The real effects of financial disruptions in a monetary economy

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ABSTRACT

A large literature in macroeconomics reaches the conclusion that disruptions in financial markets have large negative effects on output and (un)employment. Although diverse, papers in this literature share a common characteristic: they all employ frameworks where money is not explicitly modeled. This paper argues that the omission of money may hinder a model's ability to evaluate the real effects of financial shocks, since it deprives agents of a payment instrument that they *could* have used to cope with the resulting liquidity disruption. In a carefully calibrated New-Monetarist model with frictional labor, product, and financial markets we show that the existence of money dampens or even eliminates the real impact of financial shocks, depending on the nature of the shock. We also show that the propagation of financial shocks to the real economy is disciplined by the inflation level, thus delivering a policy-relevant message: high inflation regimes raise the likelihood of a financial *shock* turning into a financial *crisis*.

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1 Introduction

There is a large literature in macroeconomics studying the effects of financial turbulence on the real economy (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Wasmer and Weil, 2004). Many papers in this literature reach the conclusion that disruptions in financial markets have large negative effects on output and employment (Jermann and Quadrini, 2012; Christiano, Motto, and Rostagno, 2014; Petrosky-Nadeau, 2014). Another common thread running through most of these papers is that they employ frameworks where money is not explicitly modeled. However, the absence of money may limit the models' ability to accurately capture the real effects of financial disruptions, for at least two reasons. First, it may overstate the impact of financial turmoil on real variables, since it deprives agents of a payment instrument that they *could* have used to cope with the resulting liquidity disruption. Second, a moneyless model does not allow the study of real-financial linkages under different inflation regimes, a subject that has recently become topical and of policy interest.

In this paper, we revisit the effects of financial shocks on the real economy within the context of a model where money plays an essential role. Specifically, we build a New Monetarist model with frictional labor, product, and financial markets. As is typical in these models, a medium of exchange is necessary for transactions in the product market. This role is played by fiat money and corporate bonds that are issued by firms to cover their recruiting and operating expenses. As a result, the liquidity services of corporate bonds are reflected in their price, which affects firms' borrowing costs, entry decisions, and, ultimately, output and unemployment. In this environment, we find that the existence of money dampens or even eliminates the real impact of financial shocks, depending on the nature of the shock. The reason behind this result is the agents' ability to increase their money holdings and *substitute* the liquidity foregone due to the financial disruption. Hence, working with a moneyless model does not come without loss of generality. We also show that the size of the transmission mechanism between financial shocks and the real economy is disciplined by the inflation level, which further highlights the importance of explicitly modeling money.

Moving on to a more detailed description of the environment, we employ the model of Berentsen, Menzio, and Wright (2011) (BMW), extended to include issuance of corporate bonds with a liquidity role. Firms face costs to enter the labor market (recruiting costs), as well as additional expenses in order to engage in production (operating costs). These costs are covered by selling corporate bonds that firms issue with the assistance of financial underwriters. Unemployed workers and firms search for counterparties in a

Diamond-Mortensen-Pissarides (Diamond, 1982; Mortensen and Pissarides, 1994) labor market. The firms that have been successful in recruiting a worker produce a special good that they sell in a decentralized goods market where standard frictions, such as anonymity and imperfect commitment, make a medium of exchange necessary, as in Lagos and Wright (2005).

As we have already mentioned, in our model corporate bonds serve alongside money as media of exchange or collateral. Varying the pledgeability/acceptability of bonds in the decentralized market is our *first* way of capturing the notion of "disruptions in financial markets"; we dub this the "liquidity shock". The *second* way of capturing financial disruptions is by shocking the ability of firms to meet underwriters and issue corporate bonds; we dub this the "funding shock". These two financial shocks represent disruptions to "market" and "funding" liquidity, echoing the concepts introduced in the seminal work Brunnermeier and Pedersen (2009). Both types of financial disruptions affect real variables through two channels: i) the *asset price channel*, which refers to the lower ability of firms to raise funds when the liquidity premium of corporate bonds decreases, and ii) the *portfolio channel*, which lowers firms' product market revenue due to the reduced effective liquidity of consumers.

To highlight the role of money for the transmission of financial shocks in a transparent manner, we compare the propagation of the aforementioned shocks in the baseline model to an economy without money. An economy without money is attained by setting the pledgeability of money to zero, which makes this version of our model directly comparable to the moneyless models in the existing literature. We begin our comparison by calibrating the baseline economy with money to salient features of US data. Next, we perform a series of numerical exercises in both the baseline economy and the moneyless benchmark and compare the responses of real variables. We find that the real effects of financial disruptions are much smaller in the baseline model with money than in the moneyless economy. This is true for both liquidity and funding shocks, and both steady state comparisons and one-time unexpected (MIT) shocks.

