How does asset market liquidity affect the real economy? A quantitative assessment of the transmission channels

Miroslav Gabrovski – University of Hawaii at Manoa

Athanasios Geromichalos – University of California, Davis

Lucas Herrenbrueck – Simon Fraser University

Ioannis Kospentaris – Athens University of Economics and Business

Sukjoon Lee – New York University Shanghai

April 2025

ABSTRACT

The corporate bond market provides a vital avenue for firms to cover their borrowing needs. Moreover, the ease with which corporate bonds can be (re)traded in secondary markets affects their liquidity and, effectively, the rate at which corporations can borrow. However, the literature has also pointed out that a well-functioning secondary market can depress money demand and hurt economic activity. We perform a careful quantitative analysis of the channels through which secondary market liquidity affects the real economy in the context of a New Monetarist model. We find that a deterioration in secondary market liquidity has a negative but modest impact on output and unemployment. This small net effect, however, conceals much larger underlying forces that operate in opposite directions and largely offset each other. We also show that the results of our decomposition exercise depend on the inflation rate. Our findings highlight the importance of studying investor portfolios together with asset prices to fully capture the interaction between financial markets and the real economy.

JEL Classification: E24, E31, E41, E44

Keywords: search frictions, unemployment, corporate bonds, money, liquidity, inflation

Email: mgabr@hawaii.edu, ageromich@ucdavis.edu, herrenbrueck@sfu.ca, ikospentaris@aueb.gr, sukjoon.lee@nyu.edu

We are grateful to Lukas Altermatt, Fernando Alvarez, Michael Choi, Chao Gu, Janet Hua Jiang, Fabrizio Mattesini, Guido Menzio, Guillaume Rocheteau, Bruno Sultanum, Liang Wang, Randy Wright, Shengxing Zhang, Ashley Wumian Zhao, and Yu Zhu for useful comments and suggestions.

1 Introduction

The corporate bond market provides a vital avenue for firms to cover their borrowing needs, accounting for 55.84% of the U.S. corporate sector's total liabilities in 2024. Furthermore, the ease with which corporate bonds can be (re)traded in secondary markets affects their liquidity and, effectively, the rate at which corporations can borrow funds in the primary market (Boyarchenko, Kovner, and Shachar, 2022). Thus, the degree of liquidity in the secondary corporate bond market is paramount for economic activity since it influences firm borrowing and, consequently, output and unemployment. The aim of this paper is to perform a careful quantitative analysis of the relationship between secondary market liquidity and real economic variables in the context of a New Monetarist model with frictional labor, product, and financial markets.

In our model, a medium of exchange is necessary for transactions in the product market and money plays this role. Firms issue corporate bonds to cover their operational expenses, and these bonds can be traded in a secondary market, allowing agents to boost their money holdings if a consumption opportunity arises. Consequently, the liquidity services of corporate bonds are reflected in their price, resulting in a liquidity premium. Overall, a better functioning secondary market affects firm entry through two channels. First, it improves firms' ability to raise funds at more favorable rates, as investors are willing to pay higher prices (in the primary market) for bonds they expect to sell easily "down the road". The second channel is more subtle and refers to the agents' demand for liquid assets, which in turn influences firms' sales in the product market. A better functioning secondary market increases the agents' effective liquidity, as they have an easier time boosting their money holdings upon the arrival of a consumption opportunity. On the other hand, it also depresses the demand for money, as agents expect that if such an opportunity arises, they will have an easier time acquiring money in the secondary market. The first channel, which we dub the *asset price channel*, unambiguously increases firm entry and boosts economic activity, while the effect of the second one, which we dub the *liquidity demand channel*, depends on model parameters.

These theoretical channels are not entirely new to our analysis; they have been identified in the New Monetarist literature, albeit with different names. For example, Berentsen, Huber, and Marchesiani (2014), Geromichalos and Herrenbrueck (2016), and Huber and Kim (2019) develop models in which agents face an idiosyncratic consumption shock and can rebalance their portfolios in a secondary market after this uncertainty has been resolved. Despite important differences in their models, these papers share a common thread: a well-functioning secondary market increases the *ex post* probability of trade for agents who end up needing additional liquidity, thus inducing agents to reduce their money holdings *ex ante*. Clearly, this channel is closely linked to the second component of the "liquidity demand channel" defined earlier.[1] Since this new channel operates in the opposite direction than the common wisdom (that a well-functioning secondary market should improve welfare), studying the overall effect of secondary market liquidity on economic activity calls for a careful quantitative evaluation. The main contribution of our paper is to do exactly that, offering a numerical assessment of the real net effect of secondary market liquidity, whereas the aforementioned papers analyzed these channels only theoretically. We do so in the context of a market, namely the secondary market for corporate bonds, which is not only empirically relevant but also quantitatively important. Furthermore, incorporating financial and labor market frictions enables us to gauge the magnitude of each channel and measure its impact on output and unemployment.

To answer our research question, we employ the model of Berentsen, Menzio, and Wright (2011), extended to include the issuance of corporate bonds and a secondary market where agents can sell these bonds for money. Firms issue bonds to cover recruiting costs to enter the labor market and operating costs to produce in the goods market. Unemployed workers and firms search for each other in a Diamond-Mortensen-Pissarides (Diamond, 1982; Mortensen and Pissarides, 1994) labor market. Firms that have recruited a worker produce a special good sold in a decentralized goods market where a medium of exchange is necessary, as in Lagos and Wright (2005). In our model, money is the sole medium of exchange, but corporate bonds can be sold for cash in the secondary bond market. This *indirect* bond liquidity is crucial, as it ultimately determines the rate at which firms can borrow funds and consumers' effective liquidity, which, in turn, are important drivers of firm entry. Following the influential work of Duffie, Gârleanu, and Pedersen (2005), we model the secondary bond market as an over-the-counter (OTC) market, characterized by search and bargaining. Varying the efficiency of matching in this market is our way of capturing different levels of secondary market liquidity.

We calibrate the model to salient features of US data and study how a deterioration in secondary market liquidity affects output and unemployment. Specifically, our goal is to quantify the relative importance of the asset price channel and the two components of the liquidity demand channel for the real effects of secondary market liquidity. In what follows, for concreteness, we will refer to these as the "ex ante component" and the "ex

[1] Berentsen et al. (2014) refer to this channel as "free riding on liquidity", which we think is a fitting name: since carrying liquid assets is expensive, agents want to wait until the idiosyncratic consumption shock has been realized, and obtain liquidity in the secondary market *only* if it turns out they need it. However, all agents are ex ante identical, and this behavior (i.e., choosing to carry less money and hoping that other agents will) depresses money demand and hurts welfare.

post component" of the liquidity demand channel. The former captures the idea that a well-functioning secondary market induces agents to reduce their money holdings ex ante, as they expect to have an easier time liquidating assets, if a consumption opportunity arises. The latter captures the idea that a well-functioning secondary market allows agents ex post to allocate the money into the hands of agents who need it most.

In our exercise, we set the matching efficiency parameter in the OTC market to zero (an "asset market freeze"; see Gu, Menzio, Wright, and Zhu 2024) and perform a model-based decomposition: we shut down one channel at a time and compare the change in endogenous variables with the total effect produced in the baseline model. This allows us to compute how much output and unemployment would respond to an asset market freeze under the following counterfactual scenarios: i) if corporate bond prices did not change (which quantifies the asset price channel), ii) if agents could not readjust their money holdings (which quantifies the ex ante component of the liquidity demand channel), and iii) if both asset prices and money holdings remain fixed (which quantifies the ex post component of the liquidity demand channel). Moreover, since we model money explicitly, our framework implies that the quantitative importance of each channel depends on the cost of holding money. Hence, we repeat our decomposition exercise and report how the magnitude of each channel varies with the level of inflation.

Our main quantitative result is that the total impact of secondary market liquidity on real economic variables conceals a sizable heterogeneity among the individual channels. In particular, the ex ante and ex post components of the liquidity demand channel are substantially larger than the aggregate effect, and than the size of the asset price channel, but they cancel each other out almost completely. If agents could not readjust their money holdings after a secondary market freeze, then the resulting increase in unemployment would be three times larger than the one found in the baseline model, while the drop in output would be even greater. Agents respond to the lower matching efficiency of the asset market by making their portfolios more liquid, and they are able to undo the asset market shutdown almost completely. As a result, the magnitude of the total effect of lower secondary market liquidity in the baseline model virtually coincides with the magnitude of the asset price channel, which is negative but much smaller than either component of the liquidity demand channel.

Repeating the decomposition at different inflation levels reveals that the liquidity substitution between the two components of the liquidity demand channel depends on the inflation level. Intuitively, the higher the inflation rate, the higher the cost for consumers to hold money, and the more difficult it is to cope with the asset market freeze. Thus, the relative importance of the ex ante liquidity component falls, and the relative importance of the ex post liquidity component increases with inflation. As a result, when inflation rises above its benchmark calibration level, the two components of the liquidity demand channel do not cancel each other out anymore; now the ex post component prevails over the ex ante component. In total, higher inflation means that a deterioration of secondary market liquidity has a more profound negative effect on the real economy. It hurts economic activity through the asset price channel (as it did in the benchmark case), but also through the net effect of the liquidity demand channel, since the ex ante component that was mitigating the negative effects of the secondary market liquidity shock (in the benchmark calibration) has now weakened.

