Number 2020-07
March 25, 2020

Economic Commentary

Credit Market Frictions, Business Cycles, and Monetary Policy:
The Research Contributions of Charles Carlstrom and Timothy Fuerst

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Charles Carlstrom and Timothy Fuerst were prolific and prominent research economists who, until their untimely deaths a few years ago, were long-associated with the Federal Reserve Bank of Cleveland. Their myriad contributions include the incorporation of financial market imperfections into macroeconomic models and the study of optimal monetary policy. We provide an overview of their work and summarize a few key themes from a research conference held in their honor.

The Federal Reserve has long played a central role in the creation and dissemination of original academic research on monetary policy. Though the specific challenges confronting monetary policymakers change over time, the core questions of how to best enact policy to achieve the dual mandate of price stability and maximum sustainable employment remain. Research produced within the Federal Reserve proved critical in taming the high inflation of the 1970s and helped to usher in the decades-long period of quiescence subsequently deemed the Great Moderation. The financial crisis and ensuing Great Recession of 2007-2009 posed a number of new and difficult questions about how the Fed could best satisfy its dual mandate. For example, the crisis brought to the fore the importance of taking account of the financial system in modeling the macroeconomy. It also raised questions about how new monetary policy tools—large-scale asset purchases and forward guidance on the path of monetary policy—could be best used to achieve the Fed's goals in an environment in which short-term interest rates were constrained by the zero lower bound. More recently, researchers within the Federal Reserve System have contributed to understanding the puzzling behavior of inflation, where inflation remains muted in spite of the sustained strength of the labor market.

The research of former Federal Reserve Bank of Cleveland economists and long-time collaborators Charles (Chuck) Carlstrom and Timothy (Tim) Fuerst addressed these and a host of other issues associated with credit markets, the business cycle, and monetary policy. Carlstrom came to the Cleveland Fed full-time in 1987 shortly after finishing

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ISSN 2163-3738 DOI: 10.26509/frbc-ec-202007

up his doctoral studies at the University of Rochester and was promoted to senior economic advisor in 2001. Fuerst began as a consultant with the Cleveland Fed in 1994 while also serving on the faculty at nearby Bowling Green State University. He completed his PhD in 1990 at the University of Chicago and moved to Bowling Green after a stint on the faculty at Northwestern University. Fuerst later became a part-time senior economic advisor at the Cleveland Fed and maintained that role even after moving to the University of Notre Dame in 2012 as the holder of the William and Dorothy O'Neill Chair in economics.

Carlstrom and Fuerst teamed up shortly after Tim's move to northern Ohio in 1994. They published their first paper together in 1995 and went on to work almost exclusively with one another over the next two decades. They made a number of important contributions to our understanding of the practice of central banking. They were also best friends; Tim would typically stay with Chuck during his extended visits to the Bank. In many respects, they were opposites: Tim was very tall, Chuck was short; Tim was outgoing and loud, perhaps most famous for his constant whistling, whereas Chuck was quiet and more reserved. But they shared the traits of kindness and humility. They were universally admired and left an indelible mark on all those whose paths they crossed, most especially junior scholars working at, or passing through, the Federal Reserve Bank of Cleveland.

Tragically, they both died in their 50s within about a year of one another in 2016 and 2017. Chuck's death followed complications from a lifetime of kidney problems, and Tim's death occurred after a short bout with an aggressive form of stomach cancer. To honor their memories and highlight their contributions, the Federal Reserve Board of Governors, the Federal Reserve Bank of Cleveland, and the University of Notre Dame co-sponsored a conference on themes related to their body of work. The conference was titled "Credit Market Frictions, Business Cycles, and Monetary Policy: A Research Conference in Honor of Charles Carlstrom and Timothy Fuerst." The conference was held at Notre Dame in October of 2018 and featured presentations of original research and discussions by leading researchers working in the broad areas of macroeconomics and monetary economics. The proceedings of the conference can be found on the conference web page.

In further recognition of their work, this article provides an overview of the body of work by Carlstrom and Fuerst and summarizes a few key themes from the conference and their connections to the work of Chuck and Tim.