In terms of quantitative results, when bond pledgeability drops to zero, unemployment increases by almost one percentage point and GDP decreases by 2.1% from their calibrated values in the moneyless benchmark, but they remain virtually unaffected in the baseline model with money. Regarding funding shocks, a 25% drop in the firms' ability to issue bonds does affect unemployment and GDP in the baseline model with money, but still their response is three percentage points smaller than in the moneyless model. We should mention that the effects of funding shocks are an order of magnitude larger than the effects of liquidity shocks. Intuitively, a liquidity shock affects only the ability of firms to borrow funds at favorable rates, but a funding shock affects the ability of firms to raise funds altogether. Hence, firms that fail to access credit shut down immediately. That said, the central message of our paper still goes through: the real effects of funding shocks are smaller in the baseline model with money than in the moneyless economy.

We also investigate how inflation affects the propagation of financial shocks to the real economy by repeating the same quantitative experiments for different inflation levels. Intuitively, higher inflation makes the propagation of financial shocks stronger as the higher associated cost of carrying money makes it harder for agents to substitute the foregone liquidity. Under higher inflation, a liquidity shock leads to a greater decrease in the consumers' spending power and, as a result, a greater decrease in output. A larger decrease in output corresponds to lower incentives for firms to enter and consequently higher unemployment. Indicatively, if the inflation rate is 18% (it is 4% in the baseline economy), unemployment increases by 0.3% and GDP decreases by 1.1% from their calibrated values when bonds lose their liquidity properties entirely. When inflation is above 43%, the economy is at a non-monetary equilibrium regardless of the level of bond pledgeability, hence the impact of financial shocks in the baseline economy is then identical to that in the moneyless benchmark.

The thread that runs among all main results of our paper rests on the portfolio substitution between money and bonds. Intuitively, when money is available it allows agents to substitute away from bonds, as bonds become less liquid or more scarce following a liquidity or funding shock, respectively, thus mitigating the quantitative impact of financial disruptions. In contrast, in the moneyless economy agents cannot make this substitution and the quantitative impact of financial disruptions is large, in line with the results of the existing literature. We provide two pieces of evidence to show the empirical relevance of the money-bond substitutability. First, we use aggregate data to document that during the financial crises of 2001 and 2009 money holdings increased both as a fraction of GDP and as a fraction of financial assets. Second, this is in line with recent micro evidence from investor portfolios provided by Gabaix, Koijen, Mainardi, Oh, and Yogo (2023). They find that portfolio flows toward risky assets fall, while portfolio flows towards money increase during times of financial turmoil. As the authors explain, money is both a safe financial asset and a liquidity buffer used to smooth liquidity shocks, in accord with the money-bond substitutability in our model.

Issuing corporate bonds is one of the main avenues firms have to cover their borrowing needs. The corporate bond market has almost tripled in size since 2008 (reaching 20% of nominal GDP in 2019; see Kaplan et al. 2019 and Bochner, Wei, and Yang 2020), which indicates that firms rely heavily on bond issuance as a source of funding for new projects and job creation.[1] Moreover, the finance literature has documented that liquidity considerations are of first order importance for explaining corporate bonds yields (Bao, Pan, and Wang, 2011; Lin, Wang, and Wu, 2011; He and Milbradt, 2014; d'Avernas, 2018). For these reasons, the issuance of corporate bonds and the careful consideration of their liquidity aspects are at the core of our analysis.

Our results highlight the importance of liquidity substitution for a complete understanding of the connection between real and financial variables. Through the lens of our model, financial crises can be mitigated as long as there is no binding scarcity of liquid assets. Even if agents routinely rely on bonds for payments, what matters is to be able to substitute this liquidity with something else when needed. In our model, agents achieve this with money. In this sense, the macroprudential prescription of our model is close to what central banks actually do in times of financial turmoil: flood the balance sheets of market participants with liquid assets to ensure that there is no liquidity scarcity in the system. Our analysis implies that those financial shocks that do result in deep recessions are those in which liquidity dries up so severely that agents cannot quickly substitute into different asset classes. This discussion highlights another policy-relevant message of our paper: high inflation regimes, like the ones many developed economies have recently experienced, raise the likelihood of a financial *shock* turning into a severe financial *crisis*.

This paper is conceptually related to recent work by Lagos and Zhang (2022) who highlight the importance of explicitly modeling money for macroeconomic outcomes. The authors show that the existence of money provides additional bargaining power to sellers of goods versus financial intermediaries, and that this channel is significant even when the share of monetary transactions in the economy is arbitrarily small. Our question is different, since we focus on the effects of financial disruptions on real economic variables, but our main message is very similar: moneyless models do not come without a loss of generality. Thus, we view our work as complementary to the papers studying real-financial linkages without explicitly modeling money, such as Monacelli, Quadrini, and Trigari (2011), Jermann and Quadrini (2012), Christiano et al. (2014), Petrosky-Nadeau (2014), Buera, Jaef, and Shin (2015), and Dong (2022).

