Karl Brunner's Contributions to the

Theory of the Money Supply

Juan Pablo Nicolini

Federal Reserve Bank of Minneapolis

and Universidad Di Tella

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ABSTRACT _____

In this paper, I revisit some recent work on the theory of the money supply, using a theoretical framework that closely follows Karl Brunner's work. I argue that had his research proposals been followed by the profession, some of the misunderstandings related to the instability of the money demand relationship could have been avoided.

Keywords: Money Multiplier, Means of Payment, Transaction Services.

JEL Codes: E51, E58.

Foreword

On May 9, 1989, the day Karl Brunner passed away, I was beginning the early stages of my PhD dissertation. I never met him; however, he has been an inspiration from very early on. Although I was not aware of it at the time, I was already a monetarist. Having been born and raised in Argentina, how could I not be? During my college years, 1980–1985, the average monthly inflation rate was 14%, ranging from a low of less than 1% to a high of 30%. I could see the different versions of the quantity theory I was studying in class operating with remarkable precision as I navigated through my semesters. In addition, in the college in my hometown (Universidad Nacional de Tucuman), I was trained by several professors that had done their graduate studies in Chicago. The syllabi for my monetary theory classes (I took three) were packed with the papers of Milton Friedman, Karl Brunner, and Allan Meltzer. My interest in monetary economics kept growing in graduate school: The title of my PhD thesis is "Essays on Inflation". But Brunner's influence on my professional life is not limited to simply learning from his many papers. It has been nearly 30 years since I've been making a living by writing papers and trying to publish them. I have published several of my papers in the Journal of Monetary Economics, a journal founded by Brunner, together with Charles Plosser. I have always thought—and continue to believe—that the JME is a natural outlet for my papers, even though the editors have not shared my views on far too many occasions for my taste. For these and a few other reasons, it is an immense privilege for me to contribute to this volume.

1. Introduction

Which assets are used for transactions in equilibrium and why? These theoretical questions are at the heart of monetary economics, and they were at the center of some of Karl Brunner's work. After mentioning the dates of his birth and death and his nationality, Wikipedia states, "His main interest in economics was on the nature of the money supply process." That is the subject I do revisit in this chapter.

Probably the most well-known approximation to the first of these questions has been provided by Friedman and Schwartz (2008). They argued that the relevant measure of transactional assets is the one that has the more stable relationship with nominal income. This choice is convenient in that it provides a way to connect the theoretical concept of money in a model to a specific measure to be used in empirical research, but it is not a true answer. For instance, it does not provide any guidance when evaluating how technological progress in financial intermediation or regulatory changes affect the type of assets that are used for transactions and the frequency with which each particular asset will be used.

In reviewing this theme, I use two papers of Brunner's as a starting point. The first is "A Schema for the Supply Theory of Money" published in 1961, in which he sets the foundation for a theory of the money supply, centered on the interaction between outside money and the financial sector. The second paper is "The Place of Financial Intermediaries in the Transmission of Monetary Policy", published in 1963, in which he, along with Allan Meltzer, discusses how that same interaction has implications for the monetary transmission mechanism.[1] I view these papers as attempts to study money supply in a way similar to how Milton Friedman and others studied money demand, summarized in the famous 1956 volume *Studies in the Quantity Theory of Money*. The main purpose of that volume was to argue that the velocity of money (the inverse of real money demand) was not to be regarded as a constant. Rather, economic theory can and should be used to understand how velocity responds to changes in other economic variables. To the extent that the theory captures the main forces behind the mechanism, it can then be used to forecast how the relationship between real money demand, real output and a short-term interest rate can change over time,

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[1] It is only natural that even in this biased and partial revision of Brunner's work, one of the two papers considered is coauthored with Allan Meltzer.

as other features of the economy change.

In a similar fashion, these two papers of Brunner's represent an early effort to argue that the relationship between the monetary base, or outside money, chosen by the monetary authority, and the financial instruments used by agents in transactions, or inside money, is not to be regarded as a constant. Rather, economic theory can and should be used to understand and eventually predict how this money multiplier respond to changes in the economic environment.

Regrettably, this line of research did not take off. Even Brunner's interest in the subject seems to have faded away. One likely reason is that in the following two decades since these papers were published, the distinction between the different components of standard monetary aggregates did not seem to matter too much empirically: they all behaved pretty much in the same way, so the money multiplier seemed to be, in fact, relatively constant.[2] A second reason is that interest in the behavior of monetary aggregates, in both academic and policy circles, had dissipated by the early 1990s. This happened following the publication of several empirical papers that argued forcefully that the demand for M1 had become unstable in the United States sometime in the 1980s. The whole theoretical apparatus, the authors argued, failed to match the data, and therefore it could not reliably be used for policy.

I believe that if these early efforts to better understand the interaction between the monetary base, depositors, and financial institutions had been continued, two things would have been different.

