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journal homepage: [www.elsevier.com/locate/jedc](http://www.elsevier.com/locate/jedc)Perils of unconventional monetary policy<sup>☆</sup>Michael McMahon<sup>a</sup>, M. Udara Peiris<sup>b,\*</sup>, Herakles Polemarchakis<sup>c</sup><sup>a</sup> University of Oxford, CEPR, CAGE (Warwick), CfM (LSE), and CAMA (ANU), UK<sup>b</sup> ICEF, National Research University Higher School of Economics, Russian Federation<sup>c</sup> Department of Economics, University of Warwick, England, United Kingdom

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## ABSTRACT

Unconventional monetary policy, by relaxing restrictions on the composition of the balance sheet of the central bank, compromises control over the stochastic path of inflation; or, in open economies, over the stochastic path of exchange rates. If the composition of the balance sheet is unrestricted then the path of inflation is indeterminate. This is the case under pure quantitative easing, where the target is the size of real money balances. In contrast, credit easing policies restrict the composition of the portfolio by targeting a specific expansion in the maturity profile of bonds bought, and thus can implement a determinate path of inflation. The composition of the portfolios traded by monetary-fiscal authorities also determines premia in asset and currency markets.

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## 1. Introduction

Conventional monetary policy restricts assets on the balance sheet of the central bank to short-term Treasury Bills. Much analysis takes this as given and, as a result, the importance of restrictions on the central bank asset portfolio is typically overlooked. Unconventional monetary policy, specifically balance sheet policy in the classification of [Borio and Zabai \(2016\)](#), relaxes the restrictions on the central bank asset portfolio and allows for assets of varying maturity and risk profiles. In this paper, we show that a potentially less-restricted portfolio may eliminate the ability of the central bank to control the stochastic path of inflation.

We consider a stochastic cash-in-advance economy with flexible prices and a complete asset market, and we restrict attention to trades in securities of one-date maturity.<sup>1</sup> We explore the consequences of both Ricardian and non-Ricardian seigniorage policy; well-founded criticisms of the fiscal theory of the price level in [Buiter \(2002\)](#) and [Drèze and Polemarchakis \(2000\)](#) notwithstanding, the advantage of the non-Ricardian policy is that under both conventional and uncon-

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<sup>1</sup> Trades in long-lived assets can duplicate such trades, as in [Kreps \(1982\)](#), and allow for a role for the maturity structure of debt, as in [Cochrane \(2001\)](#) or [Angeletos \(2002\)](#).

ventional monetary policy it yields a determinate initial price level but nonetheless doesn't overturn our key finding. The conclusion in Nakajima and Polemarchakis (2005) that, surprisingly, had gone unnoticed, is that monetary policy that sets a path of short-term, nominal interest rates determines the path of expected or average inflation, but not the distribution of possible paths of inflation. The key result is that the stochastic path of inflation is determined by the adjustment of the portfolio of the monetary authority over time in response to market forces and expectations. As uncertainty unfolds, market forces and expectations determine the value of the assets on the balance sheet. As explained in Sims (2016), variations in the value of the balance sheet drive the stochastic path of monetary injections or withdrawals that, in turn, determines the path of inflation.

Once portfolio allocations are selected, the distribution of inflation outcomes is determinate. In fact, with full knowledge of the structure of the economic environment, the central bank could choose the portfolio weights to target a specific distribution of inflation. However, if the portfolio allocations are left unrestricted, the distribution of inflation is not pinned down. In this paper we show how different approaches to unconventional monetary policy affect this stochastic distribution of inflation through their effect on the portfolio of the central bank. Moreover, we extend the analysis to an open economy and show that the indeterminacy extends to the stochastic path of exchange rates. It is straightforward to show that this finding is robust to many changes in the environment including introducing price rigidity into the model.

Under a conventional (restricted) central bank asset portfolio, there is a determinate stochastic distribution of inflation outcomes even though central banks typically target only expected inflation. That is, restrictions on the portfolio of assets, even where they are driven by the central bank's conservative approach to risk, imply that the central bank can keep the distribution of inflation anchored as it targets expected inflation. Adoption of unconventional policies, such as in response to hitting the zero lower bound, may change the central bank's portfolio restrictions and lead to changes in the stochastic distribution of inflation. The composition of the portfolios traded by monetary-fiscal authorities also determines premia in asset and currency markets.

While a common feature of unconventional monetary policy is the expansion of their balance sheet, central banks have employed two distinct approaches to these policies which we discuss in detail below; namely, quantitative easing (QE) and credit easing (CE). QE focuses only on the expansion of the central bank liabilities and does not restrict the asset composition of the balance sheet. By contrast, CE targets a specific allocation of assets, much like conventional monetary policy that restricts open market operations to Treasury bills. Under CE, it is the explicit target for the composition of the balance sheet that allows the monetary authority to target the stochastic path of inflation: the target for the composition of the portfolio guarantees the necessary restrictions to obtain determinacy of the inflation distribution and limit the de-anchoring of the inflation distribution.

We also discuss a number of important extensions of the basic result. We show that policy rules that select the portfolio weights as a function of expected inflation do not overcome the indeterminacy problem. This may be surprising since policy rules may seem to imply restriction but we show they leave portfolio weights effectively unrestricted. Also, since unconventional policies are typically employed during times of crisis, when interest rates may be constrained by the effective zero lower bound. While our focus is on the implications of changes in the composition of risky assets in the portfolio of the central bank for the stochastic path of inflation, we show that this constraint does not alter our main finding.

The indeterminacy of QE in our benchmark model is nominal. While the central bank loses the control of inflation, the indeterminacy does not affect the attainable equilibrium allocations. If the central bank switched from interest rate to money supply policy, the indeterminacy would affect real allocations. Importantly, the indeterminacy becomes real if prices are sticky or the asset market is incomplete, as in Bai and Schwarz (2006).

Moving to an open economy environment, we highlight that QE transmits indeterminacy across central bank portfolios and, consequently the path of exchange rates. If markets are incomplete within each country, then fluctuations in central bank portfolios resonate abroad by affecting, not only the nominal exchange rate, but also asset prices and risk premia. Furthermore, if central banks set interest rates according to a Taylor-type rule that accounts for changes in the nominal exchange rate, as in Taylor (2001), and trading partners conducted QE, then they would not be able to guarantee the desired outcomes can be implemented. In other words, QE by trading partners manifests itself as indeterminacy of both nominal and real risk-premia, globally, and more importantly, even in countries that conduct traditional monetary policy or CE. These findings contribute to the growing view that variations in capital flows should be managed, and that these variations may stem from the monetary policy of trading partners.

The portfolio balance channel operates when bonds of different maturities are not perfect substitutes and traders have maturity-specific bond demands. In this setting, the maturity structure of outstanding debt can affect term premia. Theoretical models describing the portfolio balance channel such as Vayanos and Vila (2009) and Hamilton and Wu (2012) neglect the consequences of variations in the composition of the monetary authority portfolio on the stochastic path of inflation. We show that as the composition of the portfolios of monetary-fiscal authorities determine the stochastic path of prices, they also determine the nominal stochastic discount factor. Independent of changes in expectations about the path of short-term interest rates, the correlation between the discount factor and asset prices, and nominal exchange rates, then generates risk premia and biases whose size and sign corresponds to the chosen portfolio composition.

This paper contributes to a vast and important literature on indeterminacy of monetary equilibria: Sargent and Wallace (1975) pointed out the indeterminacy of the initial price level under interest rate policy; Lucas and Stokey (1987) derived the condition for the uniqueness of a recursive equilibrium with money supply policy; Woodford (1994) analysed the

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