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POLICY DISCUSSION PAPERS

The 2005 Summer Workshop on Money, Banking, and Payments: An Overview

By Ed Nosal, Guillaume Rocheteau, and Randall Wright

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The 2005 Summer Workshop on Money, Banking, and Payments at the Cleveland Fed covered a wide variety of topics in monetary theory and policy, banking, and payments systems research. Topics ranged from optimal monetary policy, optimal bank contracts, the private supply of money, the coexistence of credit, money, and capital, the design of payment systems, and international currencies. Effort was made to calibrate models and bring them closer to the data. These contributions illustrate the progress made in the field of monetary theory. Here we summarize and try to tie together the papers presented.

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POLICY DISCUSSION PAPERS

Introduction

In the summer of 2005 we held the latest edition of the Summer Workshop on Money, Banking, and Payments at the Cleveland Fed. We covered a wide variety of topics on monetary theory, banking, payment systems, and monetary policy. We saw presentations in which recent theoretical models are being extended in many directions to study optimal monetary policy with distributional effects, limited participation, and aggregate shocks. Additional effort has been made to calibrate these models and bring them closer to the data. One goal of this work is to better evaluate the welfare cost of inflation. Other goals include trying to explain some particular trading arrangements (for instance, barter clubs in Argentina), and trying to understand some well-documented puzzles in the literature (such as the credit card debt puzzle).

Several contributions pursued the research agenda of introducing banks and privately supplied money into rigorous models of payments. Other contributions examined the coexistence of different assets (e.g., multiple currencies, or capital and credit in addition to money) and their implications for policy. And others used mechanism design to discuss optimal payment arrangements and to ask the question of whether net or gross settlement is preferable. All these contributions illustrate the rapid progress made in the field of monetary theory. The communication of recent developments across people actively working in the area is one of the best ways to help ensure this progress continues.

Monetary Policy

Distributional Effects

In "Search, Market Power, and Inflation Dynamics," Allen Head and Beverly Lapham investigate the short-run non-neutrality of money and its implications for inflation dynamics in a monetary search economy with heterogenous agents. Lump-sum money injections affect the distribution of money holdings in equilibrium and thus generate a short-run non-neutrality. The response of prices and inflation to shocks of this type depends on induced changes to households' search intensity. Monetary shocks change the distribution of prices in equilibrium and, as a result, alter the returns to search. The changes in optimal search intensity affect sellers' profit-maximizing markups. The adjustment to prices may be sluggish even though there are no restrictions on sellers' ability to set prices in every period.

In "An Overlapping-Generations Model with Search," Tao Zhu embeds search frictions in an overlapping-generations model. The result is a tractable model of monetary exchange that allows for distributional effects of money injections. In the model, agents live two periods. Young people sequentially participate in a centralized and decentralized

market, and old agents participate only in the centralized market. These demographic features result in analytical tractability, since the distribution of money balances across the young generation is degenerate. In a series of examples, Zhu demonstrates that positive inflation rates are Pareto optimal.

Aggregate Shocks

In Ricardo Cavalcanti and Andres Erosa's "Price Stickiness and the Optimal Return to Money," the authors formulate a Ramsey problem for the Shi-Trejos-Wright model using a recursive structure that can handle aggregate shocks. The planner is concerned with utility of low and high output, y_l and y_b, respectively, for recessions and booms. Individuals care about the return to money, R, in a way that implies the incentive constraints $y_l \leq R$ and $y_b \leq R$. The value R of what money can buy is itself a function of future choices (y_l, y_b). When incentive constraints are ignored, the first-best allocation is (y_l^*, y_b^*), and the implied return is R^*. They then consider parameters such that $y_l^* < R^* < y_b^*$, and then describe the (second-best) optimum. Output should be increased in recessions, above y_l^*, in order to increase the return R and, consequently, bring output in booms closer to y_b^*. They show, moreover, that output should slowly converge to y_l^* during recessions, as if price-stickiness is an endogenous business-cycle outcome. The price-stickiness interpretation is just one of many ways to describe the efficient propagation of real shocks when money is working as a medium of exchange.