Our paper belongs to a growing body of work that extends the New Monetarist framework (see Lagos, Rocheteau, and Wright 2017 for a comprehensive review) to include a frictional labor market and study the effects of monetary and financial channels on equilibrium unemployment. The seminal paper in this strand of the literature is Berentsen et al. (2011), which we extend by adding issuance of (liquid) corporate bonds

[1] According to balance sheet data from the US Flow of Funds, in the last five years corporate bonds comprised 56% of the total liabilities (debt securities and loans) of nonfinancial corporate businesses.

and different types of liquidity shocks. Other papers in this line of work include Rocheteau and Rodriguez-Lopez (2014), Bethune, Rocheteau, and Rupert (2015), Branch, Petrosky-Nadeau, and Rocheteau (2016), Dong and Xiao (2019), Jung and Pyun (2020), Branch and Silva (2021), Bethune and Rocheteau (2021), Lahcen, Baughman, Rabinovich, and van Buggenum (2022), and Gu, Jiang, and Wang (2023). The majority of these papers focus on the relationship between inflation and unemployment. To the best of our knowledge, this is the first paper to examine the real effects of financial shocks in a model where money is essential, and under different inflation regimes.

Our paper is also related to the recent New Monetarist literature that highlights the importance of liquidity for the determination of asset prices; see Geromichalos, Licari, and Suárez-Lledó (2007), Lagos (2011), Nosal and Rocheteau (2013), Andolfatto, Berentsen, and Waller (2014), Geromichalos and Simonovska (2014), Hu and Rocheteau (2015), and Lee (2020).[2] Moreover, since we perform a calibration and numerical analysis of the model, our paper is also linked to several New Monetarist papers with a quantitative focus. Examples include Chiu and Molico (2010), Aruoba and Schorfheide (2011), Aruoba, Waller, and Wright (2011), and Venkateswaran and Wright (2013). Finally, our work is related to the literature initiated by Duffie, Gârleanu, and Pedersen (2005), which studies how frictions in OTC markets affect asset prices and trade; examples include Weill (2007, 2008), Lagos and Rocheteau (2009), Chang and Zhang (2015), Üslü (2019), and Gabrovski and Kospentaris (2021).

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 the numerical exercises and provide quantitative results. Section 6 concludes the paper. In Appendix A, we provide the notation for the model out of steady state, while Appendices B and C contain additional quantitative results.

2 The Model

Time is discrete and the horizon is infinite. There are two 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. Each period consists of four sub-periods where different economic activities take place. In the first sub-period, a labor market

[2] A more recent strand of this literature assumes that assets do not serve directly as means of payment or collateral, but they are indirectly liquid, as agents can sell them for cash in a secondary market. This approach is explored in several recent papers, such as Berentsen, Huber, and Marchesiani (2014), Mattesini and Nosal (2016), Geromichalos and Herrenbrueck (2016), and Madison (2019).

in the spirit of Pissarides (2000) opens where firms search for workers. In the second 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 necessary. In the third sub-period, firms visit a financial market where they seek the assistance and expertise of financial institutions (or underwriters) in order to issue corporate bonds.[3] 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 markets as LM (labor market), GM (goods market), FM (financial market), and CM (centralized market).

All agents discount the future between periods at rate $\beta \in (0,1)$. Households consume in the GM and the CM 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 is 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. We assume that the utility function of the special good 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 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 $j \in \{L, G, F\}$ ("L" for Labor market, "G" for Goods market, and "F" for Financial market).[4] These matching functions exhibit constant returns to scale

[3] Thus, technically, there is a third type of agents, the financial underwriters. However, as we shall see shortly, the role of these agents is quite mechanical, and there is no need to explicitly study their behavior.

[4] For instance, in the LM, s_L represents 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 GM, s_G is the measure of firms selling the special good, and b_G the measure of households buying that good. Finally, in the FM, s_F is the measure of financial institutions selling their underwriting services, and b_F the measure of firms seeking a financial institution who will assist them with the issuance of bonds.

and are increasing in both arguments. Regarding bargaining, we adopt the proportional bargaining solution of Kalai (1977), and in line with our earlier notation choice, we will let $\eta_j \in [0,1]$ denote the bargaining power of the seller in market $j \in \{L, G, F\}$.