First, better judgment would have been used to measure monetary aggregates properly. That is, if regulatory changes hab been taken into account, the data would have confirmed all the way till up the present day that money demand is remarkable stable. I will show, adapting the argument made in Lucas and Nicolini (2015), that simple theories based on Brunner's approach implied that what changed in the 1980s was not the way households behave. Rather, what changed was the availability of transactional assets, owing to important regulatory changes that occurred in the early 1980s in the United States. Regulation, in fact,

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[2]The fact that both components of M1 behaved in a similar fashion probably explains why Friedman, who was so keen on further developing the theory of money demand, chose a different route when analyzing the money supply.

changed the money supply in the United States in the early 1980s. Failure to account for these changes in the money supply led researches to claim, erroneously, that money demand had became unstable. This puzzle was really critical at the time. It led some prominent monetarists to depart from the strict constant money growth rate proposed by Friedman, and it was also responsible for the vanishing interest in studying the evolution and role of monetary aggregates.

Second, following the financial crisis of 2008, many central banks lowered their policy rates to its effective lower bound. Faced with possessing a gun without bullets, they decided to increase the balance sheets, as a way to provide additional accommodation. To understand how changes in the balance sheet or in its composition affect asset prices and eventually the labor market, one needs to have a good theory for the demand and supply of all those assets. This is the theory Brunner was pursuing in writing those papers.

By the time central banks were constrained by the zero bound, three decades had passed during which the study of monetary aggregates had been essentially absent in central banks, and only marginally present in academia—so much so that changes in the balance sheet of the central bank, a standard exercise in Don Patinkin's classic book Money, Interest, and Prices, were referred to as "unconventional monetary policy" . It is the central claim of this chapter that had we developed the theory sketched almost 60 years ago by Brunner, today we would have a better understanding of the effect of those policies, and Ben Bernanke would not have famously commented in a discussion at the Brookings Institution, "The problem with quantitative easing is that it works in practice, but it doesn't work in theory". [3]

In this chapter, I revisit joint work with Robert E. Lucas Jr. that was recently published in the July 2015 Carnegie-Rochester-NYU volume of the *Journal of Monetary Economics*. In Lucas and Nicolini (2015), we address the instability of the money demand relationship that became apparent sometime in the mid 1980s. We argue that new regulations, adopted in 1982, changed the instruments that agents use for transactions. Once a theory that takes into account these changes is used to look at the data, it becomes evident that money demand has remained remarkably stable for over a century. The theory

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[3] Ben Bernanke, "A Conversation: The Fed Yesterday, Today and Tomorrow," The Brookings Institution, January 16, 2014.

we study was developed by Prescott (1987), and refined by Freeman and Kydland (2000). The purpose of the theory is to understand how agents decide which asset to use in each transaction they make. In Lucas and Nicolini (2015), we solve a general equilibrium model in which agents chose which of the several available instruments they use for each of their transactions. In equilibrium, not only the total monetary aggregate but also the quantity of each of the possible instruments, is determined as a function of monetary policy. The theory also has implications regarding the joint behavior of the interest rates paid by each of the assets. The model is an infinite-period general equilibrium and is substantially more complicated than the blueprint in Brunner's papers.

In this chapter I review the same evidence but follow an alternative route: we explore to which extent a much simpler model, closer in spirit to the one in Brunner, can achieve a similar outcome. In particular, we remain within the realm of partial equilibrium static models, emphasizing just substitution effects. I conclude that, had he been armed with the data we use in Lucas and Nicolini (2015), Brunner would have arrived at essentially similar conclusions with a theoretical framework much closer to that in Brunner (1961).

The chapter proceeds as follows. In Section 2, we review the evidence for the United States that has been used to argue that M1 money demand became unstable sometime in the 1980s. In Section 3, we briefly discuss two regulatory changes made in the early 1980s and show the behavior of assets that are typically included in M1. We then solve a Baumol-Tobin-type model in the spirits of Baumol (1952) and Tobin (1956), extended to include three transactional assets, very much in line with Brunner (1961), and use it to interpret the data. We argue that the apparent instability observed in M1 money demand is the result of treating the supply of transactional assets as exogenously determined, rather than as the result of optimizing decisions by economic agents that are constrained by regulation. We show that a simple theory of the money supply, much in line with the model in Brunner 1961, implies that the way the monetary aggregate ought to be measured is different pre and post regulation. We will show that, had the Federal Reserve used a Brunner-type model to interpret the regulatory changes, it would have likely adjusted the way it measured money, and the puzzle of the instability of money demand would had never been born. Section 4 presents some concluding remarks.

