Liquidity as a Residual Store of Value *

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Abstract

This paper introduces a theory of liquidity as a residual store of value when consumption and investment goods are hard to find. This role for liquidity complements existing theories of money and search (e.g. Kiyotaki and Wright (1989)), where money resolves the double coincidence of wants. To highlight the distinction between these two theories, money is assumed not to be the only means of payment. In particular, this theory can explain increasing money holdings when credit is available. The model also implies a link between money, aggregate demand and equilibrium excess supply. This social role of money as a medium of exchange helps account for several facts about the Financial crisis in US and Europe.

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1 Introduction

This paper uncovers a new role for liquid assets which has not been formally shown in the existing literature. Demand for liquidity arises a consequence of a search friction in the goods market. This friction implies that households cannot transform their entire wealth in consumption or productive investment. The remaining part is invested in the asset which is liquid in the sense that it is not subject to the search friction. This asset is a commodity that does not give utility nor can be used in production, it has value insofar it can be exchanged for goods in the future. As such is a medium of exchange. Since this liquid asset has no intrinsic value, it can be called fiat money.

Like the models of money and search (e.g. Kiyotaki and Wright (1989), Shi (1997) and Lagos and Wright (2005)), money is introduced in conjunction with a search friction in the goods markets. However there, the role of money as a medium of exchange arises because of anonymity, which rules out the possibility of credit, and because money resolves the double coincidence of wants (Kocherlakota (1998), Levine (1991), Wallace (2001)). In this model, demand for liquidity arises for a different reason. To make this clear, the liquid asset is not the only means of payment in this model: there are other assets which give higher return and which are accepted as payment by firms with no costs. However, these other assets are not as easy to buy. Therefore, agents cannot invest all their wealth in these other goods and thus invest their residual savings in the liquid asset. Thus the agents see this asset as a residual store of value, where to put savings they did not manage to put to better use.[1]

A sharp way to summarize the distinction between this theory of money and the existing money and search literature is that there agents enter the market with money in order to make transactions; in this model, they exit the market with money because they cannot make transactions. These two theories are not rival but complement each other. The existing theory of money relies on

[1]The role of money as a store of value is related to the overlapping generations models of money e.g Wallace (1980) where money is the way to carry value from one period to the next. Here, however, money is not the only way to store value. Furthermore, money has an important role as a medium of exchange.

the lack of coincidence of wants and on the fact that trades must be quid pro quo; thus pertains to markets that do not use credit. On the other hand, this theory of money strongly relies on the assumption that goods are costly to trade: it explains the high share of savings held in liquid form with little return, such as deposit accounts, as a consequence of the inability to quickly transform financial wealth in goods, services or commodities.[2] As such, this theory offers an explanation for the large amount of savings held in liquid form, such as deposits, which amount to a staggering 40 % of quarterly GDP since the seventies and have been increasing since the mid '90s despite the availability of credit.

Besides being a store of value, another important role played by the liquid asset is to facilitate transactions: other things equal, the higher the value of money, the more goods are demanded and the higher the share of firm capacity sold. In fact, with the matching function used, which takes as inputs firms capacity (or aggregate supply) and available funds to purchase goods (or aggregate demand), but abstracts from search effort, efficiency calls for an infinitely large value of money: this makes aggregate demand infinitely large, thereby inducing zero market tightness (aggregate supply over aggregate demand) and making firms sell all their production capacity. This extreme result depends on the fact that aggregate demand is an endogenous variable that expands with the value of money: aggregate demand and the value of money are free to adjust to the value that supports any market tightness. Then, without search effort costs, it is efficient to have zero market tightness which implies that the probability of finding goods tends to zero.[3]

To understand this result, it is useful to draw a comparison with models of search in the labor market such as Mortensen and Pissarides (1994); there market tightness is given by the ratio between vacancies and unemployment; unemployment is a state variable, vacancies are bounded because costly to

[2]This is conveniently achieved through a search friction, but similar results would derive from the presence of other frictions that hinder the ability to trade quickly such as information acquisition. In this sense, the notion of liquidity relates to the idea that information insensitive securities should serve as liquidity, Gorton (1990).

[3]This allocation is implemented at the Friedman rule where there are no private costs from holding money as the opportunity cost is zero.

post. If vacancies were free to post, free entry would imply infinite vacancies. This case is useful to highlight the role of money as a medium of exchange via its effect on aggregate demand, but it might be unsuitable for quantitative analysis.[4] In the empirical part, I consider an alternative matching function where aggregate demand has to be combined with search effort.

A long with generating a theory of liquidity, another implication of the search friction in the goods market is that firms cannot sell their entire production capacity. Indeed this model implies a tight link between this excess supply of goods and the value of money: it is shown that as the search friction disappears, both the excess supply of goods and the value of money go to zero. As Bradford de Long reports in his blog, this idea dates back to what John Stuart Mill wrote in 1829: "an excess supply of pretty much anything else is the flipside of an excess demand for safe, liquid, reliable financial assets." This idea, which lies at the core of the neoclassical-keynesian dispute, gained renewed attention in the recent years of increased economic turmoil: according to this view, the financial crisis resulted in a recession because agents stopped spending for consumption and investment but hoarded their wealth in unproductive but safe assets. Indeed there is consensus that the financial crisis was characterized by a surge in demand of safe liquid assets as reported by the vast literature about the record-high amounts of cash held by firms and corporations (see Ivashina and Scharfstein (2010) among others). Less easy to measure in the data is the excess supply of goods. However, since this theory links this excess supply of goods to the value of money, it is possible to attempt a quantitative investigation of this conjecture.

Indeed this theory is suitable for quantitative analysis because it is grounded in the neoclassical model and can easily accommodate the elements of realism introduced by the DSGE literature to match the data. The reason why this model is tractable relative to the money and search literature is that money does not arise in order to solve the lack of double coincidence of wants. For that one needs to model trades between pairs of individuals, as them meeting

[4]It should be noticed though, that with inflation above the Friedman rule, the value of money and aggregate demand are bounded.

in a more centralized market would solve the issue. Here, the trade is between firms and households. Firms always accept what the household has to offer (money or any other form of payment) while the household may or may not like the product of each firm. In this context it is possible to study a representative firm and household in the neoclassical tradition, albeit with a matching friction.[5] For instance, to address the quantitative question I further enrich the matching process with effort. This input captures the idea that purchasing goods does not only require funds, but also some other activities, such as the acquisition of information, management and monitoring activities. Thanks to this third input, which can be associated with financial activities, it is possible to study the consequences of a financial crisis interpreted as a destruction in these financial services. The shock resembles the general idea that the sudden emergence of doubts on the quality and riskiness of available investment opportunities, led to a shift in portfolio holdings toward more liquid and safe assets, which is what is observed in the data.

What are the business cycle consequences of this shock? The model suggests that a shock that induces a 5% increase in liquidity over GDP (this is the magnitude of the increase in deposits minus loans, over GDP: a conservative measure of the total liquidity surge found in banks balance sheets, cleaned from the monetary injection by the FED), leads to a GDP drop of about 3%.

Similarly to the data, this type of recession induces a reduction in consumption, labor, investment, and an increase in liquidity. The intuition for this result is that the financial shock induces tougher search frictions, thereby reducing the probability of firms to selling their goods. This looks just like a total factor productivity shock (TFP) in a real business cycle model. On top of this, the model also generates a "labor wedge" in the sense of Chari et al. (2007). This result is very promising because Ohanian and Raffo (2012) find that a TFP and a labor wedge characterized the great recession. More precisely, they find that the US recession is mainly accounted for by a negative labor wedge, while the European recession was affected by a negative TFP shock. This result

[5] This is similar to the other papers that have a matching friction in the goods market such as Storesletten et al. (2011).

challenges the common view that the recessions had a similar impulse, or that the two economies can be described by the same theory. However, this model reconciles this puzzle because it generates a labor recession, or a TFP recession depending on the severity of the search friction: with a tighter search friction, the model is more consistent with Europe while with looser search friction, the labor wedge plays a predominant role as in the US.

2 Literature Review

Besides the mentioned literature on money and search, there are other literatures this paper relates to.

