic Papers*, 50:3, 343-361, DOI: 10.1080/00779954.2016.1191529.

Lucas, Jr., R. E. (1972). "Expectations and the neutrality of money", *Journal of Economic Theory*, 4, 103-124.

_____ (1973). "Some international evidence on output-inflation tradeoffs", *American Economic Review*, 63, 326–334.

——————— (1976). "Econometric Policy Evaluation: A Critique". In Brunner, K.; Meltzer, A. (eds.) *The Phillips Curve and Labor Markets, Carnegie-Rochester Conference Series on Public Policy*: New York, American Elsevier, pages: 19–46.

Mankiw, N. G., & Reis, R. (2002). "Sticky information versus sticky prices: a proposal to replace the new Keynesian Philips curve", *Quarterly Journal of Economics*, 117, 1295-1328.

Monetary Policy Statement (1991). "Executive Summary," *Reserve Bank Bulletin*, the Reserve Bank of New Zealand Publications, 54 (1), 15 February, 5-43.

Monetary Policy Statement (1992). "Executive Summary," *Reserve Bank Bulletin*, the Reserve Bank of New Zealand Publications, 55 (1), 3 February, 5-8.

McDermott, J. (2015). "The Dragon Slain? New-Zero Inflation in New Zealand", *RBNZ Speech*, April.

M. Lacker, J. M., & Weinberg, J. A. (2006). *Inflation and Unemployment: A Layperson's Guide to the Phillips Curve*: Richmond, Federal Reserve Bank of Richmond.

Neiss, K. S., & Nelson, E. (2005). "Inflation dynamics, marginal cost, and the output gap: Evidence from three countries", *Journal of Money Credit and Banking*, 37(6), 1019-1045.

New Zealand Parliament Speeches. (2005). Key, John: questions for oral answer — questions to ministers, 628, p627, December 8: http://www.parliament.nz/en-

nz/pb/debates/debates/speeches/48HansS_20051208_00000292/ key-john-questions-for-oral-answer-%E2%80%94-questions-to-ministers.

Phelps, E. S. (1967). "Phillips Curves, Expectations of Inflation and Optimal Unemployment over Time" *Economica*, New Series, 34, (135), 254-281.

Phillips, A. W. H. (1958). "The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861–1957", *Economica*, 25, 283–299.

Paloviita, M. (2005). "Comparing alternative Phillips curve specifications: European results with survey-based expectations", Bank of Finland Research Discussion Papers, 22). Helsinki: Finland.

RBNZ Memo. (2005). Recent NZD Uridashi bond flows:
http://www.omo.co.nz/uridashibriefing.pdf, December 2.

Reddell, M. (2016). "Raising the inflation target....in 2002," September 5, *CROAKING CASSANDRA:* https://croakingcassandra.com/2016/09/05/raising-the-inflation-target-in-2002/.

Reddell, M. and Heppleston, C. (1988). "Review of Monetary Conditions and Policy," *Reserve Bank Bulletin,* the Reserve Bank of New Zealand Publications, 51 (1), 11 - 18.

Rosenberg, B. (2010). "Real Wages and Productivity In New Zealand", paper presented at the *Labour, Employment and Work in New Zealand*, Wellington:
http://ojs.victoria.ac.nz/LEW/issue/view/170.

Rutherford, H. (2015). "Finance Minister Bill English's brother to advise Reserve Bank on interest rates", *Business Day*, Stuff, April 23:
http://www.stuff.co.nz/business/ industries/67980249/finance-minister-bill-englishs-brother-to-advise-reserve-bank-on-interest-rates

Sargent, T. J., & Wallace, N. (1981). "Some Unpleasant Monetarist Arithmetic", *Quarterly Review*, 531, Federal Reserve Bank of Minneapolis, 5 (3), 1-17:
https://www.minneapolisfed.org/research/qr/qr531.pdf).

Samuelson, P.A., & R.M. Solow. (1960). "Analytical Aspects of Anti-Inflation Policy", *American Economic Review Papers and Proceedings,* 50(2), pp. 177-94.

Sanderson, K., Nana, G. & Catt, A. (2007). "BERL's Supplementary Note on the Operation of the Monetary Policy", MP/70A, 4 pages, Wellington: Business and Economics Research Limited.

Wheeler, G. (2014). "Reflections on 25 Years of Inflation Targeting", *RBNZ Speech*, December.

White, H. (1980). "A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity", *Econometrica* 48: 817-830.

Woodford, M. (2003). *Interest and prices: foundations of a theory of monetary policy.* Princeton: Princeton University Press.