Carlstrom and Fuerst's Body of Work

Carlstrom and Fuerst were a prolific research team. Over two-plus decades, they published more than 50 articles, either in tandem or along with additional scholars (their most frequent and recent interlocutor was one of the authors of this piece, Matthias Paustian). Carlstrom and Fuerst's published work appears in both the leading general interest journals in the profession (such as the *American Economic Review* and the *Journal of Political Economy*) as well as the best field-specific journals in macroeconomics and monetary economics (the *Journal of Monetary Economics* along with journals such as the *Journal of Money, Credit, and Banking*). Together, they published some 20 articles in the Federal Reserve Bank of Cleveland's *Economic Commentary* series.

Their voluminous work was highly influential. According to RePEc, which is a bibliometric rankings database of professional economists, Chuck and Tim rank 1,448 and 1,326, respectively, in terms of lifetime academic citations out of more than 57,000 registered economists. Their influential 1997 *American Economic Review* article, "Agency Costs, Net Worth, and Business Cycles: A Computable General Equilibrium Analysis," has accumulated more than 1,500 citations to date on Google Scholar—a mark that relatively few publications in economics achieve. Tim served in editorial capacities at both the *American Economic Review* and the *Journal of Money, Credit, and Banking*.

Chuck and Tim's work touched on virtually all of the policy-relevant areas of macroeconomics and monetary economics. They were deeply committed believers in the ability of clearly articulated economic theory to inform important policy questions. Their work focused on big questions. They skillfully used the simplest possible models, models where the assumptions driving results could most transparently be identified, to address these questions. Their papers are characterized by a subtle yet profound elegance that continues to inspire young scholars today.

Carlstrom and Fuerst are perhaps best known for their work on incorporating financial intermediation—in particular, the reliance of firms on borrowing to fund expenses—into macroeconomic models. They (along with a few other researchers) were well ahead of their time. During a period in which virtually all macroeconomic models abstracted from financial intermediation altogether, in 1997 Chuck and Tim published the *American Economic Review* paper that would become famous. This paper was prescient in being published a full decade before the onset of the financial crisis and continues to be taught in PhD classes around the world. Chuck and Tim's paper extended important earlier work analyzing the macroeconomic consequences of financial intermediation with its simple, but brilliant, quantitative approach.

Financial intermediation consists of the financial system (comprised of traditional banks along with other types of intermediaries) channeling funds from savers to investors in need of the funds to undertake capital projects and other investments. Financial contracts are potentially plagued by so-called agency costs. Agency costs can arise when two parties to a transaction (such as banks and potential borrowers) are not equally well-informed about the attributes and actions of one another. For example, a bank may be hesitant to lend money to a household unable to

make a large down payment on its mortgage loan. A larger down payment gives the borrower more "skin in the game" and improves incentives for the borrower to make good on its promised repayments, making the loan more attractive to the bank.

Carlstrom and Fuerst's 1997 *American Economic Review* paper was among the first studies of the role of agency costs in the business cycle—in particular, their role in what macroeconomists refer to as the amplification and propagation of cyclical fluctuations. Adverse shocks originating from outside the financial sector—such as productivity shocks or other aggregate demand shocks—can result in lower asset prices. Lower asset prices impair borrowers' net worth. Lower net worth, in turn, exacerbates agency costs—in the example in the above paragraph, less net worth gives borrowers less skin in the game. This increases the reluctance of intermediaries to extend funds to borrowers. The resulting contraction in the supply of credit can both amplify and propagate (that is, extend over time) the effects of the original shock—the resulting decline in investment can further reduce aggregate demand, put more downward pressure on asset prices, and hence further exacerbate agency costs, ultimately making the recession both deeper (amplification) and longer-lasting (propagation). This type of negative feedback loop has come to be known as the "financial accelerator" following later work such as Bernanke, Gertler, and Gilchrist (1999), which extended Chuck and Tim's work by augmenting the model to include sluggish adjustment of prices by firms (giving rise to the familiar Phillips curve) and a role for monetary policy. The concept of agency costs and the financial accelerator mechanism has played a central role in understanding events such as the recent financial crisis.