There is a growing literature that incorporates search frictions in the goods market: examples include Storesletten et al. (2011), Huo and Ríos-Rull (2013), Petrosky-Nadeau and Wasmer (2011) and Den Haan (2014) and Duras (2014). The main contribution to this literature is to use the search friction in the goods market to construct a theory of liquidity, a key variable in the financial crisis debate.

The paper is also related to a large literature on financial multipliers surveyed in Gertler and Kiyotaki (2013). Recently, liquidity has been considered in macroeconomic models by several authors. In Kiyotaki and Moore (2012), liquidity refers to the ability to resell existing equity. A drop in resaleability constrains entrepreneurs ability to invest because they are subject to a collateral constraint. In both that model and the one in the present paper, a negative shock is recessionary. However the channels are rather different: in Kiyotaki and Moore (2012) the notion of liquidity results in a constraint to supply goods (in particular capital goods). Here the search friction induces a drop in the ability of firms to sell goods, thus it can be associated to a negative demand shock.[6]

Following Chari et al. (2007) who argued that labor wedges can account for 2/3 of the fluctuations in output, a growing literature is aiming at generating

[6]See Shi (2012) and Cui and Radde (2014) for an analysis of the liquidity channel in Kiyotaki and Moore (2012).

recessions with this feature. See for instance Bai et al. (2011), Lopez (2012) and Duras (2014). This paper contributes to this literature by showing a mechanism that incorporates both TFP and labor wedges and offering an explanation for the US and European discrepancy shown in Ohanian and Raffo (2012).

3 The Model

The novelty of this model is to introduce a liquid asset into a neoclassical business cycle model. Demand for this liquid assets arises from a search friction in the market for goods. The liquid asset is not subject to this friction. Thus this asset is liquid in the sense that it can be acquired easily.

3.1 Setup

Time is discrete and continues forever. The economy is populated by a continuum of measure one of households that live forever. In each period there is a continuum of measure one of static firms that produce with a neoclassical production function of labor and capital. There is a storable object, called money, which is intrinsically useless. As in the standard neoclassical model, in each period there is a market for goods for consumption and investment purposes, a market for labor and a market for capital. In the markets for labor and capital, firms demand these inputs, which are supplied by the agents. These two markets are competitive and clear at the beginning of the period. Instead, the market for goods is subject to a search friction: in this market firms offer their production capacity y_s, and agents have a budget to spend y_d. The search friction implies that only a fraction $\phi \leq 1$ of y_s is sold and a fraction $\psi \leq 1$ of y_d is spent. Thus an amount $y \leq Min(y_s, y_d)$ is traded. These fractions come from a constant returns to scale matching function $\mu(y_d, y_s)$. So that $\psi = \mu/y_d$ and $\phi = \mu/y_s$ can both be expressed as a function of market tightness $\theta = y_s/y_d$. In particular, the matching function is such that: $\psi(0) = 0$, $\psi(\infty) = 1$ while $\phi(0) = 1$; it is also assumed that ψ and ϕ are differentiable with $\psi'(\theta) > 0$ and $\psi'(0)$ positive and finite, $\phi'(\theta) < 0$ and $\phi'(0) = 0$.

This way to represent a search friction, with goods demand and supply directly entering the matching function is not conventional in the literature. The related literature assumes that the search friction is about the ability of firms and buyers to meet, but once they meet, they have no problem trading (e.g Diamond, Lagos Wright, Victor, Petrosky-Nadau and Wasmer ...). Here the probability for a firm to meet a worker and for a worker to meet a firm are both equal to one. The problem is that the household will only buy goods for a share of its budget. In this sense, the search friction here goes back to Kiyotaki and Wright (1989), where people meet but may not like each other's good. As it is usual with matching functions, the matching process is obscure. One can think of firms as offering a variety of goods where customers only partially succeed in finding their favorite goods and thus leave some of their allocated budget unspent.[7]

It is assumed here that all firms trading in a market with tightness θ sell a deterministic fraction $\phi(\theta)$ of their production capacity and all agents buy a deterministic fraction $\psi(\theta)$ of their allocated budget, this implies a representative household and a representative firm. One can interpret this as the outcome of an insurance market that redistributes goods and revenues among agents and firms under the law of large numbers. Importantly, this is not as assuming a big family as done by Shi (1997); here, insurance markets do not prevent each agent to act in their own best interest while there, individual incentive conditions are not taken into account as the agent acts in the interest of the entire household. The big family assumption is necessary in Shi because to highlight the role of money as resolving the double coincidence of wants problem, he

[7]A possible microfoundation goes as follows: the number of varieties produced is proportional to total output. The household's preference for varieties is such that the larger the budget, the larger the set of varieties she allocates her budget on. If some varieties are not found, the household cannot spend the money on the found varieties (a simple way to microfound this is with a ranking over varieties and assuming saxiety in the consumption of each variety, this implies that the amount desired of each variety does not increase with the budget). Then for a given amount of production (and varieties), the larger the household's budget the larger the varieties demanded relative to the varieties supplied, the higher ϕ and the smaller ψ. On the other hand the larger the supply, the lower ϕ, and the higher ψ. This explicit description of the matching process can be put down in math but the implied behavior of ϕ and ψ is captured by a simple matching function.

needs individuals trading in pairs, either in the form of barter or money versus goods. Here the trade is between many firms and many households (multilateral trades in Shi would resolve the double coincidence of wants problem). In this model there is not a lack of the double coincidence of wants: firms always accept what the household has to offer (money or a perfectly enforceable bond issued by firms) but each household may or may not buy the good offered by a particular firm. In this contest it is not necessary to model bilateral trades.

3.2 Households

A household wakes up with capital k and liquid goods m, and she knows the aggregate state Ω: the aggregate capital stock K, the amount of liquid assets M and a vector of shocks to be defined later. She solves the following problem:

$$V(k, m, \Omega) = \max_{\{c,k',n,m'\geq 0,y_d\geq 0,\theta\geq 0\}} u(c, n) + \beta EV(k', m', \Omega') \tag{1}$$

$$s.t. \quad p(\theta)y_d \leq p_m(m + dm) + wn + kr, \tag{2}$$

$$c + k' - k(1 - \delta) \leq \psi(\theta)y_d, \tag{3}$$

$$p_m m' \leq p(\theta)y_d (1 - \psi(\theta)). \tag{4}$$

Where β is the discount factor. The utility function $u(\cdot)$ is increasing in consumption c, and decreasing in labor n. The function u has the usual properties necessary for a concave problem. y_d is the amount of funds available to spend in goods or on the liquid asset in the current period. w is the wage rate, r the rental price of capital. $p(\theta)$ is the price of goods, which following the directed search protocol in Moen (1997), is function of market tightness $\theta = \frac{Y_s}{Y_d}$, where Y_s is production capacity of firms offering their goods in that sub-market and Y_d is the amount of goods the households are willing to buy. Households take the function $p(\theta)$ as given. However, they choose the market segment in which to search, distinguished by the price p and the probability ψ, both functions of the market tightness θ.[8] p_m is the price of the liquid asset m, dm a lump sum money injection. The household takes w, r and p_m as given.

[8]The competitive search is adopted here because it does not add a bargaining inefficiency, thereby not introducing a further element of departure from the neoclassical framework.

The prime $'$ indicates next periods variables. Rational expectations are taken over Ω' given Ω.

In equation (2), $p_m m + wn + kr$ amounts to the available funds the household wishes to spend. She chooses a market indexed by θ where goods cost $p(\theta)$ per unit, so y_d is the amount of physical goods she can buy.

Equation (3) shows that only a fraction ψ of demand y_d is matched with investment and consumption goods. What is left is invested in liquid assets as shown in Equation (4).

Notice that ψy_d is not equal to $p_m(m+dm)$, so agents need not to use money to buy goods, this is in contrast to the money and search literature. Indeed, absent the friction, they would use their entire y_d for purchasing goods, so they also spend $wn+kr$. Taking seriously the timing of the model, the inputs cannot be payed before revenues are maid. Therefore, implicit in this structure there is a bond issued by the firms at the beginning of the period of value $wn + kr$; then, the households can use this bond, and or money, to pay the firm and by goods. The residual bond is then redeemed by the firm at the end of the period. This is a common assumption implicit in the neoclassical model. It is worth pointing it out here, because it highlights the fact that there is no cash constraint in this model.

