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Bank of Canada
Monthly Research Update

September 2022

This monthly newsletter features the latest research publications by Bank of Canada economists. The report includes papers appearing in external publications and staff working papers published on the Bank of Canada's website.

PUBLISHED PAPERS

In-Press

James Chapman, "Discussion of 'The macroeconomics of central bank digital currencies'", Journal of Economic Dynamics and Control, Vol 142, September 2022

Jonathan Chiu & Tsz-Nga Wong, "Payments on digital platforms: Resiliency, interoperability and welfare", Journal of Economic Dynamics and Control, Vol 142, September 2022

Adam Daigneault & Justin S. Baker & Jinggang Guo & Pekka Lauri & Alice Favero & Nicklas Forsell & Craig Johnston & Sara B. Ohrel & Brent Sohngen, "How the future of the global forest sink depends on timber demand, forest management, and carbon policies", Global Environmental Change, Vol 76, September 2022

Seyed Mohammadreza Davoodalhosseini, "Central bank digital currency and monetary policy", Journal of Economic Dynamics and Control, Vol 142, September 2022

Edouard Djeutem & Geoffrey R. Dunbar, "Uncovered return parity: Equity returns and currency returns", Journal of International Money and Finance, Vol 128, November 2022

Rodney J. Garratt & Maarten R.C. van Oordt, "Entrepreneurial incentives and the role of initial coin offerings", Journal of Economic Dynamics and Control, Vol 142, September 2022

Maarten R.C. van Oordt, "Discussion of 'Central bank digital currency: Stability and information'", Journal of Economic Dynamics and Control, Vol 142, September 2022

Forthcoming

Serdar Birinci & Kurt See, "Labor Market Responses to Unemployment Insurance: The Role of Heterogeneity", American Economic Journal: Macroeconomics

BOOK CHAPTERS

Walter Engert & Kim P. Huynh, "Cash, COVID-19 and the Prospects for a Canadian Digital Dollar." In *The Euro at 20: The Future of Our Money*, edited by Johannes Beermann. Munich: Penguin Verlag, 2022.

Luis Uzeda, "State Correlation and Forecasting: A Bayesian Approach Using Unobserved Components Models." In *Essays in Honour of Fabio Canova (Advances in Econometrics, Vol. 44A)*, edited by

Juan J. Dolado, Luca Gambetti and Christian Matthes. Bingley: Emerald Publishing Limited, 2022.

STAFF WORKING PAPERS

Efrem Castelnuovo & Kerem Tuzcuoglu & Luis Uzeda, "Sectoral Uncertainty", Bank of Canada Staff Working Paper 2022-38

Denis Gorea & Oleksiy Kryvtsov & Marianna Kudlyak, "House Price Responses to Monetary Policy Surprises: Evidence from the U.S. Listings Data", Bank of Canada Staff Working Paper 2022-39

Michael Boutros, "Windfall Income Shocks with Finite Planning Horizons", Bank of Canada Staff Working Paper 2022-40

Paul Beaudry & Thomas J. Carter & Amartya Lahiri, "Looking Through Supply Shocks versus Controlling Inflation Expectations: Understanding the Central Bank Dilemma", Bank of Canada Staff Working Paper 2022-41

Cars Hommes & Kostas Mavromatis & Tolga Özden & Mei Zhu, "Behavioral Learning Equilibria in New Keynesian Models", Bank of Canada Staff Working Paper 2022-42

STAFF DISCUSSION PAPERS

James Younker, "Calculating Effective Degrees of Freedom for Forecast Combinations and Ensemble Models", Bank of Canada Staff Discussion Paper 2022-19

ABSTRACTS

Discussion of "The macroeconomics of central bank digital currencies"

N/A.

Payments on digital platforms: Resiliency, interoperability and welfare

Digital platforms, such as Alibaba and Amazon, operate an online marketplace to facilitate transactions. This paper studies a platform's business model choice between accepting cash and issuing tokens, as well as the implications for welfare, resiliency, and interoperability. A cash platform free rides on the existing payment infrastructure and profits from collecting transaction fees. A token platform earns seigniorage, albeit bearing the costs of setting up the system and holding reserves to mitigate the cyber risk. Tokens earn consumers a return, insulating transactions from the liquidity costs of using cash, but also expose them to the remaining cyber risk. The platform issues tokens if the interest rate is high, the platform scope is large, and the cyber risk is small. Unbacked floating tokens with zero transaction fees or interest-bearing stablecoins can implement the equilibrium business model, which is not necessarily socially optimal because the platform does not internalize its impacts on off-platform activities. The model explains why Amazon does not issue tokens, but Alipay issues tokens circulatable outside its Alibaba platforms. Regulations such as a minimum reserve requirement can reduce welfare.