2. One Century of M1 Demand Behavior

In this section, we review evidence on the behavior of the ratio of M1 to total output in the United States during the last century, following the tradition of Meltzer (1963) and Lucas (1988). In Figure 1.a we plot the time series of the ratio of M1 to GDP for the United States from 1915 to 1980, together with the three-month Treasury bill nominal interest rate. This clear negative relation has been documented many times in empirical studies of money demand. But these studies have typically ignored the distinction between the different components of M1. In a sense, there was no need to address the issue theoretically, since the components seemed to move proportionally over time, as we mentioned before. As a consequence, that clear negative relationship can also be identified in each of the components, cash and demand deposits, as Figures 1.b and 1.c show.

Important exceptions can be noted, however, particularly the large increase of cash during the early years of the Great Depression or the substantial increase in M1 during WW2. But the bank runs, absent in simple models of money demand, can explain that specific anomaly. By and large, Figure 1 supports the notion that the distinction between cash and deposits is of little empirical relevance during this very long period.

In Figure 2.a, we extend the sample to 2012. Clearly, an important change occurred after the early 1980s: while the nominal interest rate went down to levels similar to the rates in the 1940s, the ratio of M1 to output does not increase accordingly. Is this breakdown also reflected in the components of M1? The answer is depicted in Figures 2.b and 2.c: the breakdown in M1 is associated with a breakdown in the behavior of deposits, not cash.

As argued in Teles and Zhou (2005), the early 1980s are a hectic period in terms of regulatory changes.[4] The regulatory framework that followed the Great Depression included Regulation Q, which prohibited commercial banks from paying interest rates on bank deposits. Regulation Q was first relaxed in 1980 when banks were allowed to issue non-commercial checking accounts (negotiable orders of withdrawal, or NOW accounts) and could pay interest on them. Later, in 1982, banks were allowed to issue money market deposit accounts (MMDA), which could also be held by some businesses.
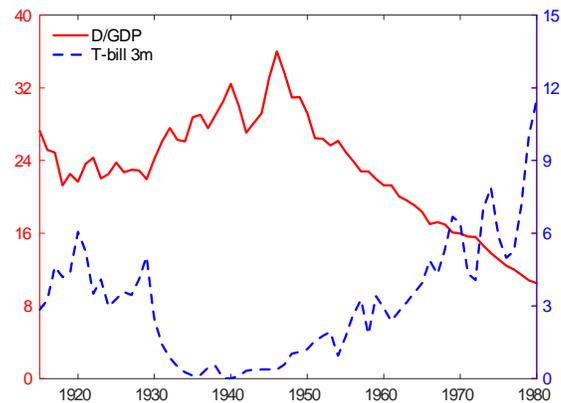
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[4]See Teles and Zhou (2005) for details.
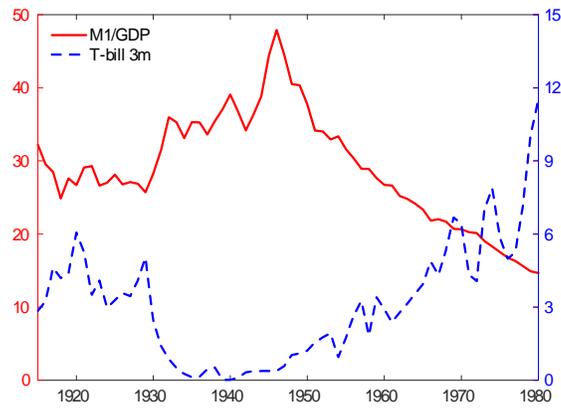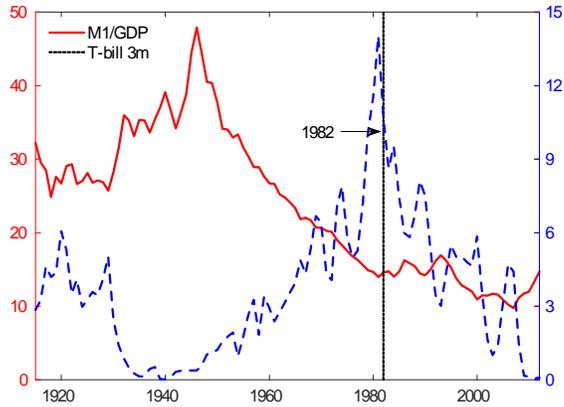
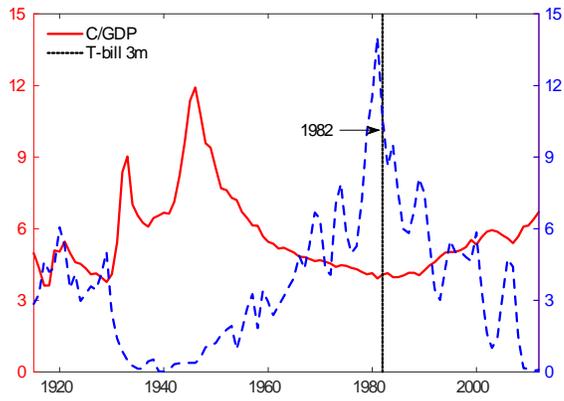a. M1 to GDP ratio
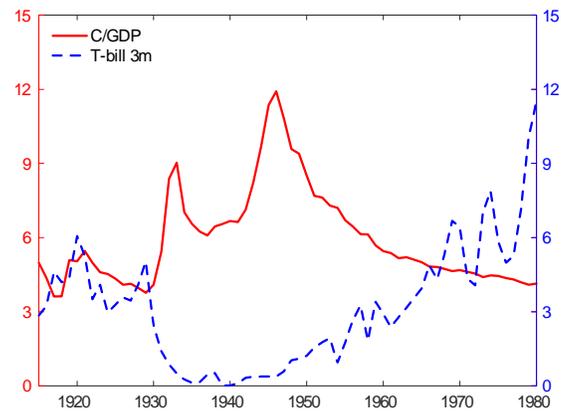
b. Currency to GDP ratio