In an interior solution, the first order conditions and the envelope conditions can be arranged as follows:

$$u_c = \lambda_c \tag{5}$$

$$u_l = -\lambda_{yd} w, \tag{6}$$

$$\lambda_{yd} p = \lambda_c \psi + \lambda_m p(1-\psi), \tag{7}$$

$$\lambda_c = \beta E\left(\lambda'_{yd} r' + \lambda'_c(1-\delta)\right). \tag{8}$$

$$\lambda_m p_m = \beta E\left(\lambda'_{yd} p'_m\right) \tag{9}$$

$$-\lambda_{yd} p_\theta + \lambda_c \psi_\theta + \lambda_m \left(p_\theta(1-\psi) - p\psi_\theta\right) = 0 \tag{10}$$

where λ_{yd}, λ_c and λ_m are Lagrange multipliers on constraints (2), (3) and (4). u_c and u_n represent the partial derivatives of the utility function. p_θ and ψ_θ

are the derivatives of the price and the probability functions with respect to θ. The household's problem is solved by a non explosive solution to these first order conditions.

Equation (7) shows that the value of an extra unit of y_d, $\lambda_{yd}p$, is equal to the sum of the other two lagrange multipliers times how much the two constraints are relaxed: ψ and $p(1-\psi)$ respectively. This equation also shows that if $\psi = 1$ then $\lambda_{yd} = \lambda_c$. Then, from Equations (5) and (6) follows that if $\psi < 1$, then there is a wedge in the labor supply condition in the sense of the business cycle accounting approach developed by Cole and Ohanian (2002) and Chari et al. (2007).

(10) is the choice of the sub-market, characterized by a market tightness θ: the first term shows a cost of increasing θ because p increases, the second term shows a benefit due to the resulting increase in ψ, the final term shows the effect on money holdings: the first term in the bracket shoes that the increase in price holding ψ constant implies more money holdings, the second term captures the fact that as ψ increases, a smaller share of available funds y_d is invested in money.

3.3 Firms

Firms produce goods used for consumption and investment. Their maximum production capacity is given by the following Cobb-Douglas technology:

$$y_s = Ak^{\alpha}n^{1-\alpha}, \tag{11}$$

where k and n are the capital and labor inputs and A is a productivity parameter which follows a Markov process.

The problem of a generic firm is to choose how much capital and labor to hire, the specific sub-market to go to indexed by the market tightness θ. This will affect ϕ the probability of selling each unit of their goods.

$$\max_{\theta,k,n} p(\theta)\phi(\theta)Ak^{\alpha}n^{1-\alpha} - wn - rk$$

The first order conditions for k and n are

$$r = p(\theta)\phi(\theta)\alpha A k^{\alpha-1} n^{1-\alpha}, \tag{12}$$

$$w = p(\theta)\phi(\theta)(1-\alpha) A k^{\alpha} n^{-\alpha}. \tag{13}$$

They will choose the market tightness that gives the highest revenue per unit of good

$$\xi = \max p(\theta)\phi(\theta). \tag{14}$$

3.4 Matching

I assume the following constant elasticity of substitution matching function:

$$Y = z_m^{1/\rho} \left(\alpha_m Y_s^{\rho} + (1-\alpha_m) Y_d^{\rho}\right)^{1/\rho}. (15)$$

where z_m is a parameter, Y_s is firms total capacity and Y_d consumers' aggregate demand. This specification is convenient because as ρ approaches minus infinity, the function converges to $\min(Y_s, Y_d)$, and the model boils down to a perfectly competitive model where firms and households take the price as given and the goods market clears in equilibrium. With $\theta = \frac{Y_s}{Y_d}$, the probabilities are given by the following equations:

$$\psi(\theta) = \frac{Y}{Y_d} = z_m^{1/\rho} \left(\alpha_m \theta^{\rho} + (1-\alpha_m)\right)^{1/\rho}, (16)$$

$$\phi(\theta) = \frac{Y}{Y_s} = \frac{\psi(\theta)}{\theta}. \tag{17}$$

3.5 Equilibrium

Before defining an equilibrium, it is useful to notice that the price of goods p can be the numeraire even though its a function of θ. In other words, the function $p(\theta)$ has some slope, but the intercept is undetermined, so it is possible to assume $p(\theta) = 1$ for some level of θ. It is convenient to choose $p = 1$ for the equilibrium value $\theta = \frac{Y_d}{Y_s}$.

To see this notice that conditions (16) and (17) imply the following resource constraint: $\psi(\theta)Y_d = \phi(\theta)Y_s$. This constraint, together with the firm's conditions (12) and (13) and budget constraints (2) and (4) and the market clearing condition for liquid assets $m' = m$ imply

$$p(c + k' - k(1-\delta)) = p\phi Y_s.$$

This condition is satisfied for any price p. So it is possible to put $p = 1$ when $\theta = \frac{Y_d}{Y_s}$. Similarly, it is possible to show that all other equilibrium conditions are unaffected by the level of p.

Definition 1 *Given a monetary policy $dm = f(\Omega)$, an equilibrium is composed of a value function V and decision rules c, k', n, y_f, y_d, m', θ for the households as function of the state (k, m, Ω), where $\Omega = K, M, A, z_m$, and K is the aggregate capital stock. Probabilities ϕ and ψ, prices r, w, p_m, revenues per unit of production ξ, aggregate demand Y_d and aggregate production capacity Y_s, aggregate labor N all functions of Ω, such that the following conditions are satisfied:*

1. *The household's decision rules and the value function solve the household problem in 3.2.*

2. *Capital, labor inputs and ξ satisfy conditions (12)–(14).*

3. *The goods and the liquid asset markets clear:*

$$\psi Y_d = \phi Y_s, \tag{18}$$

   where ψ, ϕ satisfy conditions (16), (17).

$$m' = m + dm.$$

4. *Aggregate variables are consistent with individual decisions, i.e. $M' = m'$, $K' = k'$, $N = n$ and $\theta = \frac{Y_s}{Y_d}$, where $Y_d = y_d$ and Y_s satisfy Equation (11).*

5. *z_m and A follow stationary stochastic processes of order one.*

4 Characterization

The following proposition highlights the role played by the search friction on the demand for money.

Proposition 1 *If $\psi = 1$ then money has no value.*

Proof. From equation (4) it follows that if $\psi = 1$ then $p_m m' = 0$. Since in equilibrium $m' = m + dm > 0$, then $p_m = 0$. ■

The proposition highlights how a demand for money arises as a left-over from the demand of goods: another way to say this is that $\psi < 1$ is a necessary condition for an equilibrium in which money has value. If $\psi = 1$, the budget set of the household described by equations (2)—(4), boils down to the familiar neoclassical budget constraint

$$c + k' - k(1 - \delta) \leq wn + kr. \tag{19}$$

Indeed with no search frictions ($\psi = \phi = 1$), the model boils down to the real business cycle model.

It is also possible to show that money is neutral but not superneutral.

Proposition 2 *Money is neutral but not superneutral.*

Proof. To show neutrality, take an equilibrium allocation and change the constant money supply from $m > 0$ to zm with $z > 0$. It is possible to pick $\hat{p}_m = p_m/z$ so that all equilibrium conditions are satisfied: the equilibrium conditions in which money or p_m appear are (2), (4) and the Euler equation for money, (9). Since $\hat{p}_m zm = p_m m$, equations (2) and (4) are satisfied with the original equilibrium allocation. In the Euler equation (9), the price enters as a ratio p'_m/p_m but this ratio is equal to $\hat{p}'_m/\hat{p}_m$.

Superneutrality does not hold because the Euler equation (9) depends on p'_m/p_m. Thus the inflation rate affects the multipliers λ_{yd} and λ_m. It follows from the other first order conditions that the allocation is also affected. ■

Since money is not superneutral, the following section discusses monetary policy in order to acheive efficiency.

4.1 The Friedman rule is optimal

To discuss optimal monetary policy it is first necessary to define efficiency.

Definition 2 *An allocation* $\{c, n, k'\}$ *is said to be efficient if it solves the following planner problem:*

$$\widetilde{V}(\Omega) = \max_{\{c,k',n,\theta\leq 0\}} u(c,n) + \beta E\widetilde{V}(\Omega') \tag{20}$$

$$s.t. \quad c + k' - k(1-\delta) = \phi(\theta) A k^{\alpha} n^{1-\alpha}. \tag{21}$$

where ϕ *is defined by* (16) *and* (17).