7 Appendix

The following tables report regression results based on the annualized quarterly inflation data to avoid the moving average errors. However, the data on inflation expectations are annual and not annualized. Therefore, the interpretation of regression results presented below is subject to a limitation that they are not mutually consistent, contrary to the requirements of the underlying theoretical models.

Table 1A
Annualized Quarterly Inflation Rate with White's (1980) robust standard errors

	New Classical Model				New Keynesian Model			
Dependent Variable	1987-2015	1987-1992	1993-1999	2000-2015	1987-2015	1987-1992	1993-1999	2000-2015
Inflation Rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unemployment Gap	-0.329***	-1.732***	-0.264	-0.378	-0.218***	-0.674	-0.120	-0.0352
$(u_{t,q} - u_n)$	(0.090)	(0.508)	(0.212)	(0.241)	(0.0808)	(0.519)	(0.194)	(0.273)
Expected Inflation	0.457***	-0.505	0.253	-0.136				
$\mathbf{E}_{t-1,q}[\pi_{t,q}]$	(0.096)	(0.346)	(1.387)	(0.718)				
Expected Inflation					0.727***	0.351	2.848**	1.875**
$E_{t,q}[\pi_{t+1,q}]$					(0.116)	(0.429)	(1.219)	(0.712)
Intercept	1.545***	15.572***	1.896	3.121	0.536	4.782	-4.938	-2.903
	(0.398)	(5.223)	(0.530)	(2.056)	(0.451)	(5.055)	(3.080)	(2.060)
N	115	23	28	64	115	23	28	64
adj. R-sq	0.265	0.525	-0.048	0.006	0.380	0.473	0.173	0.127
F-stat	15.14	15.17	0.80	1.24	24.47	16.25	2.96	4.9
Prob>F	0.000	0.000	0.463	0.296	0.000	0.000	0.070	0.011
Testing whether the coefficient of the unemployment gap is equal to 0								
F-stat	13.33	11.64	1.55	2.47	7.28	1.69	0.38	0.02
Prob>F	0.000	0.003	0.225	0.121	0.008	0.209	0.542	0.898
Robust standard errors in parentheses: ***p<0.01,**p<0.05, *p<0.1								

Table 1A supports conclusions derived from Table 1 included in the paper, other than the fact that column 3 becomes less significant but column 6 and 8 give the right sign.

Table 2A

Dependent Variable:	1987-2015	1987-1992	1993-1999	2000-2015
Inflation Surprise $(\pi_t - E_{t-1}\pi_t)$	(1)	(2)	(3)	(4)
$(u_t - u_n)$	-0.383***	0.146	-0.300	-0.292
	(0.113)	(0.266)	(0.198)	(0.254)
Intercept	-0.432	-4.629***	0.117	-0.157
	(0.380)	(1.570)	(0.764)	(0.372)
N	115	23	28	64
adj. R-sq	0.059	-0.038	0.003	1.320
F-stat	11.450	0.300	2.290	1.320
Prob>F	0.001	0.590	0.142	0.254
White's (1980) Robust Standard Errors in Pare	***p<0.01,**p<0.05, *p<0.1			

Column 1 based on the full sample of data provides a robust evidence for the new classical Phillips curve similar to Lucas (1972). Column 2 gives the wrong sign for the unemployment gap, plausibly due to significant changes in the inflation expectations.

Table 4A

Quarter to Quarter Annualised Inflation for Table 4 - Using White's (1980) Robust standard Errors				
	Estimated Phillips Curves (1993-2015) with ANZ Survey Data on Inflation Expectation and CPI			
Dependent Variable:	Inflation Surprise $(\pi_{t,q}-E_{t-1,q}[\pi_{t,q}])$	Inflation Surprise $(\pi_{t,q}-E_{t-1,q}[\pi_{t,q}])$	Inflation Surprise $(\pi_{t,q}-E_{t-1,q}[\pi_{t,q}])$	Inflation Rate $\pi_{t,q}$
	(1)	(2)	(3)	(4)
Expected Inflation rate $E_{t-1,q}[\pi_{t,q}]$				-1.169*
				(0.624)
(1993 - 1999) * unemp_gap $(u_{t,q}-u_n)$	-0.237*	-0.222*	-0.222*	-0.291**
	(0.122)	(0.120)	(0.121)	(0.119)
(2000 - 2015) * unemp_gap $(u_{t,q}-u_n)$	-0.304	-0.273	0.222	-0.324
	(0.244)	(0.265)	(0.339)	(0.250)
Natural Unemployment Rate Dummy			-1.506**	
			(0.686)	
2003				
2008		0.436	1.869	0.840
		(1.736)	(1.985)	(1.762)
2011		-0.128	0.141	0.0432
		(1.188)	(1.183)	(1.150)
2015				
Intercept	-0.130	-0.188	-0.189	3.086*
	(0.343)	(0.328)	(0.336)	(1.770)
Observations	92	92	92	92
White's (1980) Robust Standard Errors in Parentheses	***p<0.01,**p<0.05, *p<0.1			
F-stat	1.96	1.00	1.67	1.80
Prob>F	0.148	0.410	0.151	0.121
Chow Test F-Stat	0.10	0.05	1.99	0.02
Chow Test Prob>F	0.756	0.831	0.162	0.88