The general message of our results is that focusing exclusively on asset prices may give an incomplete account of the importance of asset liquidity for the real economy. In our model, if agents cannot rebalance their portfolios then the asset price channel severely underestimates the response of output and unemployment to a deterioration in secondary asset market liquidity. Hence, our decomposition highlights the importance of studying investor portfolios together with asset prices to fully capture the interaction between financial markets and the real economy. In this sense, the implications of our paper complement the recent work of Gabaix and Koijen (2021) and Gabaix, Koijen, Mainardi, Oh, and Yogo (2025) who highlight the importance of investor demand elasticity among different assets for a complete account of financial disruptions.

This paper is conceptually related to recent work by Cui, Wright, and Zhu (2025) who also study the impact of frictional secondary markets, but in the context of a model of capital investment. Analogously to the two components of the liquidity demand channel described above, the authors also identify that "...a well-functioning secondary market encourages primary investment since if firms have more capital than they need, it is relatively easy to sell in that market, but it also discourages primary investment since if firms want more capital than they have, it is relatively easy to buy in that market" (p. 148). Our research question is different, however, since we focus on the effect of secondary corporate bond market liquidity on firm entry and real economic activity. Moreover, by incorporating a frictional labor market into the analysis, we are able to study the effect of secondary market liquidity on output as well as unemployment.

Our paper belongs to a growing literature that extends the New Monetarist framework to include a frictional labor market and study the effects of liquidity and inflation on equilibrium unemployment. The seminal paper in this literature is Berentsen et al. (2011). We extend their framework by adding corporate bond issuance and a secondary market where these bonds can be traded. The degree of liquidity in that market affects the rate at which firms can issue corporate bonds and, consequently, firm entry and real economic activity. Other papers that explore the relationship between inflation, liquidity, and unemployment include Rocheteau and Rodriguez-Lopez (2014), Bethune, Rocheteau, and Rupert (2015), Branch, Petrosky-Nadeau, and Rocheteau (2016), Jung and Pyun (2020), Branch and Silva (2021), Bethune and Rocheteau (2021), Lahcen, Baughman, Rabinovich, and van Buggenum (2022), Gu, Jiang, and Wang (2023), van Buggenum, Ait Lahcen, Rabinovich, and Gomis-Porqueras (2024), and Gabrovski, Geromichalos, Herrenbrueck, Kospentaris, and Lee (2025).

Our paper is also related to the branch of New Monetarism that studies the role of liquidity for the determination of asset prices, e.g., Geromichalos, Licari, and Suárez-Lledó (2007), Lagos (2011), Nosal and Rocheteau (2013), Andolfatto, Berentsen, and Waller (2014), Hu and Rocheteau (2015), and Lee (2020). In these papers, assets compete with money directly as media of exchange (or collateral). The present paper adopts the concept of *indirect* asset liquidity, i.e., we explicitly model a secondary asset market and show that bonds are liquid because they can be sold in that market for money, upon the arrival of a consumption need.[2] This indirect liquidity approach has been explored in Berentsen et al. (2014), Mattesini and Nosal (2016), Geromichalos and Herrenbrueck (2016), Geromichalos, Herrenbrueck, and Lee (2023), and Madison (2019), among others.[3] As we explained, some of these papers have pointed out that a well-functioning secondary market induces agents to reduce their demand for money *ex ante*, which could hurt welfare. At the same time, a well-functioning secondary market helps the economy allocate liquidity in the hands of agents who value it most *ex post*, which is welfare enhancing. Thus, studying the effect of secondary market liquidity only at the theoretical level, as these papers have done, is not fully satisfactory. Our paper contributes to the literature by offering a careful quantitative evaluation of the various channels through which secondary market liquidity affects economic activity, within the context of an empirically relevant application.

The rest of the paper proceeds as follows. In Section 2, we describe the model environment, and, in Section 3, we analyze the equilibrium of the model. In Section 4, we describe and implement our calibration strategy. In Section 5, we perform our decomposition exercise and provide the quantitative results. Section 6 concludes the paper.

[2] Our related paper Gabrovski et al. (2025) explores the effects of financial turbulence on real economic activity with a model of direct liquidity. In that paper, bonds compete directly with money as media of exchange, and financial disruptions are modeled as shocks in the "pledgeability" of bonds. Here, our objective is to study the effect of secondary market liquidity on real economic activity. Thus, adopting an indirect liquidity framework that explicitly models an OTC secondary market for bonds is not only more empirically relevant but also a *sine qua non* for our research question.

[3] Since in our model the liquidation of bonds takes place in an OTC market, our work is also related to the literature initiated by Duffie, Gârleanu, and Pedersen (2005), who study how OTC market frictions affect asset prices and trade; other examples in this literature include Weill (2007, 2008), Lagos and Rocheteau (2009), Chang and Zhang (2015), Üslü (2019), and Gabrovski and Kospentaris (2021).

2 The Model

Time is discrete and the horizon is infinite. Each period consists of four sub-periods where different economic activities take place. In the first sub-period, a labor market resembling that of Pissarides (2000) opens where firms search for workers. In the second sub-period, economic activity takes place in a secondary asset market in the spirit of Duffie et al. (2005), where agents can trade corporate bonds for money. In the third sub-period, agents visit a decentralized goods market à la Kiyotaki and Wright (1993), where frictions, such as anonymity and imperfect commitment, make a medium of exchange (i.e., money) necessary. During the fourth sub-period, economic activity takes place in a Walrasian or centralized market, which is the settlement market of Lagos and Wright (2005) (henceforth, LW). For brevity, we refer to these four markets as LM (labor market), AM (asset market), GM (goods market), and CM (centralized market). There are two distinct types of agents, firms and households. Households are infinitely lived and their measure is normalized to the unit. The measure of firms is determined by free entry.

All agents discount the future between periods (but not sub-periods) at rate $\beta \in (0, 1)$. Households consume in the GM and CM sub-periods and work in the LM and CM sub-period. Their preferences within a period are given by $\mathcal{U}(X, H, q) = X - H + u(q)$, where H represents labor in the CM, X consumption of *general good* in the CM, and q consumption of *special good* in the GM. We assume that households can turn one unit of labor in the CM into one unit of the general good. In contrast, the special good must be purchased from firms in the GM. Firms consume only the general CM good, and they produce both the CM good and the GM good. Their preferences are given by $\mathcal{V}(X, H) = X - H$, where X, H are as above. As is the case with households, firms can turn one unit of labor into one unit of the general good in the CM. However, to produce the GM good firms must hire a worker in the LM. Following Berentsen et al. (2011), we assume that firms who are matched with a worker in the LM produce y units of output, measured in units of the CM good (the numeraire), which they ultimately use as an input for production in the GM. Specifically, if a firm sells q units in the GM, $y - q$ is left over to bring to the next CM. To finish the description of preferences, assume that u is twice continuously differentiable with $u' > 0$, $u'(0) = \infty$, $u'(\infty) = 0$, and $u'' < 0$. Let q^* denote the optimal level of production in a bilateral meeting in the GM, i.e., $q^* \equiv \{q : u'(q^*) = 1\}$.

With the exception of the CM, which is a frictionless competitive market, all other markets are characterized by *search* and *bargaining*. To ease the notation, we assume that the matching technology in each market is characterized by the function $f_j(b_j, s_j)$, where b_j and s_j represent the measure of buyers and sellers, respectively, searching for a trading partner in market $j \in \{L, A, G\}$ ("L" for Labor market, "A" for Asset market, and "G" for Goods market).[4] We assume that these matching functions exhibit constant returns to scale and are increasing in both arguments. Regarding bargaining, we will adopt the proportional or egalitarian bargaining solution of Kalai (1977), and in line with of our earlier notation choice, we will let $\eta_j \in [0,1]$ denote the bargaining power of the seller in market $j \in \{L, A, G\}$.

There are two assets in the economy, fiat money and corporate bonds. Agents can choose to hold any amount of money at the (real) ongoing price φ_t. The supply of money is controlled by the monetary authority, and it evolves according to $M_{t+1} = (1+\mu)M_t$, with $\mu > \beta - 1$. New money is introduced, or withdrawn if $\mu < 0$, via lump-sum transfers to households in the CM. Money has no intrinsic value, but it is portable, storable, and recognizable by all agents, making it an appropriate medium of exchange in the GM. In fact, we will assume that money is the unique medium of exchange in this economy. Corporate bonds are issued by firms in order to fund their recruiting efforts and production. (We describe this process in detail below.) We think of the CM as the *primary* market where these bonds are first issued by the firms and purchased by households. Later, households will have the option to rebalance their portfolios (after receiving idiosyncratic consumption opportunities) by selling bonds for money, and this takes place in the *secondary* AM. In the CM, households can purchase any amount of bonds at the (real) price ψ_t. These are one-period real bonds, i.e., each unit of the bond purchased in period t's CM will deliver one unit of the numeraire in the CM of $t+1$. The supply of corporate bonds is endogenous, as it depends on the profit maximizing behavior of firms.