This problem is peculiar because the planner is free to choose θ. It is obvious that the planner would choose $\theta = 0$, this way $\phi = 1$. As shown below, this coincides with the market equilibrium at the Friedman rule. Before showing that, it is useful to see why this is the natural definition of a planner problem where the planner is only constrained by the physical constraints, including the search friction.

To isolate the physical constraints it is useful to start from the household problem and get rid of money.

From equations (2) and the first order conditions of the firm, equations (12)—(13), one gets

$$y_d = p_m(m + dm) + \phi A k^{\alpha} n^{1-\alpha}, \tag{22}$$

since $m' = m + dm = M'$, it is possible to substitute out $p_m(m + dm)$ from equation (4) and get the goods market clearing condition:

$$\psi(\theta) y_d = \phi(\theta) A k^{\alpha} n^{1-\alpha}. \tag{23}$$

The only other condition that needs to be satisfied is equation (3). With the exception of the matching function already subsumed in the functions ψ and ϕ, all other equations describe the optimal choices in the market equilibrium and thus can be ignored. Substituting out y_d from (3) and (23) one gets the resource constraint in the planner definition, equation (21).

The reason why the planner is free to choose θ, is because equation (23) is satisfied for any θ. To see this recall that $\theta = Ak^{\alpha}n^{1-\alpha}/y_d$, and notice that from equations (16) and (17), $\psi(\theta)/\phi(\theta) = \theta$.

Intuitively, the planner can tell households what market-tightness to pick without violating any constraint. Any θ is feasible because y_d adjusts accordingly.

This extreme result depends on the fact that aggregate demand is an endogenous variable which is free to adjust to the value that supports any market tightness.

To understand this it is useful to draw a comparison with models of search in the labor market such as Mortensen and Pissarides (1994); there market tightness is given by the ratio between vacancies and unemployment; unemployment is a state variable, vacancies are bounded because costly to post. If vacancies were free to post, free entry would imply infinite vacancies. Later the matching process is modified to also include effort, this will pin down y_d. But this simpler case is useful to highlight the role of y_d and to link it to the role of money: the next proposition shows that this efficient result is implementable in the market equilibrium at the Friedman rule. The intuition behind the proof highlights the role money plays as a medium of exchange.

Proposition 3 *In the deterministic steady state of a monetary equilibrium (in which money has positive value), the market choice of θ is efficient when* $\frac{p'_m}{p_m} = \frac{1}{\beta}$.

Proof. The first order condition for θ of the planner problem is

$$-\widetilde{\lambda}_c \phi_\theta A k^{\alpha} n^{1-\alpha} = 0 \tag{24}$$

which is solved by $\phi_\theta = 0$, or $\theta = 0$. I now derive the market solution. As explained in Moen (1997), from equation (14) it follows that for there to be a continuum of markets indexed by θ, the price menu $p(\theta)$ has to make firms indifferent, i.e. $\xi = p(\theta)\phi(\theta)$. Differentiating this condition one gets

$$p_\theta = \frac{-\xi}{\phi^2}\phi_\theta.$$

Substituting this condition in the household's first order condition for θ, equation (10), one gets:

$$\phi_\theta = -\frac{\psi_\theta\left(\lambda_m - \lambda_c\right)\phi^2}{\xi\left(\lambda_m(1-\psi) - \lambda_{yd}\right)}. \tag{25}$$

In a deterministic steady state in which money has positive value, $\lambda_{yd} - \lambda_m = 0$ iff $\frac{p'_m}{p_m} = \frac{1}{\beta}$, this follows from equation (9). In this case also $\lambda_c - \lambda_m = 0$ from (7). From equations (5) and (7), it also follows that $(\lambda_m(1-\psi) - \lambda_{yd}) = -\lambda_c\psi < 0$. Since ξ and ψ_θ are both positive and finite, it follows from equation (33) that $\phi_\theta = 0$. ■

Corollary 1 *If inflation is above the Friedman rule, then $\theta > 0$ and $\phi < 1$ in steady state.*

Proof. From equation (9), $\lambda_{yd} - \lambda_m > 0$. In this case equation (33) implies $\phi_\theta > 0$ (this implication is shown following the same procedure as in the previous proof). ■

Proposition 4 *In a deterministic steady state with positive output, the value of money is infinity at the Friedman rule and bounded when inflation is above the Friedman rule.*

Proof. It has been shown that θ is equal to zero at the Friedman rule and $\theta > 0$ when inflation is above the Friedman rule. Since output is positive and bounded, $\theta = 0$ iff $y_d = \infty$, and $\theta = 0$ iff y_d is finite. Then (22) requires $p_m(m + dm) = \infty$ when $\theta = 0$ and $p_m(m + dm)$ finite otherwise. ■

A possible intuition for the Friedman rule and the value of money goes as follows: the private benefit from choosing a market with low θ is that $p(\theta)$ is lower thus y_d is larger. The private cost is that ψ is lower and more savings have to be made in the form of money. When money is a dominated asset in terms of return, this trade off implies an optimal θ greater than zero, so money is bounded. But at the Friedman rule money gives the same return as capital, so there is not cost in saving in money rather than in capital. So they only see the benefit of choosing a market with low θ and thus they choose $\theta = 0$, where y_d and $p_m m'$ are at infinity.

4.2 Money is essential

A final way to appreciate the role of money is to think of the non monetary equilibrium: what would happen if people expected future prices $p'_m = p''_m = ...$ equal to zero? With no value for money from the next period, from equation (9), either $p_m = 0$, or $\lambda_m = 0$, or both.

If $p_m = 0$, from equations (2) and firms's first order conditions, $y_d = \phi k^\alpha n^{1-\alpha}$. Then the resource constraint (21) implies $\psi = 1$ and $\theta = \infty$, which in turns implies $\phi = 0$. Since production is bounded, firms would not sell any goods, and from equation (3) consumption would be equal to negative investment, depleting capital.

If $\lambda_m = 0$, equation (4) is not binding, so it is possible to have $y_d(1 - \psi) > p_m m' \geq 0$. In this case $\psi < 1$, so agents choose $\theta < \infty$, which implies $\phi > 0$ and some production would take place. However equation (7) suggests that other things equal, the lower λ_m, the higher ψ, which implies a lower ϕ. So with $\lambda_m = 0$, if production takes place at all, it would be inefficient in the sense that ϕ would be lower than in the monetary equilibrium. This nightmare helps appreciating the role of money in this model perhaps more than anything else.

5 Quantitative exercise

The matching function used so far keeps the model simple and highlights the role of money as a medium of exchange, but it might be unsuitable for quantitative analysis. Here, I consider an alternative matching function where aggregate demand has to be combined with a financial service, produced with labor.[9] Then, as an application I study the response to a shock to the ability of financial services to match aggregate demand and aggregate supply.

[9] The limit case where only the labor input enters the matching function relates to the growing literature that considers search frictions in the goods market to endogenize the Solow residual such as Storesletten et al. (2011).

5.1 Extended matching process

Let the household problem be

$$V(k,m,\Omega) = \max_{\{c,k',m',n,n_f,y_f,a,\theta\}} u(c,n,n_f) + \beta EV(k',m',\Omega') \tag{26}$$

$$s.t. \quad p_f y_f + p(\theta)a \leq p_m m + wn + w_f n_f + kr, \tag{27}$$

$$y_d = s(a, y_f), \tag{28}$$

$$c + k' - k(1-\delta) = \psi(\theta) y_d,$$

$$p_m m' = p(\theta)(a - \psi(\theta) y_d). \tag{29}$$

The utility function $u(\cdot)$ now distinguishes between n, labor supplied to the goods sector, and n_f, labor supplied to the financial sector.[10] y_f denotes financial services, purchased at price p_f with no frictions. a is the amount of funds available to spend in goods or on the liquid asset in the current period. w and w_f are the wage rate in the goods and financial sector.

The function $s(\cdot)$ in Equation (28) transforms available funds a and financial services y_f into actual demand for goods, y_d. The function s is increasing and concave in the two inputs. This function captures the idea that buying goods does not only require funds, but also some other activities, such as the acquisition of information, management and monitoring activities. Because of this, agents choose to leave some of their total savings a, liquid. The equation after equation (28) is identical to (3), and it is rewritten for the convenience of the reader. The available funds a not exchanged for goods are invested in liquid assets as shown in Equation (29).