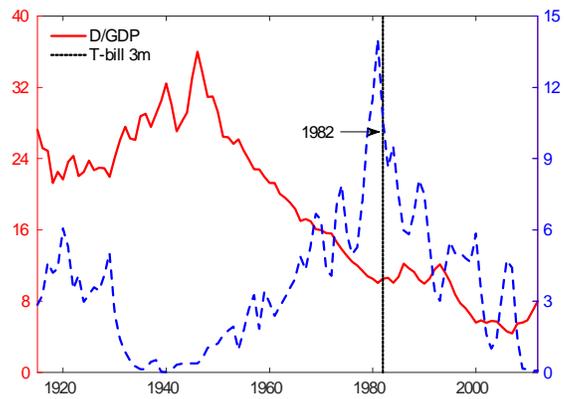
c. Demand deposits to GDP ratio

Figure 1: Time series of ratio of components of money demand to total output in the United States, 1915–1980.

a. M1 to GDP ratio

b. Currency to GDP ratio

c. Demand deposits to GDP ratio

Figure 2: Time series of ratio of components of money demand to total output in the United States, 1915–2012.

NOW accounts are essentially identical to checking accounts, but only individuals can hold them. MMDA, on the contrary, are less liquid, in the sense that a limited number of transactions (typically six) are allowed per month. But some corporations can hold these accounts. At the time, the Federal Reserve included NOW accounts in M1, together with traditional zero-interest checking accounts. However, it included MMDA with other savings accounts, which are part of M2.[5]

A natural question, motivated by the coincidence in timing with the breakdown in the stability of money demand is: how did this regulatory change affect household decisions regarding the desirability of the different components of M1? According to the theory described below, once banks are allowed to issue these close substitutes, they should be included in the monetary aggregate together with cash and traditional checking accounts.

We can simply add the newly created deposits to M1, as proposed in Lucas and Nicolini (2015), to construct what we call

New M1 = M1 + MMDA.

If we now plot the time series of NewM1 to output together with the short-term interest rate, we see no evidence of instability, as can be seen in Figure 3.
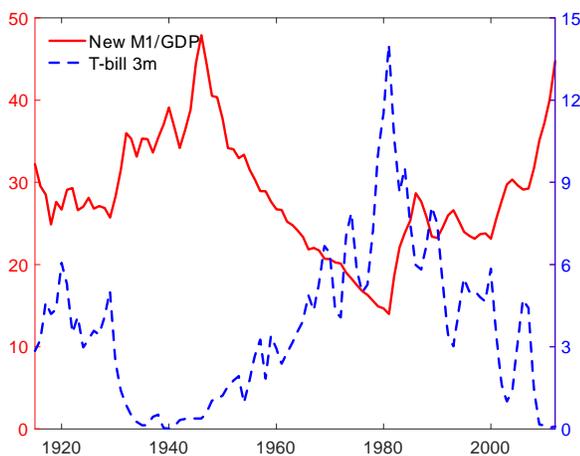

Figure 3: New M1 to GDP ratio

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[5]MMDA were well received by the market. A few quarters after they were allowed, they amounted to more than 10% of total output.

3. A Three-Asset Baumol-Tobin model

In the previous section, we arbitrarily decided to construct a new monetary aggregate just by adding up the newly created deposits. In this section, we use a model very much in the spirit of Brunner (1961), to try to shed light on this decision. We combine the insights from the Brunner model with those of Baumol-Tobin so as to combine money demand with money supply decisions. We show how the model can rationalize the behavior of real money demand before and after the regulatory changes in the early 1980s.

To do so, we study the problem of a consumer who must finance a given amount of consumption x in a given interval of time. We assume, as in Baumol-Tobin, that the flow of consumption expenditures is constant over time and that transactional assets must be used to finance those consumption expenditures.

The consumer must choose the number of portfolio adjustments within the period. Each portfolio adjustment costs γx. Thus, if the consumer makes n portfolio adjustments or trips to the bank, then the total direct costs of transactions are given by $n\gamma x$.[6]

In line with Brunner, multiple assets can be used for transactions. We consider the case of three transactional assets that can be combined into a production function of transactional services. The first is cash, C. In addition, there are two types of deposits: demand deposits, D, which pay interest i^d, and money market demand accounts, A, which pay interest i^a. Below, we explore several technologies to aggregate the three inputs into total transactional services.