Any given match in period t's LM remains productive in the next period with probability $1-\delta$, or, equivalently, $\delta \in (0,1)$ is the job separation rate in this economy. As is standard in the job search literature, firms whose match was destroyed exit the labor market and can choose to enter again with a new vacancy. Firms entering the market to search for workers must pay a recruiting cost κ_R and an operating cost κ_O, and firms that are already matched with a worker only need to pay the latter. Firms raise funds to cover these costs by issuing bonds in the CM. Since all the action in our paper comes from the liquidity properties of bonds, and how this liquidity affects the firms' entry and production decisions, we assume that firms never default. A straightforward way to obtain this

[4] Consider for example the LM. In this case, s_L stands for the measure of unemployed workers trying to match with a firm (workers sell their labor), and b_L stands for the measure of vacant firms searching for a worker. In the AM, s_A will be the measure of households trying to sell bonds and b_A the measure of households seeking to buy. (We will describe shortly the shock that induces some households to sell bonds and others to buy.) Finally, in the GM, s_G will be the measure of firms selling the special good, and b_G the measure of households buying that good.

result is to allow firms to repay their debt by working more hours in the next period's CM.[5] Firms that are matched and productive in the LM pay a wage w to the worker. Again following Berentsen et al. (2011), we assume that w is paid in numeraire good in the CM and not in the LM. Unemployed workers enjoy an unemployment benefit b also delivered in the CM.

A unique feature of our model is that the outcome of the matching process in the GM determines whether households will be active consumers in that market (i.e., matched with a firm) and, consequently, whether they will have a need for cash. We will refer to households who are active in this period's GM as C-types ("consuming"), and to the households who are inactive as N-types ("not consuming"). Since households made their portfolio choices before they knew their types, N-types will typically hold money they will not use in the current period, and C-types will typically not have enough money to carry out the desired transactions (since carrying money is costly). To make things interesting, we assume that the outcome of the GM matching process is revealed before households visit the secondary AM. Thus, in our model the AM plays a special role: it allows money, the unique medium of exchange in the economy, to reach the hands of the households who value it most. Specifically, it allows C-types to boost their money holdings by selling bonds to N-types who will not be needing their money today.[6] This is the essence of asset (bond) liquidity in our model: bonds cannot be used as means of payment in the GM, but they are *indirectly* liquid, as they can be sold for money in the AM. In terms of the notation introduced earlier, notice that we can denote the measure of C-types by s_A ("selling bonds in the AM"), and the measure of N-types as $b_A = 1 - s_A$.

Figure 1 summarizes the main economic activities in our model and clarifies the timing of the various shocks (which is important in a discrete time model). Notice that the job separation shock and the LM matching take place at the very beginning of each period

[5] Consider for example a firm that just entered the market and issued bonds to fund recruitment and production, and suppose that firm does not match with a worker in the LM. With no production in the LM and the GM, it would be impossible for the firm to repay their debt, but in this environment we assume they can do so by working more hours in the CM. This is a simple way to abstract from default which is not central to our question. One can think of this assumption as capturing the idea that firms can sell illiquid assets (such as buildings or machines) to repay their debtors in a parsimonious way.

[6] There is a large literature following LW, where an idiosyncratic consumption shock generates (ex post) heterogeneous money demand, giving rise to a market where the high-demand agents can obtain money from the low-demand agents. In Berentsen, Camera, and Waller (2007) that process takes place though a competitive banking system. In Geromichalos and Herrenbrueck (2016), like in the present paper, it takes place through an over-the-counter asset market. An important difference is that in all these papers the shock that splits agents ex post into active and inactive consumers in the GM is exogenous. But here it depends on the outcome of the matching process in the GM, which, in turn, depends on firm entry. This gives rise to an interesting channel that is unique to our framework.

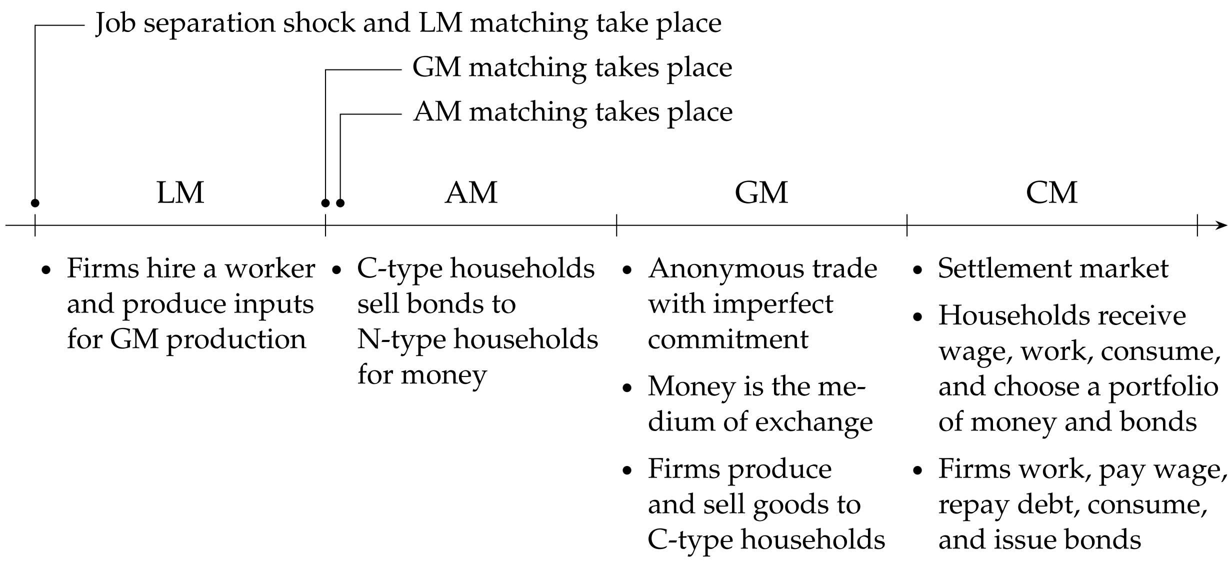

Figure 1: Timing of Events.

(or, equivalently, at the very end of the previous period).[7] Although this is not important for the results, we assume that the GM matching takes place after the job separation shock (and the LM matching). What does matter for the results, and we have already spelled out, is that the GM matching outcome is known before households visit the AM. (It is precisely what determines whether they will be buyers or sellers in the AM.) We assume that the AM matching takes place immediately after households have entered that market.

3 Analysis of the Model

3.1 Value functions

Households In the CM, a household can be either employed ($e = 1$) or unemployed ($e = 0$). For an employed household holding m units of money and a units of bonds, the value function is given by

$$W_1^h(m,a) = \max_{X,H,m',a'} X - H + \beta\Big[(1-\delta)U_1^h(m',a') + \delta\, U_0^h(m',a')\Big]$$
$$\text{s.t.} \quad X + \varphi m' + \psi a' = H + \varphi m + a + w + T,$$

where m', a' are the money and bond holdings for the next period, and U_e^h is the next period's LM value function, with $e = 0, 1$ depending on the outcome of the job separation

[7] A worker who just lost her job must wait one period before she can search for a new job.

shock δ. The household also receives the monetary lump-sum transfer T. Moving on to the CM value function of an unemployed household, we have

$$
\begin{aligned}
W_0^h(m,a) = \max_{X,H,m',a'} \; & X - H + \beta\left[\frac{f_L}{s_L}\, U_1^h(m',a') + \left(1 - \frac{f_L}{s_L}\right) U_0^h(m',a')\right] \\
\text{s.t.} \quad & X + \varphi m' + \psi a' = H + \varphi m + a + b + T.
\end{aligned}
$$

An unemployed household's employment status in the next period depends on the outcome of the LM matching process. Note that the value function W_e^h is linear, i.e., $W_e^h(m,a) = \varphi m + a + W_e^h(0,0)$, as is standard in models that build on LW. This result follows from quasi-linear preferences.

Next, we turn to the LM value functions. For a household in state $e = 0, 1$, we have

$$
U_e^h(m,a) = \frac{f_G}{b_G}\, \Omega_e^C(m,a) + \left(1 - \frac{f_G}{b_G}\right) \Omega_e^N(m,a), \quad e = 0, 1,
$$

where Ω_e^k denotes the AM value functions of a k-type household for $k = C, N$. Whether a household becomes C-type or N-type depends on the outcome of the GM matching process.[8] If the household is matched with a firm in the GM, acquiring extra liquidity in the AM is beneficial, making it a C-type. Conversely, if not matched, it does not need money in the current period, making it an N-type in the AM.