As before, all markets other than the good market are competitive, thus the household takes w, w_f, r and p_m as given.

The prime $'$ indicates next periods variables. Rational expectations are taken over Ω' given Ω.

The conditions for k' and m' are unchanged and y_d can be substituted out from (28) into the other equations. The first order conditions for n_f and y_f, a and θ are reported:

[10] It is not crucial that labor in the two sectors is not perfectly substitutable, but it helps in the quantitative section.

$$u_{n_f} = -\lambda_{bc} w_f \tag{30}$$

$$\lambda_{bc} p_f = (\lambda_y - \lambda_m p) s_{y_f} \psi \tag{31}$$

$$\lambda_{bc} p = \lambda_y \psi s_a + \lambda_m p (1 - \psi s_a), \tag{32}$$

$$-\lambda_{bc}(p_\theta a) + \lambda_y \psi_\theta s - \lambda_m (p_\theta (s\psi - a) + ps\psi_\theta) = 0 \tag{33}$$

where λ_{bc}, λ_y and λ_m are Lagrange multipliers on constraints (27), (3) and (29). s_a and s_{y_f} represent the partial derivatives of the function s and u_{n_f} the partial derivatives of the utility function for n_f.

Equation (32) equates the marginal cost of saving $\lambda_{bc} p$ with the marginal gain: the sum of the other two lagrange multipliers times how much the two constraints are relaxed: ψs_a and $p(1 - \psi s_a)$ respectively.

Equation (30) is the first order condition for n_f.

Equation (31) is the first order condition for y_f. This equation sheds light on why the liquid asset can have positive value even though its yield is lower than that of capital.

The left-hand side measures the marginal cost of increasing y_f. The right-hand side is the marginal gain: the portfolio share of capital increases by ψs_{y_f}, this relaxes the resource constraint by λ_y and tightens the the liquidity constraint by $\lambda_m p$ because it reduces liquid assets' holdings. For a positive interior solution for y_f, $\lambda_y > \lambda_m p$, i.e. capital investment is more valuable than liquid assets.

It is worth noticing that now, even abstracting from the search friction ($\psi = 1$), the demand for m can be positive while its return is lower than that of capital ($\lambda_y > \lambda_m p$). The liquid asset is demanded because one saves on the the financial service y_f.

(33) is the choice of the sub-market characterized by a market tightness θ. The equation is slightly different than the case without financial services, equation (10): the left-hand side shows marginal cost associated to choosing a market with a higher price and market tightness θ, the left-hand side shows

the gain from the resulting higher probability ψ. Implicit in this condition there is the assumption that agents cannot choose different submarkets for consumption and investment (it would be interesting to know how much bite this assumption has).

The household's problem is solved by a non explosive solution to the first order conditions.[11]

Financial firms are competitive; they use a linear technology on labor and solve the following problem taking prices as given:

$$\max_{n_f} p_f A_f n_f - w_f n_f.$$

A_f follows an AR1 process:

$$log(A'_f) = \rho_a log(A_f) + \varepsilon \tag{34}$$

where ε is an i.i.d normal random variable with zero mean and finite variance σ^2.

The matching function remains unchanged. But to highlight the role of y_f in the matching process, it would be possible to rewrite the matching function to include the financial service y_f by substituting Y_d through Equation (28). That notwithstanding, probabilities ϕ and ψ remain function of one market tightness.

To the equilibrium definition (1), it is now necessary to include A_f in Ω, define y_d as in Equation (28), add the financial labor demand $w_f = p_f A_f$, and a market clearing condition for n_f and for the financial good: $y_f = A_f n_f$.

The numerical exercise consists on the response to a shock to A_f. The next Section calibrates the model.

5.2 Calibration

This model shows several departures from the typical dynamic general equilibrium framework and to be useful, it should be possible to parameterize it

[11]Numerically, the model converges to a unique steady state. Therefore, the solution does not violate transversality conditions and the function $V(\cdot)$ that solves equation (26) is finite.

convincingly but some variables, such as the function s and the probability ψ, have no clear counterpart in the data. Fortunately, most of the parameters of this model can be identified by steady state restrictions and long run averages.

I take a period to be a quarter of a year. α determines the capital share of output in the goods sector and is equal to 0.36. δ is equal to 0.014, the average depreciation rate of total capital calculated by Cummins and Violante (2002).

The utility function is

$$u = log(c) - \chi_n \frac{n^{1+1/\nu_n}}{1+1/\nu_n} - \chi_f \frac{n_f^{1+1/\nu_f}}{1+1/\nu_f}.$$

χ_n and χ_f are such that $n + n_f$ are equal to 1/3 in steady state and n_f is 18% of total hours. The Frisch elasticities of labor supply ν_n and ν_f are equal to 0.7. This number is in the range of micro estimates: see Chetty et al. (2011) for a recent survey. Macro studies tend to choose higher elasticities to generate more propagation but it is not necessary here as the model generates more propagation than typical business cycle models.

5.2.1 The Matching Function

The parameters of the matching function are ρ, z_m, and α_m. I target a probability of selling goods ϕ in steady state equal 0.805: such is the average capacity utilization between between 1967 and 2014. The available data do not offer a restriction for ψ so I set it equal to ϕ. Sensitivity analysis shows that results are robust to alternative values of ψ.

z_m and α_m have to be such that Equations (15) and (33) are satisfied given the steady state value for the other endogenous variables to be determined later. This gives values of 0.9 for z_m and 0.967 for α_m.

A restriction on ρ is that with too little complementarity, the household's first order condition for θ does not maximize the objective function of the household. Interestingly, the Cobb-Douglas case ($\rho = 0$), often assumed in the search literature, has too little complementarity for the problem to be concave. Increasing complementarity toward the perfect competition case of $\rho = -\infty$ is necessary to make the slope of marginal cost larger than that of the marginal gain. See Figure 1: in the upper panels the marginal cost cuts the marginal gain from below, this insures that the objective function is increasing at the right of the crossing point and decreasing thereafter. The opposite is true in the lower panels, so that the crossing point is not a maximum. Since the Cobb-Douglas case is a benchmark, I choose to stay close to it under the restriction that the problem stays concave in steady state: $\rho = -1$. Sensitivity to this parameter is discussed later.

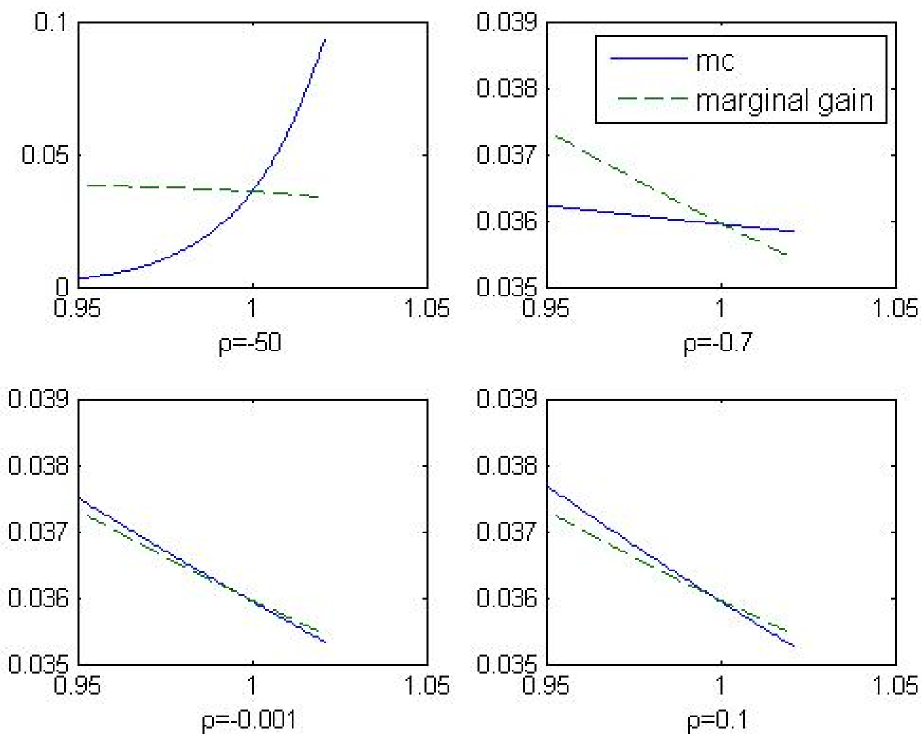

Figure 1: First order condition for θ; condition (10)