Chuck and Tim went on to write several more papers about the financial accelerator mechanism and agency costs, extending their prior work. As one prominent example, their 2010 paper in the *Journal of Money, Credit, and Banking* (co-authored with Paustian) introduced agency costs into the canonical dynamic New Keynesian model that has come to be the foundation for modern analysis of monetary policy. They showed how financial shocks act as shocks in the Phillips curve, through changes in the markup of firms' prices over their production costs. This mechanism introduces a tradeoff between the two elements of a central bank's dual mandate, and that tradeoff can alter the efficacy of inflation targeting that prevails in the canonical model without agency costs.

Carlstrom and Fuerst also made a number of contributions to the broader study of monetary policy. Their 1998 paper in the *Journal of Political Economy* established a deeply founded theory for countercyclical monetary policy—by this it is meant that in response to adverse shocks to the economy, a central bank ought to engage in expansionary monetary policy. They also wrote a number of papers about monetary policy rules, including the design of the celebrated Taylor rule (Taylor, 1993). Many of these papers were published in the Federal Reserve Bank of Cleveland's *Economic Commentary*. Their 2009 paper in the *Journal of Money, Credit, and Banking* (co-authored with Paustian) studied changes in the persistence of inflation and inflation's business cycle behavior from the 1970s to the early 2000s. In the data, it appears that inflation has become less persistent and the Phillips curve has become flatter over time. In this paper, they argued that more aggressively countercyclical monetary policy can account for these empirical changes. Their 2006 *Journal of Economic Theory* paper (co-authored with Fabio Ghironi) and their 2007 paper in the *Review of Economic Dynamics* each studied different aspects of an important but often overlooked question—in a world with multiple sectors and different types of goods, what price index should central bankers target in order to best satisfy their price stability mandate?

In the last several years of their careers, Carlstrom and Fuerst wrote a sequence of influential papers on topics relevant to monetary policymaking postcrisis. Their 2010 Federal Reserve Bank of Cleveland *Economic Commentary* was one of the first papers to discuss the practice of central banking when interest is paid on bank reserves. The payment of interest on reserves has since become a key component of the Federal Reserve's implementation of monetary policy. Their 2014 and 2015 papers (co-authored with Paustian) on the zero lower bound on interest rates—published in the *Journal of Money, Credit, and Banking* and the *Journal of Monetary Economics*, respectively—analyzed the consequences of a central bank's inability to move interest rates in response to changing economic conditions when interest rates are stuck at zero. Among other things, these studies made the subtle yet important point that the manner in which a zero lower bound episode is expected to end is crucially important for understanding how the economy behaves at the bound.

Their last paper (co-authored with Paustian) was published around the time of their deaths in 2017 in the *American Economic Journal: Macroeconomics*. The paper presented a framework for modeling large-scale asset purchases (also commonly referred to as quantitative easing, or QE). This policy tool was deployed by the Fed and other central banks to provide monetary accommodation when the conventional policy rate was constrained by the zero lower bound, and it is expected to remain a crucial tool for policy in coming years. The paper emphasized market segmentation across bond maturities and introduced a rudimentary term structure into an otherwise standard dynamic New Keynesian model. The model yields a number of useful quantitative insights concerning the effects of asset purchases on bond yields and economic activity. Were it not for their untimely deaths, there is every reason to believe that Chuck and Tim would have continued to work on alternative policy tools.

Conference Summary

To celebrate and honor the lives of Chuck and Tim, in October 2018 we held the aforementioned research conference titled "Credit Market Frictions, Business Cycles, and Monetary Policy: A Research Conference in Honor of Charles Carlstrom and Timothy Fuerst." In giving a high-level summary of the conference, we will touch on the range of topics covered and their overlap with the work of Chuck and Tim and cover in a little more detail a selected few presentations that took up issues for monetary policy in the postcrisis world—the topic that surely would have inspired Chuck and Tim had they been able to continue their research. A complete summary of the proceedings is available on the conference web page.