The AM value function of a C-type household (asset seller) is given by

$$
\Omega_e^C(m,a) = \frac{f_A}{s_A}\, V_e^h(m + \xi, a - \chi) + \left(1 - \frac{f_A}{s_A}\right) V_e^h(m,a), \quad e = 0, 1,
$$

where V_e^h denotes the GM value function of a C-type household, and ξ is the amount of money raised by selling χ units of bonds in the AM. Households that do not match in the AM (with probability $1 - f_A/s_A$) continue into the GM with their original portfolio (m,a). For an N-type household (asset buyer), the AM value function is given by

$$
\Omega_e^N(m,a) = \frac{f_A}{b_A}\, W_e^h(m - \xi, a + \chi) + \left(1 - \frac{f_A}{b_A}\right) W_e^h(m,a), \quad e = 0, 1.
$$

After the AM, N-types move directly to the CM, as they are, by definition, households that did not get the opportunity to consume in the GM.

[8] Observe that the Ω value functions are the only ones without the h superscript, which denotes 'household'. However, it is understood that C-types and N-types are households, and firms never participate in the AM. Thus, there should be no room for confusion.

The GM value function of a C-type household in state e is given by

$$V_e^h(m,a) = u(q) + W_e^h(m-x,a), \quad e = 0,1,$$

where x denotes the amount of money paid to purchase q units of the special good.

Firms First, consider a firm that just opened a vacancy. The CM value function of this firm is given by

$$W_v^f = \beta\left[\frac{f_L}{b_L}U_1^f(d') + \left(1-\frac{f_L}{b_L}\right)U_0^f(d')\right], \quad \text{where} \quad d' = \frac{\kappa_R + \kappa_O}{\psi}.$$

Here, U_e^f denotes the LM value function, which depends on whether the firm matches with a worker ($e=1$) or not ($e=0$). The term d' represents the firm's debt, which must cover the recruiting and operating costs. In particular, the firm finances the total costs $\kappa_P + \kappa_O$ by selling bonds at the price ψ, resulting in a debt of $(\kappa_P + \kappa_O)/\psi$.

The CM value function of a firm that is currently matched with a worker is given by

$$\begin{aligned} W_1^f(n,m,d) &= \max_{X,H} X - H + \beta(1-\delta)U_1^f(d') \\ \text{s.t.} \quad X &= H + n + \varphi m - d - w \quad \text{and} \quad d' = \frac{\kappa_O}{\psi}, \end{aligned}$$

where n represents the amount of LM production remaining after GM production (i.e., $n = y - q$), m is the money the firm received in the GM, and d is the debt from issuing bonds in the previous period. Note that this firm needs to raise funds only to cover the operating cost, as there is no recruiting cost since it is already matched with a worker.[9] Also, note that the value function W_1^f is linear, i.e., $W_1^f(n,m,d) = n + \varphi m - d + W_1^f(0,0,0)$, as is the case for the consumer's CM value functions.

These value functions highlight the asset price channel (discussed in the introduction) through which a more liquid secondary asset market encourages firm entry. Higher secondary market liquidity leads to a higher issue price for bonds, allowing firms to raise funds at more favorable rates. This lowers their debt, increases profitability, and ultimately encourages entry.

The last type of firm to consider in the CM is one that opened a vacancy in the previous period but was not able to find a worker. This firm cannot produce but must still

[9] Also, if this firm's job is destroyed (with probability δ), the firm exits the market and receives a payoff of 0, which is why the term U_0^f does not appear.

repay its debt, so its CM value function is given by

$$W_0^f(d) = \max_{X,H} X - H \quad \text{s.t.} \quad X = H - d.$$

We now turn to the LM. The LM value function of a matched firm is given by

$$U_1^f(d) = V_1^f(d),$$

where V_1^f denotes the GM value function of a matched firm. The LM value function of an entrant firm that did not find a worker is given by

$$U_0^f(d) = W_0^f(d).$$

Finally, the GM value function of a firm matched with a worker is given by

$$V_1^f(d) = \frac{f_G}{s_G}\left[\frac{f_A}{s_A} W_1^f(y - q^+, x^+, d) + \left(1 - \frac{f_A}{s_A}\right) W_1^f(y - q, x, d)\right] + \left(1 - \frac{f_G}{s_G}\right) W_1^f(y, 0, d).$$

Since this firm matches with a household/customer with probability f_G/s_G, the amount of the special good it sells depends on the household's money holdings, which, in turn, depend on whether the household was able to boost its money holdings in the AM. Here, q^+ (q) represents the amount of the special good traded if the household was (was not) able to trade in the preceding AM. Similarly, x^+ (x) represents the amount of money exchanged in the GM if the household was (was not) able to trade in the preceding AM.

The last value function highlights the liquidity demand channel (discussed in the introduction) through which a more liquid secondary asset market affects firm entry. Higher secondary market liquidity increases consumers' effective liquidity by allowing a larger number of C-type households to match in the AM and enter the GM with greater money holdings available for spending, thereby increasing firm profitability. However, as noted in the introduction, higher secondary market liquidity also reduces consumers' ex ante demand for money and negatively affects the terms of trade in the GM, making the overall effect ambiguous.

3.2 Terms of trade

Terms of trade in the GM Consider a meeting between a C-type household with m units of money and a matched firm with y units of LM output, used as production inputs for the special good. The two parties bargain over the quantity of the special good q

to be produced by the firm and the cash payment x to be made by the household. The household's and firm's surpluses are given by

$$S_G^h = u(q) + W_e^h(m - x, a) - W_e^h(m, a) = u(q) - \varphi x,$$
$$S_G^f = W_1^f(y - q, x, d) - W_1^f(y, 0, d) = -q + \varphi x,$$

where the linearity of W_e^h and W_1^f has been used. The terms of GM trade, (q, x), are determined by proportional bargaining, where the firm's bargaining power is η_G:

$$\max_{q,x} S_G^f \quad \text{s.t.} \quad S_G^f = \frac{\eta_G}{1-\eta_G} S_G^h, \quad x \leq m, \quad \text{and} \quad q \leq y.$$

The constraints $x \leq m$ and $q \leq y$ state that the household and the firm cannot leave the GM with negative money holdings or LM output. Following Berentsen et al. (2011), we assume that y is sufficiently large so that the constraint $q \leq y$ does not bind. The Kalai constraint implies

$$\varphi x = \eta_G\, u(q) + (1 - \eta_G) q \equiv \sigma(q),$$

which means that the household must pay $\sigma(q)/\varphi$ units of money, or equivalently, $\sigma(q)$ units of real balances, to the firm to purchase q units of the special good. The bargaining solution is then given by

$$q(m) = \min\{q^*,\, \sigma^{-1}(\varphi m)\},$$
$$x(m) = \min\{m^*,\, m\},$$

where $m^* \equiv \sigma(q^*)/\varphi$ is the amount of money that allows the household to purchase the optimal amount q^*. If the household has sufficient money to purchase q^*, it will pay m^*; otherwise, it will spend all its money. Note that due to the cost of carrying money, the household will never choose to hold $m > m^*$, meaning its liquidity constraint will always bind. Therefore, we focus on the binding branch of the bargaining solution: $q(m) = \sigma^{-1}(\varphi m)$ and $x(m) = m$.

Terms of trade in the AM Consider a meeting between a C-type household with portfolio (m, a) and an N-type household with portfolio $(\widetilde{m}, \widetilde{a})$. The surpluses of the C-type and N-type households are given by

$$\begin{aligned}S_A^C &= V_e^h(m+\xi, a-\chi) - V_e^h(m,a) = u\big(\sigma^{-1}(\varphi(m+\xi))\big) - u\big(\sigma^{-1}(\varphi m)\big) - \chi,\\ S_A^N &= W_e^h(\widetilde{m}-\xi, \widetilde{a}+\chi) - W_e^h(\widetilde{m},\widetilde{a}) = -\varphi\xi + \chi,\end{aligned}$$

where the bargaining solution to GM trade and the linearity of W_e^h have been used. The terms of AM trade, (ξ, χ), are determined by the C-type's take-it-or-leave-it offer:[10]

$$\max_{\xi,\chi} S_A^C \quad \text{s.t.} \quad S_A^N = 0, \quad \chi \le a, \quad \text{and} \quad \xi \le \widetilde{m}.$$

The first constraint, which represents the N-type's participation condition, implies $\xi = \chi/\varphi$; that is, χ units of bonds can be traded for χ/φ units of money. Since carrying money is costly, the C-type household will bring $m < m^*$ and seek to acquire the shortfall needed to reach m^*, namely, $m^* - m$. Whether it can obtain this amount depends on its asset holdings, a. If a is sufficiently large, the C-type household will acquire exactly $m^* - m$ by selling $\varphi(m^* - m)$ units of bonds. Otherwise, it will liquidate all its asset holdings and acquire a/φ units of money.[11] Thus, the bargaining solution is given by

$$\begin{aligned}\xi(m,a) &= \min\{m^* - m,\, a/\varphi\},\\ \chi(m,a) &= \min\{\varphi(m^* - m),\, a\}.\end{aligned}$$

3.3 Optimal portfolio choice

Households choose their optimal portfolio in the CM independently of trading histories in previous markets, as is standard in models that build on LW. Their objective function

[10] In this model, agents are willing to pay a liquidity premium for bonds they expect to *sell* in the AM. The magnitude of this premium is determined by the matching efficiency in the AM (to be denoted with α_A) and the bargaining power of sellers (η_A). That is, it depends on how easy it is for agents to sell their bonds, as well as how much surplus they can extract through OTC bargaining. It turns out that for our model to match the liquidity premia observed in the data, both α_A and η_A must be large. Without loss of generality, we set $\eta_A = 1$, as this significantly simplifies the model, and let the observed liquidity premia determine the value of α_A in our calibration. Alternatively, we could perform our calibration with a general value of η_A, but this would only lead to a substantially more complicated model and a higher calibrated value of α_A, with no material change in the quantitative results.