5.2.2 The Financial Sector

The financial sector consists of the productivity parameter A_f and the "shopping" function s, for which I choose the following specification:

$$s(a, y_f) = a^\lambda y_f^{1-\lambda}. \tag{35}$$

The parameters A_f, λ, and the discount factor β are jointly determined to match a capital-GDP ratio of 10, the size of the financial sector, and the value of money as a share of GDP. The financial sector $p_f y_f$ is equal to the 18% of GDP: this is the average output share of finance, insurance, real estate, rental, and leasing. Money supply $p_m m$ is set to 23% of GDP; this is the average share of GDP of all US commercial banks assets invested in cash and securities other than loans. GDP in the model is defined as follows:

$$GDP = \phi y_s + p_f y_f. \tag{36}$$

To see why these three moments pin down these three parameters notice that first order conditions for k', m' and a—Equations (8),(9) and (32)—imply the following steady state condition

$$r = \left(1 + \frac{1-\beta}{\psi s_a \beta}\right)(1 - \beta(1-\delta)). \tag{37}$$

r is pinned down through the capital-output ratio as from the goods firm first order condition $r = \alpha\phi y_s/k$. Given r, Equation (37) shows a relationship between s_a and β (ψ has already been fixed and in any case this subsection is almost completely insensitive to it). s_a and β also affect the lagrange multiplier λ_{bc} through the first order condition for a, Equation (32). So given λ_{bc}, Equations (32) and (37) pin down s_a and β.

λ_{bc} is determined through the effect it has on the size of the financial sector. More precisely, λ_{bc} affects w_f, which in turn affects p_f through the first order condition for the financial firm $p_f = w_f/A_f$. p_f and A_f jointly determine the size of the financial sector $p_f y_f$. A_f is pinned down through the target money supply (it can be shown that the money target implies a ratio a/y which depends on A_f and other variables and parameters already determined).

The resulting β is 0.99 and s_a is 0.055. Given the function s, it is then possible to solve for λ. Intuitively, the low value found for s_a means that financial services are important: holding financial services constant, a unit increase in available funds a only leads to a 0.055 increase in aggregate demand. It is then necessary to increase y_f to be able to demand more goods.

Table 1 summarizes the parameters.

Table 1: Summary of Parametrization

Parameter	Moment to Match	Value
α	labor share	0.41
δ	Cummins and Violante (2002)	0.014
χ_n	market hours goods sector	27.9
χ_f	market hours financial sector	816.9
ν_n, ν_f	Micro estimate labor Frisch elasticity	0.7
ρ	Elasticity of Matching function	-1
z_m	ψ and ϕ	0.80
α_m	ψ and ϕ	0.82
A_f	Money supply, capital and financial sector over GDP	16.6
λ	Money supply, capital and financial sector over GDP	0.06
β	Money supply, capital and financial sector over GDP	0.99

5.3 The financial crisis

The financial crisis was characterized by a surge in the amount of assets held in liquid form. There is a vast literature about the record-high amounts of cash held by firms and corporations (see Ivashina and Scharfstein (2010) among others) and this phenomenon is not only confined to firms. Figure 2 shows the share of assets of all U.S.commercial banks invested in cash and securities other than loans and Figure 3 shows these same assets as a fraction of GDP.

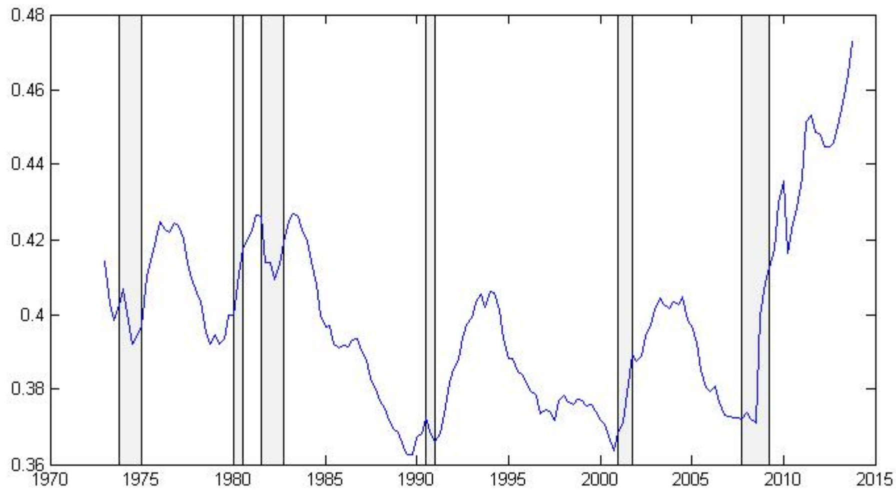

Figure 2: Cash and liquid securities over Assets
Source: Board of Governors of the Federal Reserve System. Release: H.8 Assets and Liabilities of Commercial Banks in the United States. The gray areas indicate NBER recessions starting at the peak of a business cycle and ending at the trough.

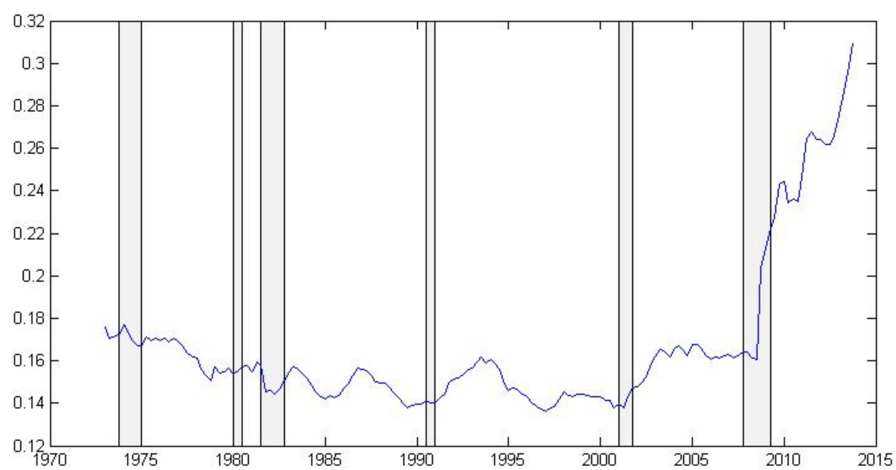

Figure 3: Cash and liquid securities of all U.S. commercial banks over GDP

Banks cash and liquid assets can be taken as an indication of aggregate savings held in liquid form after bank intermediation.[12]

[12]The most liquid form of firms and households' savings are deposits. However, banks use these deposits to issue loans and make investments, thereby neutralizing the liquidity

These assets increased dramatically during the financial crisis. This goes well beyond the liquidity injection from the FED: Figure 4 shows bank assets decomposed by cash, loans, and other securities. There was a drop in loans and an increase in cash during the Great recession. If the increase in cash was all due to monetary injection from the FED, then the overall value of assets would have increased by the same amount.[13] In this case, loans would have not decreased. The fact they did implies that the increase in cash is larger than quantitative easing.