How the future of the global forest sink depends on timber demand, forest management, and carbon policies

Deforestation has contributed significantly to net greenhouse gas emissions, but slowing deforestation, regrowing forests and other ecosystem processes have made forests a net sink. Deforestation will still influence future carbon fluxes, but the role of forest growth through aging, management, and other silvicultural inputs on future carbon fluxes are critically important but not always recognized by bookkeeping and integrated assessment models. When projecting the future, it is vital to capture how management processes affect carbon storage in ecosystems and wood products. This study uses multiple global forest sector models to project forest carbon impacts across 81 shared socioeconomic (SSP) and climate mitigation pathway scenarios. We illustrate the importance of modeling management

decisions in existing forests in response to changing demands for land resources, wood products and carbon. Although the models vary in key attributes, there is general agreement across a majority of scenarios that the global forest sector could remain a carbon sink in the future, sequestering 1.2–5.8 GtCO2e/yr over the next century. Carbon fluxes in the baseline scenarios that exclude climate mitigation policy ranged from −0.8 to 4.9 GtCO2e/yr, highlighting the strong influence of SSPs on forest sector model estimates. Improved forest management can jointly increase carbon stocks and harvests without expanding forest area, suggesting that carbon fluxes from managed forests systems deserve more careful consideration by the climate policy community.

Central bank digital currency and monetary policy

Many central banks are contemplating whether to issue a central bank digital currency (CBDC). A CBDC has certain potential benefits, including the possibility that it can bear interest. However, using a CBDC is costly for agents. I study the optimal monetary policy when only cash, only a CBDC, or both cash and a CBDC are available to agents. If the cost of using a CBDC is not too high, more efficient allocations can be implemented by using a CBDC than using cash, and the first best can be achieved. Having both cash and a CBDC available may result in lower welfare than in the cases where only cash or only a CBDC is available. The welfare gains of introducing a CBDC are estimated under various scenarios for the United States and Canada. For example, if the cost of using a CBDC relative to cash is around 0.25% of the transaction value, introducing a CBDC can lead to an increase of 0.12–0.21% consumption for the United States and 0.04–0.07% for Canada.

Uncovered return parity: Equity returns and currency returns

We propose an uncovered expected returns parity (URP) condition for the bilateral spot exchange rate that results from free entry into international finance by global financiers. Under URP, bilateral spot exchange rates are realizations of two underlying parity conditions that depend, in part, on the expected returns of risky assets available to financiers. We estimate finite mixture model regressions for six currencies against the US dollar (Australia, Canada, Japan, Norway, Switzerland and the UK) and show that expected excess equity returns are a statistically significant determinant of exchange rate dynamics. We subject our results to numerous robustness exercises

and find consistent evidence of the importance of expected excess equity returns for exchange rate dynamics.

Entrepreneurial incentives and the role of initial coin offerings

This paper examines whether initial coin offerings (ICOs) are a beneficial form of financing with desirable economic properties. We do so by examining how financing a start-up via an ICO changes the incentives of an entrepreneur to exert effort to reduce cost. An ICO can result in a better or worse alignment of the interests of the entrepreneur and the investors compared with debt and venture capital financing. Notably, an ICO can be the only form of financing that induces optimal effort, and there are projects that should not take place unless they can be financed through an ICO.

Discussion of "Central bank digital currency: Stability and information"

N/A.

Labor Market Responses to Unemployment Insurance: The Role of Heterogeneity

We document considerable scope of heterogeneity within the unemployed, especially when the unemployed are divided along eligibility and receipt of unemployment insurance (UI). We study the implications of this heterogeneity on UI's insurance-incentive trade-off using a heterogeneous-agent job-search model capable of matching the wealth and income differences that distinguish UI recipients from non-recipients. Insurance benefits are larger for UI recipients who are predominantly wealth-poor. Meanwhile, incentive costs are non-monotonic in wealth because the poorest individuals, who value employment, exhibit weak responses. Differential elasticities imply that accounting for the composition of recipients is material to the evaluation of UI's insurance-incentive trade-off.