[11] The amount of money the C-type can acquire in the AM also depends on the N-type's money holdings, $\widetilde{m}$. The discussion so far has assumed that $m + \widetilde{m} \ge m^*$, that is, the combined money holdings of the C-type and N-type are sufficient for the C-type to reach m^*, thereby ignoring the last constraint in the bargaining problem. This assumption holds in equilibrium as long as inflation is not too high, ensuring that all households carry at least $m^*/2$ units of money. In the quantitative exercises, we verify that $m + \widetilde{m} \ge m^*$ is indeed the relevant case. Moreover, in the equilibrium where $m + \widetilde{m} < m^*$, bonds carry no liquidity premium—an outcome that is clearly unrealistic. This arises because, in such a scenario, money is so scarce that bonds become relatively abundant. For more details, see Geromichalos and Herrenbrueck (2016).

in the CM is derived by substituting their GM, AM, and LM value functions into the CM value function, retaining only the terms that depend on the choice variables:

$$J(m', a') = -(\varphi - \beta\varphi')m' - (\psi - \beta)a' + \beta\,\frac{f_G}{b_G}\,S_G^h + \beta\,\frac{f_G}{b_G}\,\frac{f_A}{s_A}\,S_A^C.$$

The interpretation is straightforward. The first two negative terms represent the cost of choosing the portfolio (m', a'), net of its payout in the next period's CM. The portfolio also provides liquidity benefits, but these are only relevant if the household becomes a C-type; thus, the remaining terms are multiplied by f_G/b_G. A C-type household always enjoys at least S_G^h from GM trade. Additionally, it gains an extra benefit S_A^C if it has the opportunity to sell bonds for cash in the AM, which occurs with probability f_A/s_A.

3.4 Equilibrium

In the steady state equilibrium conditions, we summarize the cost of holding money via the transformation $i = (1+\mu)/\beta - 1$, which can also be interpreted as the nominal yield on a completely illiquid asset. (Thus, i should not be thought of as representing, for instance, the yield on T-bills; see Geromichalos and Herrenbrueck, 2022 and Herrenbrueck, 2019.)

Money and bond market equilibrium Households' demand for money and bonds arises from their optimal portfolio choices. The money demand equation is given by

$$i = \frac{f_G}{b_G}\left(1 - \frac{f_A}{s_A}\right)\left(\frac{u'(q)}{\sigma'(q)} - 1\right) + \frac{f_G}{b_G}\,\frac{f_A}{s_A}\left(\frac{u'(q^+)}{\sigma'(q^+)} - 1\right), \tag{1}$$

where the AM trading protocol implies

$$q^+ = \min\{q^*;\, \sigma^{-1}(\sigma(q) + a)\}, \tag{2}$$

which is equivalent to $\sigma(q^+) = \min\{\sigma(q^*),\, \sigma(q) + a\}$. As a result of trading in the AM, a C-type household either acquires enough real balances to purchase q^* or boosts its real balances by selling all its bond holdings. The equilibrium price of money is determined by the money market clearing condition, $\varphi M = \sigma(q)$.

Households' bond demand determines the equilibrium bond price:

$$\psi = \beta\left(1 + \frac{f_G}{b_G}\,\frac{f_A}{s_A}\left(\frac{u'(q^+)}{\sigma'(q^+)} - 1\right)\right). \tag{3}$$

The fundamental value of bonds is β, and their liquidity premium is defined as the percentage difference between their price and fundamental value. The second term in the parentheses represents the liquidity premium of bonds, which is the product of three terms: (i) the probability that a household becomes a C-type and thus needs liquidity, (ii) the probability of matching in the AM, given that the household is a C-type, and (iii) the marginal surplus of the match, i.e., the net utility gain in the GM from bringing one more unit of bonds and selling it in the AM. The bond supply is given by

$$A = b_L \frac{\kappa_R + \kappa_O}{\psi} + (1 - s_L)(1 - \delta)\frac{\kappa_O}{\psi}, \tag{4}$$

and the bond market clears: $a = A$.

Labor market equilibrium Free entry implies $W_v^f = 0$; that is,

$$0 = \beta \left[\frac{f_L}{b_L} V_1^f \left(\frac{\kappa_R + \kappa_O}{\psi} \right) - \left(1 - \frac{f_L}{b_L} \right) \frac{\kappa_R + \kappa_O}{\psi} \right].$$

By combining the firms' value functions, we obtain

$$V_1^f(d) = R - d - w + \beta(1 - \delta) V_1^f \left(\frac{\kappa_O}{\psi} \right),$$

where R, representing the firm's expected revenue net of production costs, is defined as

$$R \equiv y + \frac{f_G}{s_G} \left[\frac{f_A}{s_A} \eta_G(u(q^+) - q^+) + \left(1 - \frac{f_A}{s_A} \right) \eta_G(u(q) - q) \right].$$

To derive the job creation curve, first evaluate the equation at $d = \kappa_O/\psi$ and solve for $V_1^f(\kappa_O/\psi)$. Next, use the linearity of $V_1^f(d)$ to obtain $V_1^f((\kappa_R + \kappa_O)/\psi) = V_1^f(\kappa_O/\psi) - \kappa_R/\psi$. Finally, substitute this expression into the free entry condition:

$$\frac{\kappa_R + \kappa_O}{\psi} + \frac{f_L}{b_L} \frac{\beta(1 - \delta)}{1 - \beta(1 - \delta)} \frac{\kappa_O}{\psi} = \frac{f_L}{b_L} \frac{R - w}{1 - \beta(1 - \delta)}. \tag{5}$$

The job creation curve is central to the analysis, as it captures the firms' incentive to enter the labor market. The left-hand side of equation (5) represents the recruiting and operating costs firms incur over their lifetime, while the right-hand side represents the expected net revenue from operations. Secondary market liquidity influences both sides. On the cost side, firms finance recruiting and operating expenses by issuing bonds, making the bond price ψ a key determinant. As secondary market liquidity improves, bond prices rise, allowing firms to issue fewer bonds (i.e., take on less future debt), thereby lowering entry costs and encouraging firm entry—this is the asset price channel. On the revenue side, secondary market liquidity affects firms through the liquidity demand channel. A more liquid secondary market increases households' effective liquidity, which raises R. However, it may also reduce households' ex ante demand for money, which lowers R. Therefore, the net effect through the liquidity demand channel is ambiguous.

The wage curve is determined through wage bargaining in the LM. The worker's and firm's surpluses are given by $U_1^h(m,a) - U_0^h(m,a)$ and $U_1^f((\kappa_R+\kappa_O)/\psi) - U_0^f((\kappa_R+\kappa_O)/\psi)$, respectively. The worker's bargaining power is η_L, and the total surplus is split according to proportional bargaining:

$$\eta_L\left[U_1^f\!\left(\frac{\kappa_R+\kappa_O}{\psi}\right) - U_0^f\!\left(\frac{\kappa_R+\kappa_O}{\psi}\right)\right] = (1-\eta_L)\Big[U_1^h(m,a) - U_0^h(m,a)\Big].$$

Using the bargaining solution and the value functions of firms and households, we derive the wage curve:

$$w = \frac{(1-\eta_L)(1-\beta(1-\delta))b + \eta_L\left(1-\beta\left(1-\delta-\dfrac{f_L}{s_L}\right)\right)\left(R-\beta(1-\delta)\dfrac{\kappa_O}{\psi}\right)}{1-\beta(1-\delta)+\eta_L\,\beta\,\dfrac{f_L}{s_L}}. \tag{6}$$

Finally, the Beveridge curve is given by

$$(1-s_L)\delta = f_L. \tag{7}$$

Measures of sellers and buyers The measures of successful matches in the LM, AM, and GM are determined by their respective matching technologies, given by $f_L = f_L(b_L, s_L)$, $f_A = f_A(b_A, s_A)$, and $f_G = f_G(b_G, s_G)$, where $b_A = 1 - f_G$, $s_A = f_G$, $b_G = 1$, and $s_G = 1 - s_L$. The measures of buyers and sellers in the LM, b_L and s_L, are determined in equilibrium.

We now define a steady state equilibrium of the model.

Definition 1. The steady state equilibrium of the model corresponds to a constant sequence (b_L, s_L, q, q^+, ψ, A, w) that satisfies equations (1), (2), (3), (4), (5), (6), and (7).