In an environment where money is required to facilitate trade, what effects would a real shock have on economic activity? And would activist government policies be helpful? In "Sectoral Shocks and Policy Responses in a Monetary Search Model," Dror Goldberg addresses these issues. He finds that a real shock at a point in time can be propagated over time. For example, a temporary negative supply shock can reduce output for a number of periods after the initial impact, after which the economy eventually "recovers." An activist monetary policy of increasing the money supply can mitigate the negative output responses to the initial shock.

Limited Participation

In "Endogenously Segmented Asset Market in an Inventory-Theoretic Model of Money Demand," Jonathan Chiu takes up a model that has recently been somewhat popular in monetary economics, which is based on so-called "limited participation." Agents receive income, which is deposited into accounts that they are unable to use right away, and, depending on where (or who) one is, access to credit markets may be restricted. Some people have used these models to try to account for the behavior of things like exchange

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rates or the velocity of money (see, for example, work by Alvarez, Atkeson, and a variety of coauthors). Chiu shows that previous results are not particularly robust. He proceeds in a rather natural way by allowing agents to *choose* when to access credit markets, where accessing these markets is costly. Many of the previous results in the literature, which exogenously restrict when agents can access markets, are overturned. Chui's insight is a useful one.

In "Credit and Open Market Operations with Segmented Markets," Stephen Williamson explores the implications of market segmentation for monetary policy. Williamson makes the distinction between connected households, which benefit from the money injections of the central bank, and unconnected households. A connected household is on the receiving end of central bank actions, while an unconnected household is not. This segmentation, in general, produces price dispersion across markets. Price dispersion generates uninsured consumption risk, which is important in determining the effects of money growth and money growth shocks on the economy, as well as the optimal policy. The optimal money growth rate can be very close to zero, with welfare costs associated with small inflations being very large. Small money shocks can have small effects on aggregates but important effects across sectors, while large money shocks can have proportionately large effects on aggregates.

In "Avoiding the Inflation Tax," Huberto Ennis studies the effects of inflation on the purchasing behavior of buyers in an economy where money is essential for certain transactions. A long-standing intuition in this subject is that when inflation increases, agents try to spend their money holdings faster. The standard framework fails to capture this kind of effect (e.g., Lagos and Rocheteau, 2005). Ennis proposes a simple modification to the model in which trading of goods and rebalancing of money holdings happen less frequently. In such a framework, higher inflation induces buyers to search for transactions more intensively and buy goods of worse quality. The modification proposed also sheds new light on the connection between search-theoretic and inventory-theoretic models of money.

Central Bank Lending

A channel system is one where a central bank is willing to supply (lend) an arbitrary amount of balances to banks at a fixed interest rate and to absorb (borrow) an arbitrary amount of deposits at a fixed interest rate. In "Optimal Monetary Policy in a Channel System" Aleksander Berentsen and Cyril Monnet find that it is always optimal for the central bank to set its lending and borrowing rates equal to one other. The optimal monetary policy sets the central bank's nominal interest rate equal to zero, i.e., the Friedman rule,

when there is no possibility of default. However, if there is a possibility of agents defaulting on their loans to the central bank, then the central bank will set a strictly positive interest rate and, thus, the Friedman rule is no longer optimal.

Liquidity Provision

In "Liqudity, Inflation, and Monetary Policy," Marcus Hagedorn develops a model of liquidity where lowering nominal interest rates can be a central bank's optimal response to a lower inflation target. This response, although consistent with conventional wisdom, is at odds with what some monetary models (new Keynesian models) might imply. In a repeated Diamond and Dybvig economy, there is uncertainty about the need for liquidity in every period. A financial intermediation sector provides liquidity (or money) to those agents who urgently need it and invests and saves for those who do not. The theoretical part of the paper shows that inflation can decrease in response to an increase in nominal interest rates. A lower inflation target then requires a higher nominal interest rate. The quantitative part of the paper demonstrates that the model fits the data well despite being parsimoniously parameterized. Hagedorn then uses the calibrated model to assess whether the above stated conventional wisdom is justified. The following result is obtained: Inflation is decreasing in nominal interest rates if nominal interest rates are low (i.e., when the market is "liquid") and increasing if nominal interest rates are high (i.e., when the market is "illiquid").