Cash, COVID-19 and the Prospects for a Canadian Digital Dollar

We provide an analysis of cash trends in Canada before and during the COVID-19 pandemic. Focusing on the pandemic period, we explore the implications on demand for, use of and access to cash. We find that cash demand has been strong pre-pandemic and increased sharply during the pandemic. While cash use fell initially due to the decreased number of in-person shopping opportunities, it

recovered as containment measures eased. We explore the potential two scenarios for issuance of central bank digital currency or Canadian digital dollar. We discuss the Canadian experience in maintaining cash as an efficient and accessible method of payment and store of value.

State Correlation and Forecasting: A Bayesian Approach Using Unobserved Components Models

This chapter investigates the impact of different state correlation assumptions for out-of-sample performance of unobserved components (UC) models with stochastic volatility. Using several measures of US inflation, the author finds that allowing for correlation between inflation's trend and cyclical (or gap) components is a useful feature to predict inflation in the short run. In contrast, orthogonality between such components improves the out-of-sample performance as the forecasting horizon widens. Accordingly, trend inflation from orthogonal trend-gap UC models closely tracks survey-based measures of long-run inflation expectations. Trend dynamics in the correlated-component case behave similarly to survey-based nowcasts. To carry out estimation, an efficient algorithm which builds upon properties of Toeplitz matrices and recent advances in precision-based samplers is provided.

Sectoral Uncertainty

We propose a new empirical framework that jointly decomposes the conditional variance of economic time series into a common and a sector-specific uncertainty component. We apply our framework to a large dataset of disaggregated industrial production series for the US economy. Our results indicate that common uncertainty and uncertainty linked to nondurable goods both recorded their pre-pandemic global peaks during the 1973-75 recession. In contrast, durable goods uncertainty recorded its pre-pandemic peak during the global financial crisis of 2008-09. Vector autoregression exercises identify unexpected changes in durable goods uncertainty as drivers of downturns that are both economically and statistically significant, while unexpected hikes in non-durable goods uncertainty are expansionary. Our findings suggest that: (i) uncertainty is heterogeneous at a sectoral level; and (ii) durable goods uncertainty may drive some business cycle effects typically attributed to aggregate uncertainty.

House Price Responses to Monetary Policy Surprises: Evidence from the U.S. Listings Data

Existing literature documents that house prices respond to monetary policy surprises with a significant delay, taking years to reach their peak response. We present new evidence of a much faster response. We exploit information contained in listings for residential properties for sale in the United States between 2001 and 2019 from the CoreLogic Multiple Listing Service Dataset. Using high-frequency measures of monetary policy shocks, we document that a one standard-deviation contractionary monetary policy surprise lowers housing list prices by 0.2%– 0.3% within two weeks—a magnitude on par with the effect on stock prices. House prices respond more strongly to the surprises to future rates as compared with the surprise changes in the federal funds rate. Sale prices are mostly predetermined by list prices and do not respond independently to monetary policy surprises.

Windfall Income Shocks with Finite Planning Horizons

How do households respond to unanticipated income shocks? I build and estimate a quantitative model of bounded rationality in which reoptimization is costly. Households respond to windfall income shocks by choosing a finite planning horizon over which to reoptimize. The optimal horizon is increasing in income, wealth, and the magnitude of the income shock. In the estimated model, the distribution of consumption responses is consistent with two motivating facts: highly liquid households have large consumption responses out of income shocks that cannot be driven by borrowing constraints, and larger income shocks induce smaller consumption responses.

Looking Through Supply Shocks versus Controlling Inflation Expectations: Understanding the Central Bank Dilemma

Central banks in most advanced economies have reacted similarly to the increase in inflation that started in 2021. They initially looked through the rising inflation by leaving monetary policy relatively unchanged. Then, after inflation continued to increase, central banks pivoted by quickly tightening monetary policy. The pivot was explained, at least in part, as aiming to anchor drifting inflation expectations. Why might central banks want to look through supply-driven inflation sometimes and pivot away at other times? When does a change in monetary policy stance help anchor expectations? When is a strong monetary policy tightening compatible with a soft landing? In this paper we present a simple environment that helps clarify these issues by offering an optimal policy perspective on recent central

bank behaviour. In particular, we examine optimal policy in an environment where there is a risk of wage-price spirals and where the central bank views wage- and price-setters as having bounded rationality. We show how this can provide a coherent explanation of many aspects of recent central bank behaviour.