4 Calibration

We calibrate the model at a monthly frequency. Several parameters are set exogenously, either to their direct empirical counterparts or following the literature. The discount fac-

Parameter	Description	Value
	Externally Calibrated Parameters	
β	Discount Rate	0.9975
i	Illiquid Interest Rate (Annual)	7%
δ	Separation Rate	3%
y	Match Output in the LM	1
b	Unemployment Flow Value	0.71
α_G	Matching Efficiency in the GM	1
	Internally Calibrated Parameters	
B	Household's Utility Coefficient	0.9368
γ	Household's Utility Elasticity	0.1490
α_L	Matching Efficiency in the LM	0.8676
α_A	Matching Efficiency in the AM	1.1246
η_L	Worker's Bargaining Power in the LM	0.5417
η_G	Firm's Bargaining Power in the GM	0.9326
κ_R	Firm's Recruiting Costs	0.1255
κ_O	Firm's Operating Costs	0.0510

Table 1: Calibrated Parameters.

tor β is set to $0.9975 = 1/1.03^{1/12}$, consistent with a 3% annual real return, as in Bethune, Choi, and Wright (2020). Regarding the illiquid nominal rate i, no observed interest rate can be used directly, as no traded asset is perfectly illiquid. Instead, we use an estimate of 7%, based on time preference, expected real growth, and expected inflation, following Herrenbrueck (2019).[12] For the separation rate δ, we use the estimate from Shimer (2005) of a 3% monthly separation rate for the U.S. economy. We set the match output y in the labor market to 1, following Berentsen et al. (2011), and the value of unemployment b to 0.71, following Hall and Milgrom (2008). Finally, we set the GM matching efficiency α_G to 1, which is standard in New Monetarist models (see Kiyotaki and Wright (1993) and Berentsen et al. (2011), among others). The top panel of Table 1 summarizes the externally set parameter values.

Next, we specify the functional forms used in the calibrated model. As in much

[12] For comparison, Berentsen et al. (2011) use an annual rate of 7.4% (the average rate on AAA corporate bonds), while the average rate in the data from Lucas and Nicolini (2015) is 6.28%.

of the New Monetarist literature (e.g., Berentsen et al., 2011; Bethune et al., 2020), we adopt the constant-relative-risk-aversion (CRRA) form for the household's utility of the GM good: $u(q) = Bq^{1-\gamma}/(1-\gamma)$. Our model features three frictional markets: LM, AM, and GM, each with matching functions f_L, f_A, and f_G, respectively. We parameterize all matching functions symmetrically using the constant-return-to-scale (CRS) functional form: $f_j(b_j, s_j) = \alpha_j b_j s_j/(b_j + s_j)$, where $j \in \{L, A, G\}$.

In total, this leaves us with eight parameters to be calibrated through the lens of the model: the household utility function parameters, B and γ; the matching efficiencies in the labor and asset markets, α_L and α_A; the bargaining shares of sellers in the labor and product markets, η_L and η_G; and the firms' recruiting and operating costs, κ_R and κ_O.

To pin down these parameters, we use various labor, monetary, and financial moments. First, the matching efficiency in the labor market, α_L, is adjusted to match the 6% long-run average unemployment rate in the U.S. economy, as reported in Petrosky-Nadeau (2013). To pin down the firm's bargaining power in the product market, η_G, we follow Bethune et al. (2020) and target the average markup of 1.39 in the product market, with the model counterpart given by $(1 - f_A/s_A) \cdot \sigma(q)/q + f_A/s_A \cdot \sigma(q^+)/q^+$. The firm's operating costs, κ_O, are informed by corporate bond supply data: we match the average issuance level of investment-grade bonds as a fraction of GDP from Refinitiv, which corresponds to $\psi A/((1-s_L)R)$ in the model.[13] Given this, the matching efficiency in the asset market, α_A, is set to match the available measurement of the liquidity premium of corporate bonds. d'Avernas (2018) estimates that 30% of the corporate bond spread can be attributed to liquidity considerations, whereas Friewald, Jankowitsch, and Subrahmanyam (2012) estimate the spread of investment-grade bonds to be around 1%. Together, these two numbers provide a measure of the liquidity premium of corporate bonds.

Regarding the utility function parameters, we follow the standard practice in the New Monetarist literature by targeting the ratio of money holdings relative to GDP, which in our model is given by $\sigma(q)/((1 - s_L)R)$. We jointly pin down B and γ by targeting the average of this ratio (Bethune et al., 2020) and the elasticity of money holdings with respect to the return on AAA bonds (Berentsen et al., 2011), using data from Lucas and Nicolini (2015). To pin down the firm's recruiting costs, κ_R, we use the estimate from Silva and Toledo (2009) that the hiring cost is 12.9% of the monthly compensation for a newly hired worker. Finally, for the worker's bargaining power in the product market, η_L, we apply the Hosios condition (Hosios, 1990) and target the elasticity of the labor market matching function with respect to the measure of unemployed workers, evaluated

[13] We focus on investment-grade bonds since there is no default in the model, and this bond category is considered practically default-free.

Target	Data	Source
Unemployment Rate	6%	Petrosky-Nadeau (2013)
Product Market Markup	1.39	Bethune et al. (2020)
Issuance of Corporate Bonds over GDP	6.05%	Refinitiv
Liquidity Premium of Corporate Bonds	0.3%	d'Avernas (2018)
		Friewald et al. (2012)
Average Money Holdings over GDP	23.2%	Lucas and Nicolini (2015)
Elasticity of Money Demand wrt AAA Rate	−0.51	Lucas and Nicolini (2015)
Recruiting Costs as a Fraction of Wage	12.9%	Silva and Toledo (2009)

Table 2: Calibration Targets.

at equilibrium tightness.

The flexibility of our model allows us to pin down parameter values that exactly match the empirical target moments with their model counterparts. The calibrated parameter values are presented in the bottom panel of Table 1, while Table 2 summarizes the target moments and their sources. We use the calibrated model as a laboratory to conduct various quantitative exercises in the following section.

5 Quantitative Analysis

In this section, we present the implications of the model for the relationship between secondary market liquidity and real economic variables. To do so, we analyze how the steady state unemployment rate u and the aggregate output $(1-u)R$ respond to changes in the AM matching coefficient α_A at different levels of inflation. This approach follows Berentsen et al. (2011) and is common practice in search theory (see, e.g., Hornstein, Krusell, and Violante (2005), Petrosky-Nadeau (2013), and Ljungqvist and Sargent (2017), among others). Effectively, our goal is to quantify the relative impact of the different model channels through which a deterioration in secondary market liquidity affects real economic variables. Moreover, since we model money explicitly, our theory implies that the quantitative importance of each channel depends on the cost of holding money, i.e. the level of inflation. Thus, we perform the numerical exercises at different inflation levels by varying the level of the nominal interest rate i.

Figure 2 summarizes the results. The solid blue lines capture the total impact of changes in secondary market frictions through the lens of the model. We vary α_A from 0

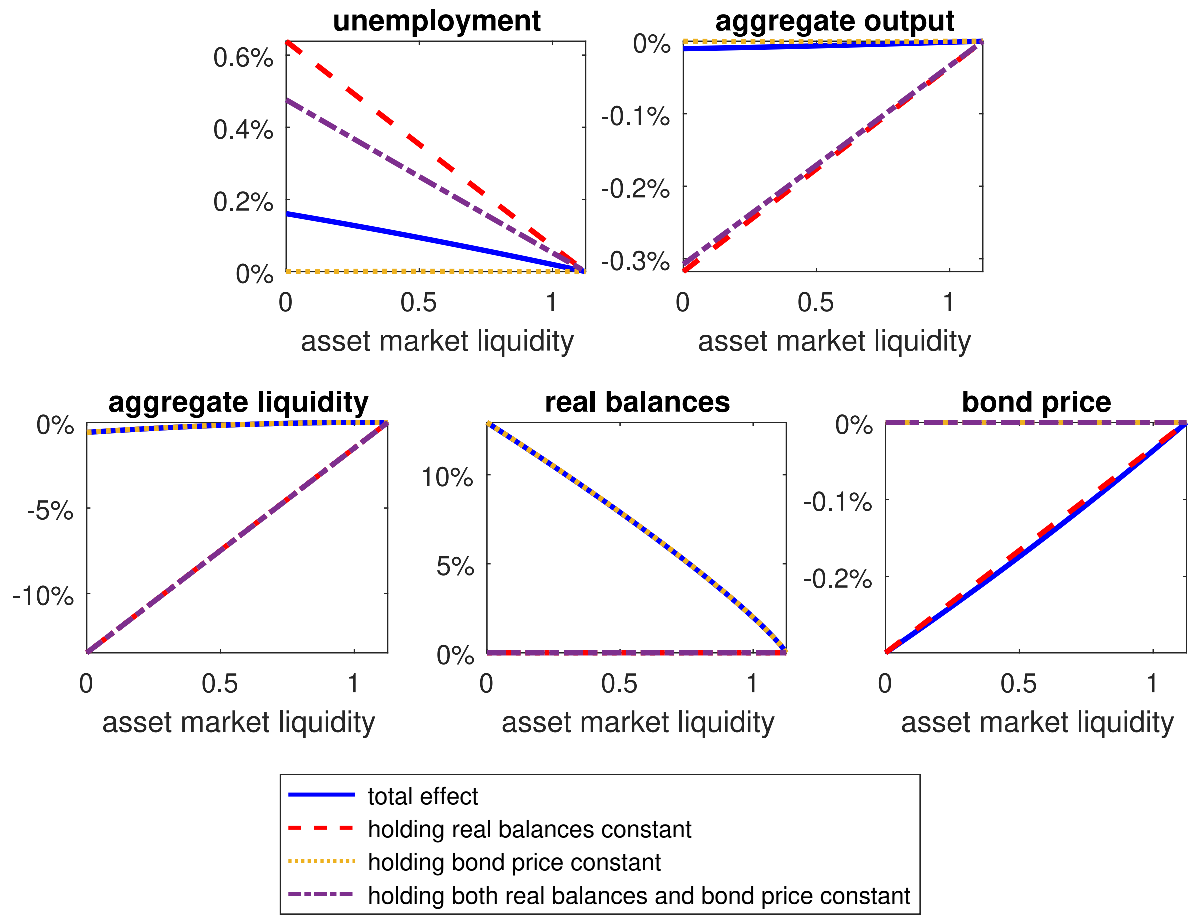

Figure 2: The impact of the secondary asset market liquidity on the real economy while holding various model channels fixed.