Inside Money and Banking

Banking

In a model where money is essential, Aleksander Berensten and Christopher Waller introduce commercial banks and a central bank. In their paper "Optimal Stabilization Policy with Flexible Prices," all agents hold positive money balances before entering the decentralized market, where money is required for trade. Before entering the decentralized market, agents learn whether they will be buyers or sellers; sellers hold "too much" money and buyers "too little" in the decentralized market. Although a commercial bank is helpful in reallocating money balances from sellers to buyers, if governments are unable to tax agents, a central bank can improve the distribution of money holdings, and hence welfare, by offering money loans in the decentralized market, which are repayable before the next decentralized market opens. The central-bank loans resemble repurchase and sale agreements.

In a finite environment, inside money—which is a claim on future stochastic output—may be required to facilitate exchange. If (stochastic) output is not costlessly observable to all agents, then monitoring may be required. It has been shown, in an environment with no aggregate uncertainty, that it is optimal to have the agent who issues the inside money also do the monitoring. In "Aggregate Uncertainty, Money, and Banking," Hongfei Sun relaxes the no-aggregate-uncertainty assumption and finds that a money and banking arrangement, i.e., where the agent who issues the inside money also does the monitoring, dominates an arrangement where issuer of the inside money and the monitor are different agents.

The optimal deposit contracts in models of banking in the tradition of Diamond and Dybvig are extremely complicated and do not at all resemble the kind of deposit contracts that banks offer in reality. For example, an optimal deposit contract in the models will be a function of how many people before the current depositor did and did not want to make withdrawal, and the order in which the withdrawals are made. In practice, the amount that a depositor withdraws is independent of the withdrawal history of previous depositors, unless, of course, the bank is under financial distress. In "Moral Hazard and the Design of Bank Liabilities," David Andolfatto and Ed Nosal suppose that the bank is run by an agent whose object is to maximize his own well-being, as opposed to a planner, whose objective is to maximize social welfare. They find that when reasonable restrictions are imposed on what can and cannot be verified, and when verification may be costly, the optimal bank contract becomes much simpler. When verification is costly, the optimal bank contract resembles what we observe in reality.

Private Supply of Money

In practice, issuers of inside money tend to be regulated. One popular regulation is that issuers of inside money are required to redeem on demand and at par. Is there any justification for such a regulation? In "Imperfect Monitoring and the Discounting of Inside Money," David Mills finds that such a regulation can actually lower welfare. In an unregulated environment, a lower quality inside money would be discounted by agents in the economy. A par redemption requirement lowers the value of all inside money to that of the lowest quality in the economy. This result is somewhat reminiscent of Gresham's Law, which says that bad money drives out good money.

In "Time Consistency of the Private Provision of Fiat Money," Luis Araujo and Braz Camargo study whether private money is viable in the absence of any external control in an economy that is characterized by decentralized trade and information. The bank, which is a self-interested agent, has a monopoly over the provision of fiat money and is not restricted in how much money it can issue over time. If the bank can commit to a choice of money supply, then a monetary equilibrium with no overissue of money exists. This equilibrium, however, is not time-consistent; the equilibrium does not survive when it is not possible for the bank to commit. Araujo and Camargo show that all monetary equilibria will be characterized by overissue in each period when the bank is unable to commit.

In "A Model of Banknote Discounts" Laurence Ales, Francesca Carapella, Pricila Maziero, and Warren Weber construct a model that builds on Trejos and Wright, and Cavalcanti and Wallace, and attempts to explain the following stylized facts regarding banknotes during the 1820–1860 period: (i) local banknotes were always quoted at par to one another; (ii) "foreign" banknotes were typically quoted at a discount to local banknotes and varied by location; (iii) the discount on "foreign" notes fluctuated over time; (iv) the discounts were asymmetric across locations; (v) discounts on "foreign" notes were higher when those notes were not being redeemed at par, which was $1 of silver for a $1 note; and (vi) local banknotes were quoted at a discount to specie when local banks suspended payments on their notes.