Given a number of portfolio adjustments, n, average holdings of the asset j are given by

$$\frac{\theta_j x P}{2n}, \ \text{ for } \ j = c, d, a$$

where $\theta_j = \frac{j}{xP}$, for $\ j = C, D, A$.

Thus, if we let i be the interest rate on government bonds — the non-transactional

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[6]Note that we depart from the standard Baumol-Tobin specification in that in our formulation, the cost of making transactions is proportional to total consumption. We adopt this alternative assumption for two reasons. First, it is consistent with a general equilibrium version in which the fixed cost involves labor rather than consumption. Second, it implies an income elasticity of money demand equal to 1, as in the data. The standard assumption delivers an income elasticity of 1/2, which is clearly at odds with the data.

asset —, the opportunity cost of making transactions is given by

$$\frac{\theta_c x P i + \theta_d x P(i - i^d) + \theta_a x P(i - i^a)}{2n}.$$

A. The Case of Fixed Shares

As a first approximation, we assume that the shares of each asset used for total transactional services are constants. Note that this implies that the money multiplier is indeed constant. Thus, by allowing for just two assets up to 1981 and for three assets afterward, we are assuming a single change of the multiplier — which so far we leave unexplained — in 1982.

The problem of the consumer in this case becomes one of minimizing the total cost of making transactions, which is defined in terms of units of the final good, given by

$$x \left(\frac{\theta_c(i - i^c) + \theta_d(i - i^d) + \theta_a(i - i^a)}{2n} + \gamma n \right),$$

given the interest rates $(i_t, i_t^c, i_t^d, i_t^a)$ and the parameter γ. As the vector $(\theta_c, \theta_d, \theta_a)$ is assumed to be a parameter, the only economically relevant choice for the agent is the variable n.

Note that if the interest rates paid by the two deposit types were zero, as it was before the 1980s, then the expression becomes
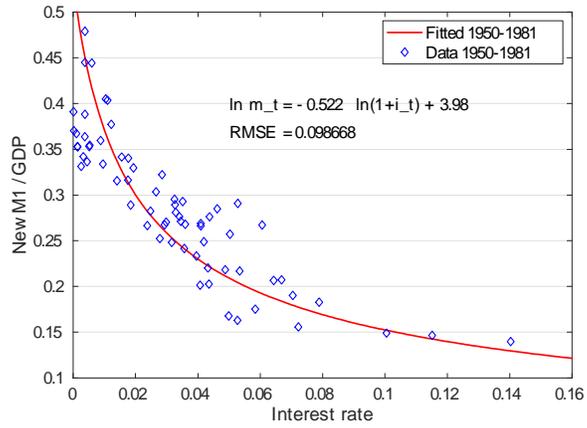
$$x \left(\frac{i}{2n} + \gamma n \right),$$

since the sum of the shares is equal to 1. This is similar to the Baumol-Tobin optimal problem, which delivers the well-known square root formula for n, given by
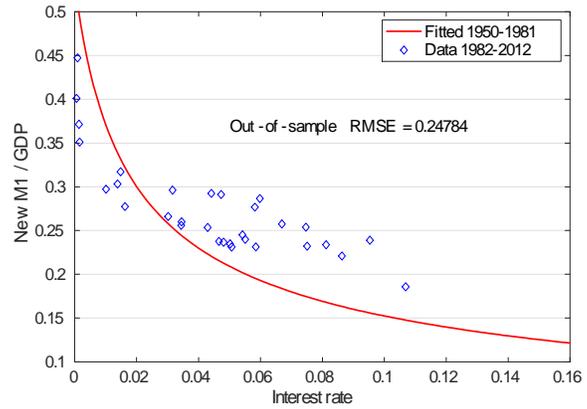
$$n = \sqrt{\frac{i}{4\gamma}}.$$

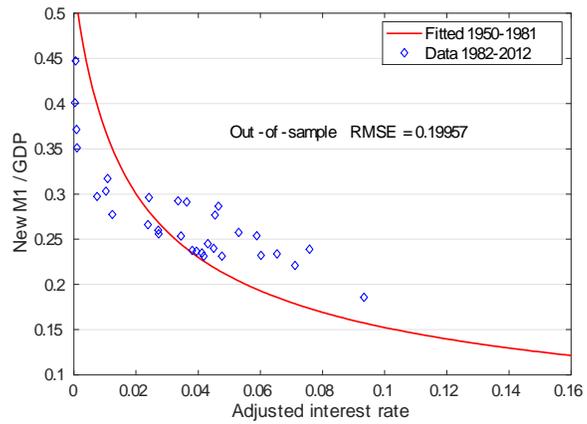More generally, when the interest rates on deposits are not zero, we can let

$$\theta_c(i - i^c) + \theta_d(i - i^d) + \theta_a(i - i^a) \equiv I$$

a. Interest rate, 1950 − 1981

b. Interest rate, 1982 − 2012

c. Adjusted interest rates, 1982 − 2012

Figure 4: Model fits

which is the opportunity cost of using money. Then, the solution will be given by

$$n = \sqrt{\frac{I}{4\gamma}}.$$

This discussion therefore suggests that the relevant variable that determines the equilibrium value for the ratio of money to output ought to be the opportunity cost of money, not the short term interest rate, as used in Figure 3.