to its calibrated value and present the results as percentage deviations from the model's steady state levels for the benchmark calibration. The case of $\alpha_A = 0$ corresponds to an "asset market freeze", a case in which the asset market seizes to operate (Gu et al., 2024). In total, a lower level of asset market efficiency lowers aggregate output and raises unemployment (top panels of Figure 2). This effect works through two model channels: the *asset price channel* and the *liquidity demand channel*. Before gauging their relative magnitude, let us first explain how each channel operates in the model.

First, the asset price channel: a lower α_A decreases the liquidity premium and the price of corporate bonds (equation 3), which increases the firms' borrowing cost and, in turn, lowers firm entry and aggregate output, and increases unemployment. This channel can be seen in the solid blue line of the bottom right panel of Figure 2 where the bond price, ψ, is positively correlated with the level of asset market efficiency, α_A. Next, the liquidity demand channel: α_A influences how easy it is for consumers to trade bonds for money, but also affects the incentives of consumers to hold their wealth in real balances. That is, a lower α_A reduces consumers' *ex post* liquidity obtained from the asset market (mathematically: $f_A/s_A(\sigma(q^+) - \sigma(q))$) but raises consumers' *ex ant* liquidity from their portfolio choice ($\sigma(q)$). The total effect on consumers' *aggregate* liquidity ($\sigma(q) + f_A/s_A(\sigma(q^+) - \sigma(q))$) depends on these two forces. The solid blue line in the bottom middle panel of Figure 2 shows that ex ante liquidity increases as α_A decreases, with consumers bringing more money before asset market trade from the CM. The solid blue line in the bottom left panel of Figure 2 shows that aggregate liquidity declines as α_A decreases, which implies that the negative impact from lower asset trade dominates the positive impact from more liquid portfolios.

To quantify the relative impact of each one of these forces on the real economy, we perform a model-based decomposition: we shut down one channel at a time and compare the change in model variables with the total effect captured by the solid blue lines of Figure 2. We shut down the asset price channel by fixing the asset price at the level of the benchmark economy with α_A at its calibrated value; the results are shown with the yellow dotted lines of Figure 2. We shut down the ex ante part of the liquidity demand channel by fixing real money balances at the level of the benchmark economy with α_A at its calibrated value; the results are shown with the red dashed lines in the same figure. Fixing both variables at the same time yields the purple dash-dotted lines. Hence, the ex post part of the liquidity demand channel, due to the disrupted asset market trade, can be inferred by the difference between zero and the purple dash-sotted line that shuts down the other two forces simultaneously.

The main takeaway from the decomposition is that the ex ante and ex post components of the liquidity demand channel cancel each other out. In graphical terms, the difference between the red dashed and the solid blue lines (the relative impact of the ex ante part) is roughly equal to the difference between the purple dash-dotted lines and zero (the relative impact of the ex post part) in the top panels of Figure 2. If it were not possible for agents to readjust their real money balances, then the drop in aggregate liquidity and the resulting increase in unemployment would be three times larger than in the baseline model, while the drop in output would be even greater. Agents respond to the lower matching efficiency of the asset market by making their portfolios more liquid, and they are able to undo the asset market disruption almost completely at the baseline inflation level. As a result, the magnitude of the total effect of lower secondary market liquidity in the baseline model is equal to the magnitude of the asset price channel (the difference between the yellow dotted and the solid blue lines in the top panels of Figure 2).

In Table 3, we report the decomposition results for the benchmark level of 4% inflation, as well as a lower ($\pi = 1\%$) and a higher ($\pi = 7\%$) level. The numbers refer to the

Unemployment Rate			Aggregate Output		
$\pi = 1\%$	$\pi = 4\%$	$\pi = 7\%$	$\pi = 1\%$	$\pi = 4\%$	$\pi = 7\%$
(a) Ex ante part of liquidity demand channel					
−320.24%	−296.14%	−279.16%	−11,287.50%	−2,985.44%	−1,658.14%
(b) Ex post part of liquidity demand channel					
313.41%	296.27%	286.05%	11,043.75%	2,986.41%	1,699.61%
(c) Asset price channel					
106.83%	99.88%	93.11%	343.75%	99.03%	58.53%
Total Effect: (a)+(b)+(c)					
100%	100%	100%	100%	100%	100%

Table 3: Decomposition of the effects of a secondary asset market freeze ($\alpha_A = 0$) on real economic variables for different inflation levels.

responses of the unemployment rate and the aggregate output for the secondary market freeze case of $\alpha_A = 0$ compared to the benchmark calibrated value of α_A as fractions of the total effect (for example, 100% means that the magnitude of a particular channel is equal to the total effect produced by the baseline model). Moreover, a positive sign indicates that a particular channel moves in the same direction as the total effect, while a negative sign means the channel moves in the opposite direction. The baseline inflation columns confirm the analysis of Figure 2: the effects of the disrupted asset market trade would be massively larger on the real economy if agents did not have the ability to undo these effects by holding more money in their portfolios. At 4% inflation, the two effects cancel out almost perfectly and the total effect is roughly equal to the effect of the asset price channel. The corresponding impact of the liquidity demand channel on output is an order of magnitude larger than the unemployment impact, which again shows that a small total effect masks substantially larger liquidity forces operating in opposite directions.

The main takeaway of Table 3 is that this liquidity substitution between the ex ante and ex post parts of the liquidity demand channel is disciplined by the inflation level: the higher the inflation rate, the higher the cost for consumers to hold money and the more difficult it is to cope with the asset market freeze. As a result, the relative importance of ex ante liquidity falls and the relative importance of ex post liquidity increases as inflation rises. Hence, when inflation rises above its benchmark calibration level, the two components of the liquidity demand channel do not cancel each other out anymore; now the ex post component prevails over the ex ante component. In total, higher inflation means that a deterioration of secondary market liquidity has a more profound negative effect on the real economy. It hurts economic activity through the asset price channel (as it did in the benchmark case), but also through the net effect of the liquidity demand channel, since the ex ante component that was mitigating the negative effects of the secondary market liquidity shock (in the benchmark calibration) has now weakened. Overall, this makes the liquidity demand channel as a whole more important for the response of real variables, while the importance of the asset price channel diminishes as inflation rises.

6 Conclusion

The corporate bond market is a major avenue for firms to satisfy their borrowing needs and, as a result, it is of central importance for economic activity. Economic intuition suggests that a well-functioning secondary bond market boosts economic activity by allowing firms to borrow at lower rates and by allocating liquidity into the hands of agents who need it most. However, the New Monetarist literature has identified a channel through which a well-functioning secondary market induces agents to free ride on others' money holdings, thus depressing money demand and hurting economic activity. With several opposing forces at work, studying the effect of secondary market liquidity only at the theoretical level, as the literature has done, is not fully satisfactory. In this paper, we provide a careful quantitative evaluation of the relationship between secondary market liquidity and real economic variables in the context of a New Monetarist model with frictional labor, product, and financial markets.

We build on the work of Berentsen et al. (2011), which contains a frictional labor market that gives rise to equilibrium unemployment, and a frictional product market that gives rise to a need for a medium of exchange. We extend this framework by assuming that firms face recruiting and operating costs, which they must cover by issuing corporate bonds. In our model, only money can serve as a medium of exchange, but corporate bonds are also liquid as agents can sell them for cash in a secondary OTC market. This *indirect* bond liquidity is crucial, as it determines the rate at which firms can borrow funds and the effective liquidity of consumers (i.e., the amount of money with which they will eventually enter the product market). In total, there are three channels through which secondary market liquidity affects output and unemployment: the asset price channel, as well as the ex ante and ex post components of the liquidity demand channel.