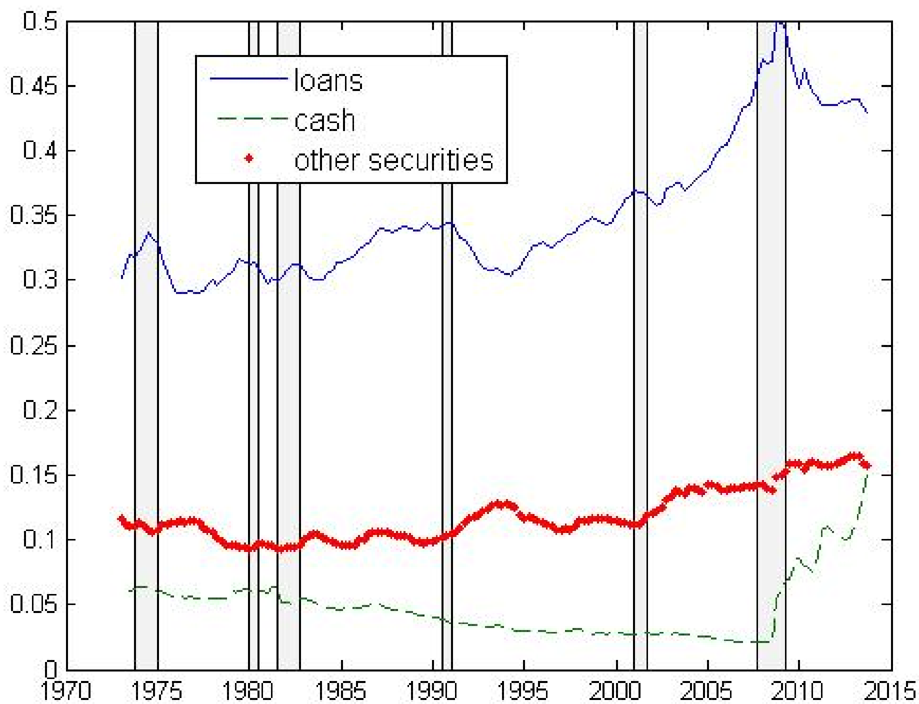

Figure 4: Asset decomposition of all U.S. commercial banks over GDP

An alternative way to appreciate the increase in liquidity beyond quantitative easing (QE) is to focus on the primary voices of banks assets and liabilities:

hoarding of households and firms. The liquidity held by the banking sector is the final amount of savings truly held in liquid form.

[13]Money injection is a liability for banks, this expands their balance sheets and other things equal, it implies a one to one increase in the total value of assets.

deposits and loans. These two voices abstract from other form of liabilities such as quantitative easing.

Figure 5 show a sharp increase of deposits minus loans during the financial crisis; deposits minus loans can be interpreted as cash not reintroduced in circulation and not due to QE. The figure also shows that this measure of cash hoarding has increased also during previous crisis where QE was not adopted.

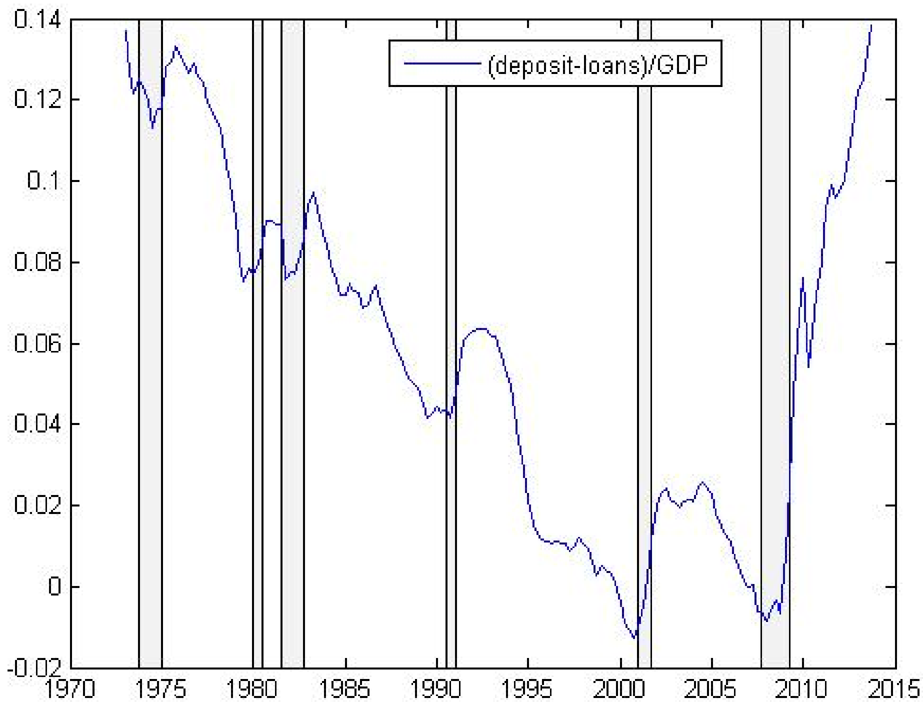

Figure 5: Deposits minus Loans all U.S. commercial banks over GDP

In this model, such a surge in liquidity can be generated by a drop in the ability of the financial sector to match the demand and supply of goods.

Liquidity Shock

What happens if A_f drops? This shock resembles an increase in information and screening, credit acquisition, monitoring, agency and retail costs.

This exercise speaks to the conjecture often present in the current economic debate that the massive increase in liquid savings is recessionary because it drives resources away from the purchase of goods. I model A_f as an AR1 with persistence 0.4: this is consistent with the conjecture that this shock is associated with recessions, which typically last for a year and a half. The size of the shock is such that liquidity over GDP increases by 5%, such as the increase of deposits minus loans over GDP during the financial crisis (south west panel in Figure 6). This is no way near the observed increase in Figure 3, which was about 30% on impact, and continued growing thereafter, but that figure also contains quantitative easing.

Figure 6 shows that GDP drops by about 3 % points. This result comes about from the fact that with less productive financial services Y_d drops (last panel in Figure 6)), this induces an increase in market tightness θ and a decline in ϕ, the probability of firms to sell their goods. This is observationally equivalent to a TFP shock in a standard real business cycle model and induce the same response of the other key variables: n, c, y, k', w, and r all drop. However, here liquidity increases and the price of the liquid asset increases, i.e. there is deflation. Liquidity increases because goods are harder to find, but there is a further endogenous reason why agents substitute capital investment to money holdings: this is because the return on capital is lower and that of money is higher because of deflation, these two facts lower the cost of holding money. Then, it is optimal to choose a market tightness with lower probability of finding goods ψ and substitute capital investment with money holdings.

The model also implies a perverse effect on the price of the financial service p_f and on wages and labor in the financial sector: they increase. In this model, a negative financial shock makes bankers richer! This may provide a rational for the general perception that the financial sector is inequitable and that it has not payed for the financial crisis it caused.

It is now possible to decompose the recession into a TFP and labor wedge as done by Cole and Ohanian (2002) and Chari et al. (2007). Figure 8 shows these wedges in the first row: the recession comes mainly from a drop in the labor wedge. Ohanian and Raffo (2012) find that this is indeed the case in the U.S. but not in Europe. This result challenges the common view that the recessions had a similar impulse. However, Figure 9 shows that reducing the complementarity in the matching function, therefore making the friction stronger, results become consistent with Europe: the productivity wedge is now magnified while the labor wedge is smaller.

Therefore, this paper suggests that the evidence in Ohanian and Raffo (2012) is due to stronger search frictions in Europe.