To check whether the data conforms to the theory, Figure 4 shows cross plots of NewM1 and both the short term interest rate and the opportunity cost of money. In order to avoid the effect of episodes like the Grat Depression and WW2, mentioned above, we focus now on the period that goes from 1950 to 2012. To appreciate the effect of the change in regulation, we first show in Figure 4.a the data from 1950 to 1981, together with a fitted log-log curve.[7] For this period, since banks could not pay interest on deposits, the interest rate and the opportunity cost of money are the same, so $i = I$.

Note that the evidence is consistent with the Baumol-Tobin assumption, since the fitted elasticity is equal to 1/2. The mean squared error of the in-sample fitted exercise is almost 0.10.

In Figure 4.b, we show the cross plot of NewM1 and the interest rate for the period 1982 to 2012, together with the curve that was fitted using data only up to 1981. The data exhibit a negative relationship, but one that appears to be flatter than the one estimated during the previous period. The mean squared error now becomes 0.24, which implies an increase of 0.14 relative to the in sample fit. Alas, this is not the correct specification according to the simple model above, since some components in NewM1 do pay interest, so now $I < i$. The correct specification is shown in Figure 4.c, where we plot NewM1 and the opportunity cost of money for the period 1982 to 2012 and the curve fitted using the data up to 1981. The fit is clearly better than in Figure 4.b. Accordingly, the mean squared error now goes down to 0.20. Thus, almost a third of the increase in the mean squared error (relative to the in-sample fit) can be accounted for by the theory, even maintaining fixed the shares of each

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[7]In fitting the curve, we add 1% to the interest rate every period because the data do not support an asymptote when interest rates are zero. For a theory and an empricial analysis that supports this decision, see Benati et al. (2017).

of the components.

B. The Case of Endogenous Shares

Now, we assume that total transactional services are a constant returns to scale function of the three transactional assets $f(C, D, A) = M$. For simplicity in notation, let

$$r \equiv i, \quad r^d \equiv i - i^d, \quad r^a \equiv i - i^a.$$

Thus, the problem is to choose n and $(\theta_c, \theta_d, \theta_a)$ so as to minimize

$$\gamma n x + \frac{rC + r^d D + r^a A}{P}$$

subject to

$$n f(C, D, A) \geq x P$$

and

$$\theta_c + \theta_d + \theta_a = 1$$

Note that we now allow for smooth substitutions among the three different asset types, so the multiplier will no longer be constant. However, this theory will not be able to account for the discrete change in the multiplier implied by the regulatory changes in 1981. We address that feature in the next subsection.

This is a concave problem, so the first order conditions are necessary and sufficient for an optimum. These are

$$\gamma n x = \lambda f(C_t, D_t, A_t)$$

$$\frac{r}{P} = \lambda f_C$$

$$\frac{r^d}{P} = \lambda f_D$$

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$$\frac{r^a}{P} = \lambda f_A.$$

Using the first two, we have

$$\gamma n x = \frac{r}{f_C P} f(C, D, A) = \frac{r}{f_C P} M.$$

Using the cash-in-advance constraint, we obtain

$$(1) \quad \gamma n^2 = \frac{r}{f_C}.$$

Now, combining the last three, we have

$$(2) \quad \frac{r^d}{r^c} = \frac{f_D}{f_C}$$

$$(3) \quad \frac{r^a}{r^c} = \frac{f_A}{f_C}.$$

These three equations, together with the constraint

$$nf(C, D, A) = xP,$$

solve for $n, C, D,$ and A.

Note that as the technology to produce transactions is constant returns to scale, it can be written as

$$f_C C + f_D D + f_A A = M$$

then

$$f_C \frac{C}{M} + f_D \frac{D}{M} + f_A \frac{A}{M} = 1,$$

but using the conditions above

$$\frac{r}{\gamma n^2}\frac{C}{M} + \frac{r^d}{\gamma n^2}\frac{D}{M} + \frac{r^a}{\gamma n^2}\frac{A}{M} = 1,$$

or

$$r\theta_c + r^d\theta_d + r^d\theta_a = \gamma n_t^2,$$

where the left-hand side is the opportunity cost of money, and the weights are endogenous, given by equations (2) and (3).

Thus, the solution for the number of portfolio adjustments is the same as before. The difference, of course, is that now the values for θ_j, for all j, are no longer constant, but rather depend on the interest rates.