In order to study each of these channels quantitatively, we calibrate the model to the U.S. economy and then consider a secondary market freeze and perform a model-based decomposition of the magnitude of the three channels. Our main result is that the total impact of secondary market liquidity on real economic variables conceals a sizable heterogeneity among the individual channels. In particular, the ex ante and ex post components of the liquidity demand channel are sizable, but they cancel each other out, as agents respond to the lower matching efficiency in the secondary market by making their portfolios more liquid. As a result, the magnitude of the total effect of lower secondary market liquidity in the baseline model virtually coincides with the magnitude of the asset price channel, which is negative but much smaller than either component of the liquidity demand channel. When inflation rises above its benchmark calibration level, the two components of the liquidity demand channel do not cancel each other out anymore. Instead, the ex post component prevails over the ex ante component, and a deterioration of secondary market liquidity has a more profound negative effect on the real economy.

References

Andolfatto, D., A. Berentsen, and C. Waller (2014). Optimal disclosure policy and undue diligence. *Journal of Economic Theory 149*, 128–152.

Berentsen, A., G. Camera, and C. Waller (2007). Money, credit and banking. *Journal of Economic Theory 135*(1), 171–195.

Berentsen, A., S. Huber, and A. Marchesiani (2014). Degreasing the wheels of finance. *International economic review 55*(3), 735–763.

Berentsen, A., G. Menzio, and R. Wright (2011). Inflation and unemployment in the long run. *American Economic Review 101*(1), 371–98.

Bethune, Z., M. Choi, and R. Wright (2020). Frictional goods markets: Theory and applications. *Review of Economic Studies 87*(2), 691–720.

Bethune, Z. and G. Rocheteau (2021). Unemployment and the distribution of liquidity. Technical report, Discussion paper.

Bethune, Z., G. Rocheteau, and P. Rupert (2015). Aggregate unemployment and household unsecured debt. *Review of Economic Dynamics 18*(1), 77–100.

Boyarchenko, N., A. Kovner, and O. Shachar (2022). It's what you say and what you buy: A holistic evaluation of the corporate credit facilities. *Journal of Financial Economics 144*(3), 695–731.

Branch, W. A., N. Petrosky-Nadeau, and G. Rocheteau (2016). Financial frictions, the housing market, and unemployment. *Journal of Economic Theory 164*, 101–135.

Branch, W. A. and M. Silva (2021). Liquidity, unemployment, and the stock market. *Available at SSRN 4081916*.

Chang, B. and S. Zhang (2015). Endogenous market making and network formation. Technical report, Systemic Risk Centre, The London School of Economics and Political Science.

Cui, W., R. Wright, and Y. Zhu (2025). Endogenous liquidity and capital reallocation. *Journal of Political Economy 133*(1), 146–189.

d'Avernas, A. (2018). Disentangling credit spreads and equity volatility. *Swedish House of Finance Research Paper* (18-9).

Diamond, P. A. (1982). Wage determination and efficiency in search equilibrium. *The Review of Economic Studies 49*(2), 217–227.

Duffie, D., N. Gârleanu, and L. H. Pedersen (2005). Over-the-counter markets. *Econometrica 73*(6), 1815–1847.

Duffie, D., N. Gârleanu, and L. H. Pedersen (2005). Over-the-counter markets. *Economet-*

rica 73(6), 1815–1847.

Friewald, N., R. Jankowitsch, and M. G. Subrahmanyam (2012). Illiquidity or credit deterioration: A study of liquidity in the us corporate bond market during financial crises. *Journal of Financial Economics 105*(1), 18–36.

Gabaix, X. and R. S. Koijen (2021). In search of the origins of financial fluctuations: The inelastic markets hypothesis. Technical report, National Bureau of Economic Research.

Gabaix, X., R. S. Koijen, F. Mainardi, S. S. Oh, and M. Yogo (2025). Limited risk transfer between investors: A new benchmark for macro-finance models. Technical report, National Bureau of Economic Research.

Gabrovski, M., A. Geromichalos, L. Herrenbrueck, I. Kospentaris, and S. Lee (2025). The real effects of financial disruptions in a monetary economy. *Journal of Monetary Economics*, 103735.

Gabrovski, M. and I. Kospentaris (2021). Intermediation in over-the-counter markets with price transparency. *Journal of Economic Theory 198*, 105364.

Geromichalos, A. and L. Herrenbrueck (2016). Monetary policy, asset prices, and liquidity in over-the-counter markets. *Journal of Money, Credit and Banking 48*(1), 35–79.

Geromichalos, A. and L. Herrenbrueck (2022). The liquidity-augmented model of macroeconomic aggregates: A New Monetarist DSGE approach. *Review of Economic Dynamics 45*, 134–167.

Geromichalos, A., L. Herrenbrueck, and S. Lee (2023). Asset safety versus asset liquidity. *Journal of Political Economy 131*(5), 1172–1212.

Geromichalos, A., J. M. Licari, and J. Suárez-Lledó (2007). Monetary policy and asset prices. *Review of Economic Dynamics 10*(4), 761–779.

Gu, C., J. H. Jiang, and L. Wang (2023). Credit condition, inflation and unemployment. Technical report, Working Paper.

Gu, C., G. Menzio, R. Wright, and Y. Zhu (2024). Market freezes. *Journal of Money, Credit and Banking 56*(6), 1291–1320.

Hall, R. E. and P. R. Milgrom (2008). The limited influence of unemployment on the wage bargain. *American Economic Review 98*(4), 1653–74.

Herrenbrueck, L. (2019). Interest rates, moneyness, and the fisher equation. Working paper, Simon Fraser University.

Hornstein, A., P. Krusell, and G. L. Violante (2005). Unemployment and vacancy fluctuations in the matching model: Inspecting the mechanism. *FRB Richmond Economic Quarterly 91*(3), 19–51.

Hosios, A. J. (1990). On the efficiency of matching and related models of search and unemployment. *Review of Economic Studies 57*(2), 279–298.

Hu, T.-W. and G. Rocheteau (2015). Monetary policy and asset prices: A mechanism design approach. *Journal of Money, Credit and Banking 47*(S2), 39–76.

Huber, S. and J. Kim (2019). The role of trading frictions in financial markets. *Journal of Economic Dynamics and Control 99*, 1–18.

Jung, K. M. and J. H. Pyun (2020). A long-run approach to money, unemployment, and equity prices. *Unemployment, and Equity Prices*.

Kalai, E. (1977). Proportional solutions to bargaining situations: Interpersonal utility comparisons. *Econometrica 45*(7), 1623–1630.

Kiyotaki, N. and R. Wright (1993). A search-theoretic approach to monetary economics. *American Economic Review 83*(1), 63–77.

Lagos, R. (2011). Asset prices, liquidity, and monetary policy in an exchange economy. *Journal of Money, Credit and Banking 43*, 521–552.

Lagos, R. and G. Rocheteau (2009). Liquidity in asset markets with search frictions. *Econometrica 77*(2), 403–426.

Lagos, R. and R. Wright (2005). A unified framework for monetary theory and policy analysis. *Journal of Political Economy 113*(3), 463–484.

Lahcen, M. A., G. Baughman, S. Rabinovich, and H. van Buggenum (2022). Nonlinear unemployment effects of the inflation tax. *European Economic Review 148*, 104247.

Lee, S. (2020). Liquidity premium, credit costs, and optimal monetary policy.

Ljungqvist, L. and T. J. Sargent (2017). The fundamental surplus. *American Economic Review 107*(9), 2630–65.

Lucas, R. E. and J. P. Nicolini (2015). On the stability of money demand. *Journal of Monetary Economics 73*, 48–65.

Madison, F. (2019). Frictional asset reallocation under adverse selection. *Journal of Economic Dynamics and Control 100*, 115–130.

Mattesini, F. and E. Nosal (2016). Liquidity and asset prices in a monetary model with OTC asset markets. *Journal of Economic Theory 164*, 187–217.

Mortensen, D. T. and C. A. Pissarides (1994). Job creation and job destruction in the theory of unemployment. *Review of Economic Studies 61*(3), 397–415.

Nosal, E. and G. Rocheteau (2013). Pairwise trade, asset prices, and monetary policy. *Journal of Economic Dynamics and Control 37*(1), 1–17.

Petrosky-Nadeau, N. (2013). TFP during a credit crunch. *Journal of Economic Theory 148*(3), 1150–1178.

Pissarides, C. A. (2000). *Equilibrium unemployment theory*. MIT press.

Rocheteau, G. and A. Rodriguez-Lopez (2014). Liquidity provision, interest rates, and unemployment. *Journal of Monetary Economics 65*, 80–101.

Shimer, R. (2005). The cyclical behavior of equilibrium unemployment and vacancies. *American Economic Review 95*(1), 25–49.

Silva, J. I. and M. Toledo (2009). Labor turnover costs and the cyclical behavior of vacancies and unemployment. *Macroeconomic Dynamics 13*(S1), 76–96.

Üslü, S. (2019). Pricing and liquidity in decentralized asset markets. *Econometrica 87*(6), 2079–2140.

van Buggenum, H., M. Ait Lahcen, S. Rabinovich, and P. Gomis-Porqueras (2024). Asset safety and liquidity over the business cycle. Technical report.

Weill, P.-O. (2007). Leaning against the wind. *The Review of Economic Studies 74*(4), 1329–1354.

Weill, P.-O. (2008). Liquidity premia in dynamic bargaining markets. *Journal of Economic Theory 140*(1), 66–96.