Behavioral Learning Equilibria in New Keynesian Models

We introduce behavioral learning equilibria (BLE) into a multi-variate linear framework and apply it to New Keynesian DSGE models. In a BLE, boundedly rational agents use simple but optimal first-order autoregressive (AR(1)) forecasting rules whose parameters are consistent with the observed sample mean and autocorrelation of past data. We study the BLE concept in a standard three-equation New Keynesian model and develop an estimation methodology for the canonical Smets and Wouters (2007) model. A horse race between rational expectations equilibrium (REE), BLE and constant gain learning models shows that the BLE model outperforms the REE benchmark and is competitive with constant gain learning models in terms of in-sample and out-of-sample fitness. Sample autocorrelation learning of optimal AR(1) beliefs provides the best fit when short-term survey data on inflation expectations are considered in the estimation. As a policy application, we show that optimal Taylor rules under AR(1) expectations inherit history dependence, requiring a lower degree of interest rate smoothing than REE.

Calculating Effective Degrees of Freedom for Forecast Combinations and Ensemble Models

Forecast combinations, also known as ensemble models, routinely require practitioners to select a model from a massive number of potential candidates. Ten explanatory variables can be grouped into 2^{1078} forecast combinations, and the number of possibilities increases further to $2^{1078+2\text{^}1078}$ if we allow for forecast combinations of forecast combinations. This paper derives a calculation for the effective degrees of freedom of a forecast combination under a set of general conditions for linear models. It also supports this calculation with simulations. The result allows users to perform several other computations, including the F-test and various information criteria. These computations are particularly useful when there are too many candidate models to evaluate out of sample. Furthermore, computing effective degrees of freedom shows that the complexity cost of a forecast combination is driven by the parameters in the weighting scheme and the weighted average of parameters in the auxiliary

models as opposed to the number of auxiliary models. This identification of complexity cost contributions can help practitioners make informed choices about forecast combination design.

UPCOMING EVENTS

Patrick Augustin (McGill University)
Organizer: FMD/FSD EFR Seminar Series
Date: 4 October 2022

Ginger Zhe Jin (University of Maryland, College Park)
Organizer: FMD/FSD EFR Seminar Series
Date: 6 October 2022

Cooper Howes (Federal Reserve Board of Governors)
Organizer: EFR CEA/INT Speaker
Date: 7 October 2022

Thomas Mertens (Federal Reserve Bank of San Francisco)
Organizer: CEA/INT EFR Seminar Series
Date: 14 October 2022

Benoit Mojon (BIS)
Organizer: EFR CEA/INT Speaker
Date: 18 October 2022

Kenneth Judd (Hoover Institution at Stanford University)
Organizer: BAP Virtual Speaker
Date: 18 October 2022

Makoto Nakajima (Federal Reserve Bank of Philadelphia)
Organizer: EFR CEA/INT Speaker
Date: 21 October 2022

Pierpaolo Benigno (University of Bern)
Organizer: BAP Virtual Speaker
Date: 24 October 2022

Charles Martineau (University of Toronto, Scarborough)
Organizer: FMD/FSD EFR Seminar Series
Date: 25 October 2022

Petr Sedláček (University of New South Wales and University of Oxford)
Organizer: FMD/FSD EFR Seminar Series
Date: 27 October 2022

Peter Morrow (University of Toronto)
Organizer: CEA/INT EFR Seminar Series
Date: 28 October 2022

Matteo Benetton (UC Berkeley)
Organizer: BAP Hybrid Speaker
Date: 1 November 2022

Bank of Canada Annual Economic Conference
Date: 3-4 November 2022

Lu Liu (University of Pennsylvania)
Organizer: FMD/FSD EFR Seminar Series
Date: 10 November 2022

Diversity and Inclusion in Economics, Finance and Central Banking Conference
Date: 14-15 November 2022

Karel Mertens (Federal Reserve Bank of Dallas)
Organizer: CEA/INT EFR Seminar Series
Date: 18 November 2022

Evan Dudley (Queen's University)
Organizer: FMD/FSD EFR Seminar Series
Date: 22 November 2022