To obtain further insights, consider the following nested constant elasticity technology, given by

$$f(C,D,A) = \left[\varphi\left([\theta C^{\rho_1} + (1-\theta)D^{\rho_1}]^{\frac{1}{\rho_1}}\right)^{\rho_2} + (1-\varphi)A^{\rho_2}\right]^{\frac{1}{\rho_2}}.$$

Conditions (2) and (3) then become

$$(4) \quad \frac{f_D}{f_C} = \frac{(1-\theta)}{\theta}\left(\frac{D}{C}\right)^{\rho_1-1} = \frac{r^d}{r^c}$$

and

$$(5) \quad \frac{f_D}{f_A} = (1-\theta)\frac{\varphi}{(1-\varphi)}\left[\theta\left(\frac{C}{D}\right)^{\rho_1} + (1-\theta)\right]^{\frac{\rho_2-\rho_1}{\rho_1}}\left(\frac{D}{A}\right)^{\rho_2-1} = \frac{r^d}{r^a}.$$

In this case, the ratios of the components of money are proportional to the corresponding ratios of their opportunity costs. Note also that in the case in which $\rho_2 = \rho_1$, those proportions are then constant.

As an illustration, we plot in Figures 5.a and 5.8 the cross plots of the ratios of assets

and the ratios of opportunity costs.[8] The data are consistent with a common value of $\rho_2 = \rho_1$ roughly equal to $1/2$.
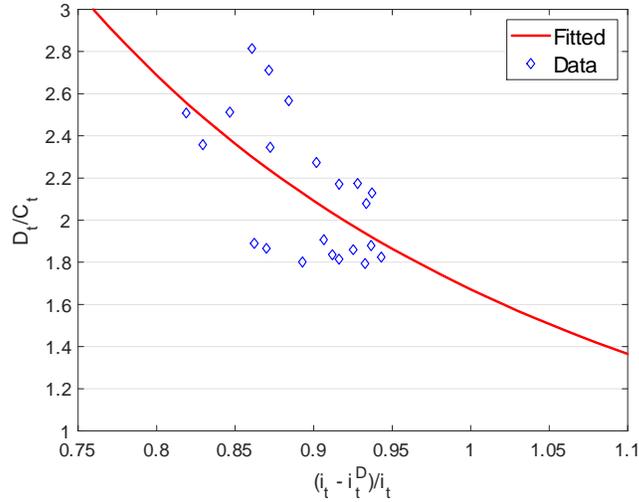
a. Demand for demand deposits, $1987 - 2008$
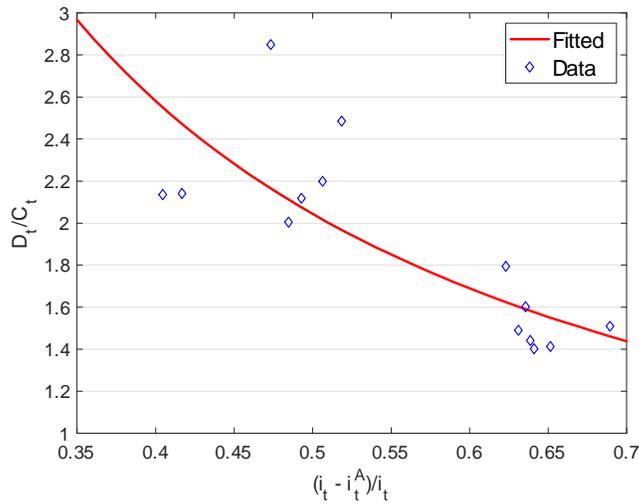
b. Demand for MMDAs, $1987 - 2000$

Figure 5: Model fits

The theory, together with the validation arising from Figures 5.a and 5.b suggests that the version of the model with a technology to produce transactional services that corresponds

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[8]For the MMDA plot, we only have interest rate data up to 2000. For demand deposits, we disregarded the years after the crisis, beacause of the very low value for the short term interest rate. This model does not perform well for very low interst rates, as shown in Benati et al. (20170.

to a constant elasticity of substitution, with a common $\rho_2 = \rho_1 = 1.5$, will improve the match of the data from 1982 onward, relative to the model with constant weights. However, given the remarkable match between the data and the model with constant weights, plus the fact that the interest rate variations during the period were not that large, we conjecture that the quantitative improvement provided by the more complicated theory would be very marginal at most. Thus, we do not pursue that strategy further.

C. A Unifying Framework

We do, however, use a variation of the technology just discussed to provide a theoretical framework that can account for the behavior of the money supply for the entire last century in the United States. To do so, imagine that transactional services can be provided by a combination of a class of very liquid assets, such as cash and demand deposits, and other less liquid assets. The potential advantage of the less liquid assets is that they can pay higher returns. This idea is consistent with the work of Barnett (2000), in which assets can be indexed by their liquidity services on the one hand, and by their returns on the other.