In all, the conference featured 11 presentations of original research papers from leading scholars in macroeconomics and monetary economics. Each presentation was followed by a formal discussion from another researcher as well as an open conversation among audience participants. The conference also included an after-dinner keynote address by Michael Woodford, who has played a seminal role in developing the framework of modern monetary policy analysis. In general, attendees were a mix of established contemporaries of Chuck and Tim's along with several younger scholars working at the cutting edge of macroeconomics and monetary economics. Many participants described their esteem for Chuck and Tim and how their own research had been inspired and influenced by the work of Chuck and Tim. For example, Lawrence Christiano began the conference's opening presentation by noting how his paper was very much in the style of Chuck and Tim's work—it used a simple model and was going after a big idea.

The topics covered by the conference's papers all touched in some way on themes Chuck and Tim considered in their research. These topics include business cycle propagation (Ilut and Saijo) and selected implications of financial intermediation for monetary policy (Gilchrist, et al.) or the financial accelerator mechanism for the business cycle (Balke, Martinez-Garcia, and Zeng). Other papers at the conference took up the rationale and design of broad government policies relating to the business cycle (Phan), the design of monetary policy rules (Christiano and Takahashi; Cairo and Sim), and the dependence of monetary policy transmission on the state of the business cycle (Eichenbaum, Rebelo, and Wong). Other presentations relating to postcrisis monetary policy examined the efficacy of asset purchases in an international setting (Wu and Zhang) and government debt policy in a low interest rate environment (Acharya and Dogra).

Another conference paper taking up postcrisis policy was "Forward Guidance" by Hagedorn, et al. The Federal Reserve considers forward guidance about the future path of monetary policy to be an important tool. This paper seeks to provide a solution for what macroeconomists refer to as the "forward guidance puzzle": Central bank promises of low interest rates in the future can have implausibly large stimulative effects on the economy in the present. Further, and counterintuitively, promises about policy further out in the future can be more stimulative than promises about policy in the nearer future. The paper, presented by Kurt Mitman, develops a macroeconomic model that departs from the implicit assumptions of standard New Keynesian models around the complete availability of credit to households. In the resulting model, consumption decisions at the household level are much less forward-looking (compared to the standard model that produces the forward guidance puzzle) and depend more strongly on the household's income. As a result, forward guidance announcements by the central bank can have small aggregate effects and the puzzle can disappear.

The paper "Money-Financed Fiscal Programs: A Cautionary Tale" by Erceg, English, and Lopez-Salido examined the potential efficacy of another policy tool—known as "helicopter drops"—that some have suggested as an option in a postcrisis world. The economist Milton Friedman coined the term "helicopter money" as a potential means by which a central bank could provide economic stimulus during a period of low interest rates. In their most extreme form, helicopter drops involve direct payments to households by the central bank. More recently, economists have used the term to refer to fiscal expansions backed by the central bank—that is, the monetization of fiscal deficits. While Erceg, English, and Lopez-Salido find that money-financed fiscal programs can be efficacious if properly communicated and credible, they nevertheless urge caution in the adoption of such policies. Such programs risk either permanently high inflation if fully carried out or impotence if the public doubts the central bank's level of commitment. In presenting the paper, Christopher Erceg argued that more limited forms of fiscal-monetary cooperation are likely better ways to deal with the problem of the zero lower bound.

Finally, Michael Woodford's after-dinner keynote address took up "Stabilization Policy in a Low-Interest Rate World." Woodford began by noting how Chuck and Tim's early work on the financial accelerator proved prescient when it came to the financial crisis and ensuing Great Recession and highlighted the need for continued research on the efficacy of monetary policy tools such as forward guidance and asset purchases. He noted that much such analysis relies on models in which the expectations of households, firms, and financial market participants are fully and perfectly informed—in the parlance of macroeconomists, the models rely on strict, full-information rational expectations. These expectations make policy tools such as forward guidance highly effective. Along some dimensions, these expectations make policy implausibly effective. Moreover, a growing body of empirical evidence points to actual expectations not being perfectly informed (for example, they adjust to new information sluggishly rather than rapidly). Woodford concluded by calling for further research into alternative models of expectations formation in place of strict full-information rational expectations.

Conclusion

Charles Carlstrom and Timothy Fuerst were prolific and prominent research economists who were long-associated with the Federal Reserve Bank of Cleveland. Their myriad contributions include the incorporation of financial market imperfections into macroeconomic models and the study of optimal monetary policy. The participation of a number of well-known researchers, including younger scholars who never directly knew or interacted with Chuck or Tim, at the conference held at the University of Notre Dame in October of 2018 serves as a testament to their influence and standing in the economics profession.