Table 4B

Quarter to Quarter (with Oil Price Inflation) Table 4 - Using Robust standard Errors				
	Estimated Phillips Curves			
Dependent Variable:	Inflation Surprise $(\pi_{t,q}-E_{t-1,q}[\pi_{t,q}])$	Inflation Surprise $(\pi_{t,q}-E_{t-1,q}[\pi_{t,q}])$	Inflation Surprise $(\pi_{t,q}-E_{t-1,q}[\pi_{t,q}])$	Inflation Rate $\pi_{t,q}$
	(1)	(2)	(3)	(4)
Expected Inflation rate $E_{t-1,q}[\pi_{t,q}]$				-1.033*
				(0.594)
(1993 - 1999) * unemp_gap $(u_{t,q}-u_n)$	-0.188	-0.181	-0.188	-0.248**
	(0.122)	(0.122)	(0.123)	(0.122)
(2000 - 2015) * unemp_gap $(u_{t,q}-u_n)$	-0.278	-0.257	0.173	-0.305
	(0.241)	(0.258)	(0.315)	(0.250)
Oil Price Inflation (Quarter to Quarter)	0.0274	0.0270	0.022	0.0224
	(0.0169)	(0.0166)	(0.0158)	(0.0160)
Natural Unemployment Rate Dummy			-1.316**	
			(0.640)	
2008		0.240	1.529	0.631
		(1.758)	(1.962)	(1.770)
2011		-0.139	0.0983	0.0140
		(1.239)	(1.226)	(1.202)
Intercept	-0.268	-0.298	-0.279	2.614
	(0.348)	(0.347)	(0.349)	(1.693)
Observations	92	92	92	92
Robust standard errors in parentheses	***p<0.01,**p<0.05, *p<0.1			
F-stat	2.18	1.50	1.59	2.24
Prob>F	0.096	0.199	0.159	0.047
Chow Test F-Stat	0.19	0.12	1.59	0.07
Chow Test Prob>F	0.664	0.733	0.211	0.795

Note that the F-stat for the whole regression drops, the Chow test robustly rejects the hypothesis that the slopes remain unchanged, and estimates show an increase in magnitude.

Table 5A

Table 5 - Quarter to Quarter Data (Nontradable Inflation)				
	Estimated Phillips Curves (1993-2015) with ANZ Survey Data on Inflation			
Dependent Variable:	Inflation Surprise	Inflation Surprise	Inflation Surprise	Inflation Rate
	(1)	(2)	(3)	(4)
Expected Inflation rate				-0.136
				(0.428)
(1993 - 1999) * $unemp\_gap$	-0.128	-0.129	-0.129	-0.257***
	(0.0851)	(0.0889)	(0.0893)	(0.0836)
(2000 - 2015) * $unemp\_gap$	-0.322**	-0.274	-0.264	-0.447**
	(0.161)	(0.179)	(0.236)	(0.184)
Natural Unemployment Rate Dummy			-0.0287	
			(0.567)	
2008		-0.141	-0.114	0.500
		(0.386)	(0.636)	(0.415)
2011		-0.915	-0.910	-0.247
		(0.797)	(0.811)	(0.795)
Intercept	0.910***	0.913***	0.913***	4.197***
	(0.187)	(0.210)	(0.211)	(1.232)
Observations	92	92	92	92
adj. R-sq	0.022	0.015	0.003	0.056
F-stat	2.43	1.74	1.40	3.95
Prob>F	0.094	0.149	0.233	0.003
Chow Test F-Stat	1.52	0.72	0.32	1.12
Chow Test Prob>F	0.022	0.397	0.571	0.293
Robust standard errors in parentheses	***p<0.01,**p<0.05, *p<0.1			

Column 1 now has stronger Chow test results to reject the hypothesis of the slopes being the same. The slopes still generally increase in all regressions.