We will therefore assume that the role fulfilled by the less liquid asset can also be fulfilled by the liquid asset, but in a more effective way. In particular, we let D_1 be the amount of demand deposits that are combined with cash to produce the liquid transaction asset, and let D_2 be the amount of demand deposits that are used to fulfill the role of the less liquid asset. Then, we assume that transaction services are produced according to the following technology:

$$ f(C, D, A) = \left[\varphi \left([\theta C^{\rho_1} + (1-\theta) D_1^{\rho_1}]^{\frac{1}{\rho_1}} \right)^{\rho_2} + (1-\varphi) [\nu A + D_2]^{\rho_2} \right]^{\frac{1}{\rho_2}}, $$

where $0 < \nu < 1$ represents the relative disadvantage of using a less liquid asset as the MMDA.

The optimal problem is very similar to the one before, except that given the linear structure on the last term of the production function of transactions, non-negativity constraints on both D_2 and A must be imposed on the problem.

It is trivial to show that in general, one, and only one, of the two non-negativity

constraints will be binding, so that the equilibrium will be characterized by either $D_2 = 0$ or $A = 0$.[9] In addition, given that $\nu < 1$, only demand deposits will be used (so $D_2 > 0$ and $A = 0$) if there is no interest rate differential. Thus, by not allowing banks to pay interest on deposits, Regulation Q implied that, in equilibrium, $D_2 > 0$ and $A = 0$. However, once the restriction was lifted in 1982 and banks could attract agents by paying interest on MMDA deposits, the ensuing equilibrium implied that $D_2 = 0$ and $A > 0$. While after the regulatory change, money demand remained stable, a mismeasured aggregate that ignores the evolution of deposits A would give the wrong impression of an unstable money demand.

This specification is broadly consistent with the behavior of the money multiplier during the almost 100-year period of US monetary history we are reviewing. Before the Great Depression, nominal interest rates were very small, so $i \simeq I$. Demand deposits could pay interest, so there was no advantage for A during that period. As $i \simeq I$, the money multiplier changed very little. From the Great Depression up to 1981, interest rates vary greatly, but because of Regulation Q, $i = I$; thus, there was no advantage for A, and the multiplier changed little. Facing that evidence, it was hard to argue against the notion that the money multiplier was not roughly constant. From this point of view, Brunner's concerns seemed little more than an intellectual curiosity. But once regulation changed, the comparative advantage of A over D became evident, and the substitution of one for the other started rapidly, at the precise moment at which interest rates started to fall. This substitution implied that D failed to increase when interest rates dropped, which was interpreted at the time as an instability in the money demand relationship.

At the same time, this specification allows for smooth changes in the money multiplier as interest rate changes affect the relative attractiveness of the alternative means of payments. Thus, this parametric form can provide an even better adjustment to the data after 1982.

It is important to highlight one immediate shortcoming, however. Note that it is reasonable to expect that as the short-term interest rate becomes close to zero, so does the interest rate paid by the MMDA. Thus, the relative advantage in terms of return differentials also goes to zero. The theory thus implies that a reversal should have been observed, with

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[9]In a knife-edge case, the interest rate advantage offered by A is exactly compensated by its disadvantage, represented by ν, so that households are indifferent between using D_2 or A.

a large increase in demand deposits and a vanishing stock of MMDA once the interest rates went down to almost zero after 2008. The share of MMDA on NewM1 did go down and the share of demand deposits went up since 2008. However, in contrast to what the theory suggests, the stock of MMDA is still sizable. This fact cannot be captured by the specification of this subsection. Further research is required to try to understand this behavior.

4. Conclusion

Households do not have a demand for taxis, they have a demand for transportation. The reduction in the equilibrium number of taxi rides in Minneapolis in 2017 does not reflect an instability in the demand for transportation by the citizens of Minneapolis. As everybody knows, it just reflects that technology changes made transportations services as Uber and Lyft possible. Much in the same way, households and firms do not have a demand for deposits, they have a demand for transactional assets. And in the same way, technology or regulation can change the way alternative assets can provide transaction services.

Transactions in the world today are huge, and by and large imply assets that are more complicated than the simple three assets that are included in NewM1. Understanding their behavior will certainly imply more complicated models than the first prototypes that Brunner analyzed. Much more work is required before we can begin to understand how liquidity works, or more importantly, why it stops working from time to time. To make progress, we certainly need to go beyond assumptions about transactions technologies made in this chapter in order to make progress. But the reasonable success of capturing the behavior of simple monetary aggregates with these simple models provides the hope that progress can be made.

These ideas were at the heart of the quest for a theory of the money supply launched by Brunner at a time in which its application was not obvious, and his research agenda faded away. The meltdown in financial markets that started in 2007 in developed economies provided the application. I find it unfortunate that at the time, central banks had little guidance from the well-established and tested theories that Brunner envisioned many decades ago.

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