Mariana Colacelli presents an empirical analysis of basic microfounded models of money in "Secondary Currency: An Empirical Analysis." She collected her own survey data from "barter clubs" in Argentina. Barter clubs are privately organized markets that issue their own currencies. Theory predicts that people are more likely to use these private monies when several things are true, such as, there is a shortage of official currency and private monies are well managed (e.g., they are difficult to counterfeit). She runs several empirical tests and finds that, by and large, the predictions of the model are well supported by the data. She then calculates the welfare gains to individuals from using private monies.

Money and Credit

In "On the Complementarity of Money and Credit" Leo Ferraris constructs a model where both money and credit are used in exchange. Money is costly to hold but is needed for the usual double-coincidence-of-wants problem; credit can be used to augment purchases. Money and credit can simultaneously exist because agents must post collateral to

issue credit. Credit is ultimately repaid with money and repayment takes time. Specifically, agents with outstanding credit have to work in the future to obtain money, which can be used to pay off debt; a clearinghouse would obviate the need to settle debt with money. In this model an anticipated inflation has some negative consequences. Inflation increases the cost of holding a promise to future money (credit) more than the opportunity cost of holding money itself. Hence, inflation reduces credit and, thereby, also reduces output.

Irina Telyukova and Randall Wright present an analysis of the interaction between money and consumer debt in "A Model of Money and Credit, with Application to the Credit Card Debt Puzzle." They document that many individuals in the United States simultaneously have significant credit card debt and money in the bank. The so-called "credit card debt puzzle" is that given high interest rates on credit cards and low interest rates on bank accounts, why do people not pay down this debt? Some economists go to elaborate lengths to explain this behavior. As an alternative, Telyukova and Wright present a simple and natural extension of a standard model in monetary theory to incorporate consumer debt—which is interesting in its own right—and which shows that the coexistence of debt and money in the bank is not puzzle. Consumers simply do not want to use their liquid assets to pay down their debt because they value liquidity.

In "Gross Loan Flows," Ben Craig and Joseph Haubrich apply the methodology of Davis and Haltiwanger to study gross loan flows at the level of banks. They show that changes in net lending hide much larger and more variable gross lending flows. They present a series of stylized facts about gross loan flows and the way they vary over time, bank size, and the business cycle. They relate these observations to the flow of job creation and destruction in the labor market. Also, they show how their results relate to the predictions of a simple search model of the credit market along the lines of Wasmer and Weil (2003).

Assets and Liquidity

S. Boragan Aruoba, Christopher Waller, and Randall Wright in "Money and Capital," continue their work on the integration of modern monetary theory with mainstream macroeconomics along several dimensions. In particular, they study a numerical version of the Lagos-Wright monetary model, extended to include capital as a productive input. Compared to earlier models with money and capital, this one has rich feedback across markets, and monetary policy has interesting implications for investment, consumption, and employment. The paper calibrates the model and uses it to study quantitatively the effects

of monetary and fiscal policy. The authors do not simply make comparisons across steady states, rather, they take dynamic transitions into account. They find, for example, that the cost of 10 percent inflation, versus constant prices, can be between 1 percent and 5 percent of consumption, depending on the precise details of the model economy.

In "Asset Prices and Liquidity in an Exchange Economy," Ricardo Lagos extends a search model of monetary exchange to include real assets. Financial assets are valued for their liquidity, the extent to which they are useful in facilitating exchange, as well as for being claims to streams of future consumption goods. The implications for average asset returns, the equity premium puzzle, and the risk-free rate puzzle are explored both analytically and quantitatively in a version of the model that nests the standard framework of Mehra and Prescott (1985).

In "A Search-Based Theory of the On-the-Run Phenomenon," Dimitri Vayanos and Pierre-Olivier Weill propose a model in which assets with identical cash flows can trade at different prices. This is sometimes referred to as the "on-the-run phenomenon." Agents can establish long or short positions in assets, and both the spot and the asset-lending markets are subject to search frictions. Short-sellers will concentrate in one asset because of thick-market externalities. As a result, that asset enjoys both greater liquidity, as measured by search times, and a higher lending fee or "specialness." Liquidity and specialness translate into price premia that are consistent with no-arbitrage.