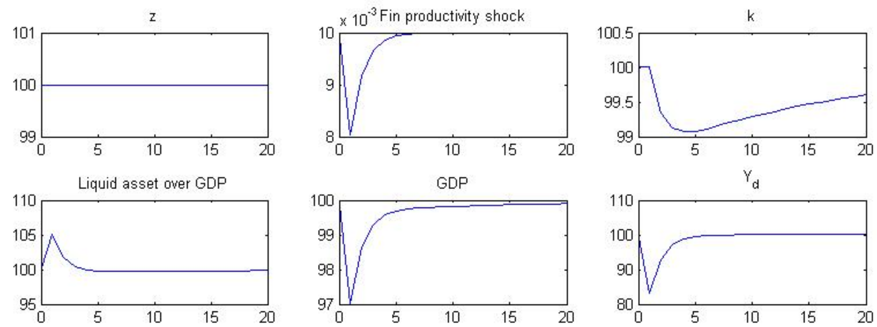

Figure 6: Impulse response functions to a financial shock

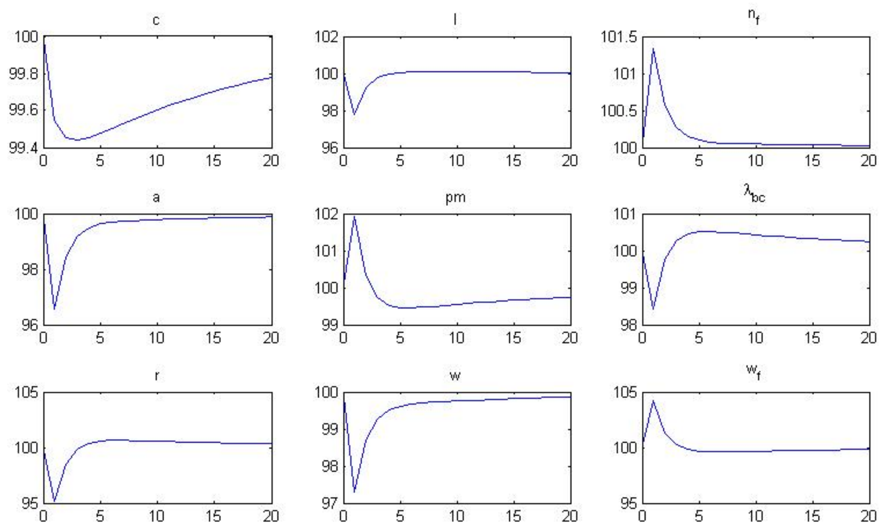

Figure 7: Impulse response functions to a financial shock

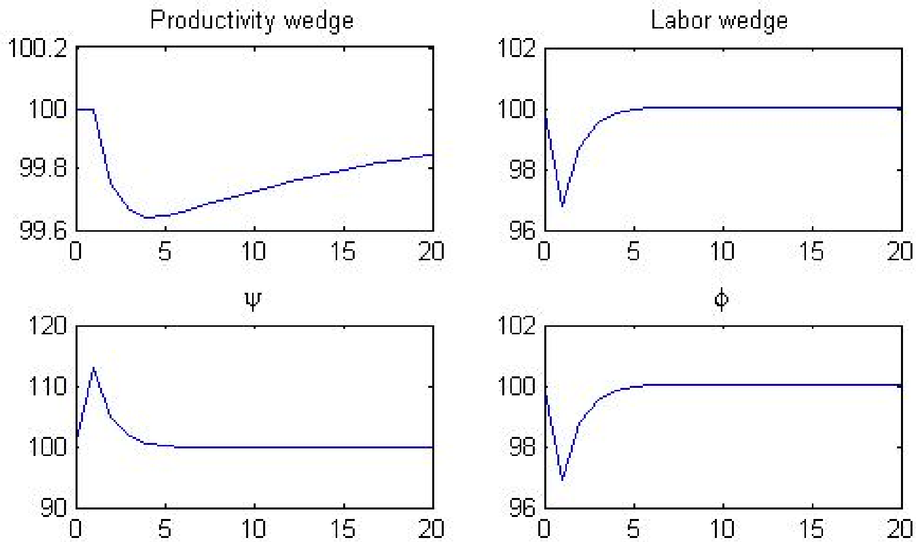

Figure 8: Wedges with low financial frictions

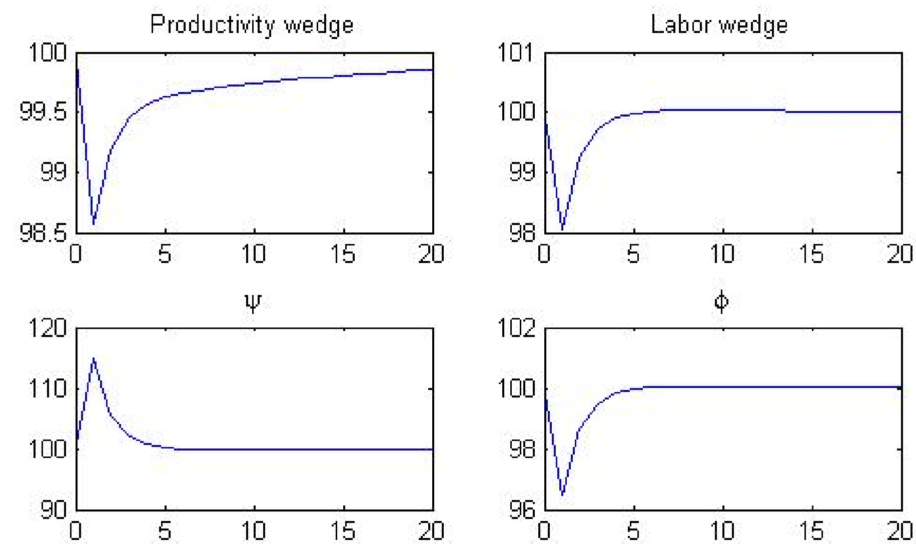

Figure 9: Wedges with high financial frictions

6 Conclusions

This paper has built a theory where liquidity resolves the need to carry over value when goods for consumption and for investment are hard to find. Like the existing literature of money and search, it relies on search frictions in the goods market, but the demand for many comes from opposite reasons. The existing theory of money relies on the lack of coincidence of wants and on the fact that trades must be quid pro quo; thus pertains to markets that do not use credit. This theory of money depends on the inability of the buyers to transform all their wealth in goods and services. Money offers a way to preserve value for that part of the wealth not transformed into goods and services. Therefore the private motive to hold money is because is a store of value. But money also has a social role as a medium of exchange: it facilitates transactions because its value increases aggregate demand and thereby, the efficiency of firms. At the Friedman rule, this social role is internalized by the agent.

Importantly, this theory of liquidity does not only apply to cash holdings in order to make quid pro quo transactions and does not require the absence of credit. Therefore, it is a candidate to explain the large amount of liquidity observed in the data despite the availability of credit.

A long with generating a theory of liquidity, another implication of the search friction in the goods market is that firms cannot sell their entire production capacity. Indeed this model implies a tight link between this excess supply of goods and the value of money: it is shown that as the search friction disappears, both the excess supply of goods and the value of money go to zero. This formal result relates to an old idea in economics which lies at the core of the neoclassical-keynesian dispute which many conjectured to have played a role in the financial crisis. The model indeed finds that a financial shock causes a recession of the observed magnitude, while generating the observed surge in liquidity. The model also offers an explanation for the fact that the crisis propagated rather differently in the US and in Europe.

A virtue of this theory is that it is incredibly simple: casted into a neo-classical model with a representative agent, it can be extended in many ways.

For instance, It would be interesting to model the financial sector further: in this model aggregate liquidity is held by the household, but in real life it is channeled through banks and other financial institutions. In particular, here households buy investment goods directly; an alternative could be to have a financial sector collecting households savings and lending to firms which then can invest. This would speak to the much talked issue of banks lending to firms, inside money, and their aggregate effects. And, if this is a fruitful way to think of monetary economics, and the economy in general, it would be interesting to study monetary and fiscal policy and see if the existing results carry over to this framework where the business cycle can arise from a lack of demand, as well as from neoclassical sources. It would also be possible to assess the role of unconventional monetary policy such as quantitative easing. Another interesting venue could be to include inventories: they would find a natural place in this model with excess supply of goods. Finally, this theory emphasizes a new reason for money demand as a store of value. An alternative reason to store money is because of precautionary savings in the presence of heterogeneous agents: it would be fascinating to extend this model to heterogeneous agents a la Aiyagari (1994), to incorporate this further demand for liquidity and study its redistributive and business cycle properties with the methods of Krusell and Smith Jr (1998).

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A Appendix

A.1 Data

The analysis is based on quarterly data from 1973Q1 to 2013Q4 because loans and deposit data are only available for these dates.

Nominal and Real GDP, consumption and investment are taken from the NIPA tables of the Bureau of Economic Analysis (BEA), Tables 1.1.5 and 1.1.6. Last revised on January 30 2014.

Consumption is defined as personal consumption expenditures on non-durables and services, while investment is the sum of personal consumption expenditures on durables and gross private domestic investment.

Hours per capita are constructed by dividing Hours by population taken from the Bureau of Labor Statistics (BLS). Hours, ID PRS85006033. Civilian Noninstitutional Population, ID LNU00000000.

Effective Federal Funds Rate (FF) from FRED Source: Board of Governors of the Federal Reserve System from 1954.III to 2012.II i.e. 1954.5 to 2012.25 http://research.stlouisfed.org/fred2/series/FEDFUNDS

Deposits and loans are taken from the Board of Governors of the Federal Reserve System Release: H.8 Assets and Liabilities of Commercial Banks in the United States

Deposits, all commercial banks, seasonally adjusted.

Loans and leases in bank credit, all commercial banks, seasonally adjusted