In addition to their sharp intellects and prolific research contributions, Chuck and Tim were also unfailingly kind and generous, particularly with younger researchers. Tim left behind his loving wife Toni and four children. Chuck was survived by his mother, Shirley, and close friend and confidant Michelene Orteza. Both Chuck and Tim left behind scores of friends associated with universities and central banks scattered across the globe. They were taken from us too soon. We miss them.

References

Bernanke, Ben S., Mark Gertler, and Simon Gilchrist. 1999. "The Financial Accelerator in a Quantitative Business Cycle Framework." In John .B. Taylor and M. Woodford (ed.) *Handbook of Macroeconomics*, 1341–1393. https://doi.org/10.1016/s1574-0048(99)10034-x.

Carlstrom, Charles T., and Timothy S. Fuerst. 1995. "Interest Rate Rules vs. Money Growth Rules: A Welfare Comparison in a Cash-in-Advance Economy." *Journal of Monetary Economics*, 36(2): 247–267. https://doi.org/10.1016/0304-3932(95)01221-4.

Carlstrom, Charles T., and Timothy S. Fuerst. 1997. "Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis." *American Economic Review*, 87(5): 893–910.

Carlstrom, Charles T., and Timothy S. Fuerst. 1998b. "A Note on the Role of Countercyclical Monetary Policy." *Journal of Political Economy*, 106(4): 860–866. https://doi.org/10.1086/250033.

Carlstrom, Charles T., and Timothy S. Fuerst. 2007. "Asset Prices, Nominal Rigidities, and Monetary Policy." *Review of Economic Dynamics*, 10(2): 256–275. https://doi.org/10.1016/j.red.2006.11.005.

Carlstrom, Charles T., and Timothy S. Fuerst. 2010. "Monetary Policy in a World with Interest on Reserves." Federal Reserve Bank of Cleveland, *Economic Commentary*, 2010-04.

Carlstrom, Charles T., Timothy S. Fuerst, and Fabio Ghironi. 2006. "Does It Matter (for Equilibrium Determinacy) what Price Index the Central Bank Targets?" *Journal of Economic Theory*, 128(1): 214–231. https://doi.org/10.1016/j.jet.2004.09.003.

Carlstrom, Charles T., Timothy S. Fuerst, and Matthias Paustian. 2009. "Inflation Persistence, Monetary Policy, and the Great Moderation." *Journal of Money, Credit, and Banking*, 41(4): 767–786. https://doi.org/10.1111/j.1538-4616.2009.00231.x.

Carlstrom, Charles T., Timothy S. Fuerst, and Matthias Paustian. 2010. "Optimal Monetary Policy in a Model with Agency Costs." *Journal of Money, Credit, and Banking*, 42(s1): 37–70. https://doi.org/10.1111/j.1538-4616.2010.00329.x.

Carlstrom, Charles T., Timothy S. Fuerst, and Matthias Paustian. 2014. "Fiscal Multipliers under an Interest Rate Peg of Deterministic versus Stochastic Duration." *Journal of Money, Credit, and Banking*, 46(6): 1293–1312. https://doi.org/10.1111/jmcb.12141.

Carlstrom, Charles T., Timothy S. Fuerst, and Matthias Paustian. 2015. "Inflation and Output in New Keynesian Models with a Transient Interest Rate Peg." *Journal of Monetary Economics*, 76: 230–243. https://doi.org/10.1016/j.jmoneco.2015.09.004.

Carlstrom, Charles T., Timothy S. Fuerst, and Matthias Paustian. 2017. "Targeting Long Rates in a Model with Segmented Markets." *American Economic Journal: Macroeconomics*, 9(1): 205–242. https://doi.org/10.1257/mac.20150179.

Taylor, John B. 1993. "Discretion versus Policy Rules in Practice." *Carnegie-Rochester Conference Series on Public Policy*, 39: 195–214. https://doi.org/10.1016/0167-2231(93)90009-l.