Raphael Silviera and Randall Wright, in "Liquidity and the Market for Ideas," study markets where innovators sell ideas to entrepreneurs, who may be better at implementing them. The markets for ideas are decentralized, with random matching and bilateral bargaining. Entrepreneurs hold liquid assets, such as cash, lest potentially profitable opportunities are lost. The paper extends search-based models of the demand for money along several dimensions, including allowing agents with insufficient money to put deals on hold while they try to raise the funds. Given liquidity costs, i.e., interest rates, the equilibrium level of ideas traded is compared to the efficient outcome. The optimal response of monetary policy is discussed.

Payment Systems

What features might an optimal payment system embody when exchange between agents may be subject to informational asymmetries and imperfect monitoring? Thorsten Koeppl, Cyril Monnet, and Ted Temzelides address this question in "Transactions and Mechanism Design." One can think of liquidity as short-term borrowing. In providing liquidity through a payment system, there will be a trade-off between efficiency and incentives to tell the truth. Specifically, although additional liquidity may lead to better trading outcomes, it will also impair the incentives for agents to tell the truth. If the payment system limits the amount of liquidity available to agents by placing caps on short-term borrowing, then the first-best allocation will not be supportable. If, however, agents are allowed to trade for several rounds before accounts are settled at a centralized place, then the first-best allocation is supportable if settlement takes place with a sufficiently high frequency.

In "A Model of Interbank Settlement," Ben Lester analyzes a model of the payment system where banks are modeled explicitly, and in a rather novel way. As in the real world, banks need to make payments in the model throughout the day or, perhaps, at the end of the day, depending on the system that is in place to settle accounts between banks. Lester first studies a partial equilibrium model, where he can investigate the effects on the banking system of changing some variables and can compare the operating characteristics of real-time gross settlement and net settlement systems. He then embeds the partial model into a general equilibrium structure to analyze the impact that policy and other variables will have on, for example, the loan market and interest rates.

Recent models of monetary exchange and payments have ruled out credit arrangements by appealing to the notion of anonymity in bilateral trades. In "A Random Matching Theory," C. D. Aliprantis, Gabriele Camera, and Daniela Puzzello develop a theory that makes the notion of anonymity more explicit and rigorous. They consider different notions of anonymity (weak and strong) and identify which one is satisfied in standard models of money. For instance, one notion of anonymity requires that two individuals have not shared a common trading partner in the past. Monetary models have adopted a notion of weak anonymity in which agents only match for one period and never meet again. While it has been claimed in the monetary literature that this weaker notion of anonymity rules out bilateral credit, it does not imply that stronger notions of anonymity may open the door to more elaborate trading arrangements.

Multiple Currencies

In "A Theory of International Currency and Seigniorage Competition," Yiting Li and Aki-hiko Matsui study currency competition and its effects on the circulation of currencies and welfare. They show that a country's inflationary policy has a negative impact on the circulation of its currency. This effect imposes a discipline on countries and, the more open is a country, the stronger is the discipline. The worldwide circulation of a currency increases seigniorage and welfare of the issuing country and decreases its inflation rate. The country whose currency is not used as an international currency will raise its infla-tion rate. The authors show, however, that there is a limit on the inflation rate, beyond which the country cannot maintain the circulation of national money.

Liu Qing and Shouyong Shi study a model with two countries and two currencies in "Currency Areas and Monetary Coordination." Unlike most models in the literature, they do not impose "cash-in-advance" constraints on the two countries which force people to use a particular money to buy a particular good. In the model, this outcome is (more or less) endogenous. The model structure is used to ask how monetary policy affects the domestic economy and how it spills over to the foreign economy. The paper stresses that the results can depend on whether monetary policies are set independently across the countries or whether there is some coordination between countries.

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(presenters in *italic*)

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Session II: August 15–19, 2005

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Multiple Currencies

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