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. Corporate bonds are issued by firms in order to fund their recruiting efforts and production. Recall that in order to issue bonds firms must first meet an underwriter. We assume that the meeting process takes place in the FM, however, the issuing of bonds takes place in the CM, which is precisely why we have chosen this specific timing of events.[5] Thus, we think of the CM as the primary market where these bonds are issued by the firms (with the help of an underwriter they met in the preceding FM) and purchased by households. 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.

We now move on to the discussion of one of the most important elements of the model, that of liquidity. To capture the empirically relevant observation that corporate bond prices include a liquidity component (or premium), we assume that bonds serve alongside money as means of payment or collateral that can facilitate trade in the GM. To capture the idea that money and corporate bonds need not be equally effective liquid assets, we assume that the *pledgeability* (or acceptability) of money is $\lambda_m \in [0,1]$, while the pledgeability of bonds (assets) is $\lambda_a \in [0,1]$. These terms denote the fraction of money and bonds, respectively, that can be used for transactions in a GM trade. Assuming that $\lambda_m = 1$, i.e., assuming that money is universally accepted as a medium of exchange, seems natural. However, one of the main goals of the paper is to show that the real effects of financial shocks are less significant in a model where agents have access to money. We believe that the transparency of this exercise would improve if we can also show that the effectiveness of our mechanism weakens as agents have "less access" to money, and this is precisely what a diminishing value of λ_m captures.[6]

[5] In that sense, one could think of the FM, not as a distinct fourth market, but as the "first stage" of the CM. These would be equivalent specifications.

[6] Put differently, allowing λ_m to vary, allows us to capture different levels of "money availability" in the model, including the limit as $\lambda_m \to 0$, which one can interpret as a *moneyless* economy. This is an interesting benchmark, as it coincides with the vast majority of the existing literature, where money is not explicitly modeled. We would like to thank an anonymous referee and the editor for suggesting this experiment.

Next, consider the FM. The only economic activity in this market is the search and matching between firms and underwriters. Firms who wish to enter the FM and search for an underwriter must pay an entry fee κ_F per period. Notice that the term b_F (the mass of "buyers" in the FM) will include existing firms who wish to issue bonds to fund their next period production, and new entrants who wish to issue bonds to fund their recruiting *and* production. Firms that are not successful at finding an underwriter must exit. Since the role of underwriters is trivial, i.e., they provide their expertise to help firms issue bonds, we keep this market as simple as possible: we set the measure of underwriters equal to the unit ($s_F = 1$), and do not explicitly model their preferences or actions.[7] Despite our strategy to suppress the role of underwriters, it should be clear that the FM plays an important role in our model. Specifically, in Section 5, we study the effects of two types of "financial shocks". The first is a shock in the pledgeability of the bonds (the term λ_a), and the second is a shock in the ability of firms to raise funding, which in our model amounts to a shock in the efficiency of matching in the FM.

Any given match in period t's LM is terminated in the next period with probability δ, i.e., $\delta \in (0, 1)$ is the economy's *exogenous* job separation rate. But firms also need to exit if they do not find an underwriter in the FM. Thus, an existing job in period t remains active in $t+1$ with an effective probability $(1-\delta)f_F/b_F$. Firms that enter the market to search for workers must pay recruiting costs κ_R and operating costs κ_O, and firms that are already matched with a worker only pay the latter. These costs must be funded through issuance of corporate bonds, as discussed. Since the focus of our paper is on bond liquidity, and how it affects firm entry, we abstract away from firm default. Specifically, firms who entered the market and were able to issue bonds to fund recruitment and production (i.e., they matched in the FM), but were not able to match with a worker in the LM, will not be able to produce in the LM (or the GM); nevertheless, we assume that they can repay their debt by working more in the CM. One can think that this assumption captures the idea that firms can sell assets (such as buildings or machines) to repay their debtors.[8] Firms that are matched and productive in the LM pay a wage w to the worker.

[7] It is also implicitly assumed that underwriters do not get a fraction of the surplus generated through the issuance of bonds, i.e., $\eta_F = 0$. See also Footnote 5, and the related discussion.

[8] One could assume that firms that do not meet a worker, and can, therefore, not produce in the LM, default on their debt. We could easily deal with this setup, if we paired it with the assumption that households do not buy firm-specific debt, but they purchase a mutual fund or a composite bond of all firms. Then, even if a fraction x of firms default every period, the households expect it, and the only thing that would change in our analysis is that the fundamental value of the bond would now be $(1-x)\beta$, as opposed to just β. That is not to say that modeling debt default in a (more) meaningful way is not interesting. But recent literature reveals that studying the relationship between asset riskiness/default and liquidity properly is a complicated task; see for example Geromichalos, Herrenbrueck, and Lee (2023). Since the focus of this paper is on the liquidity properties of corporate bonds and how they affect job entry and (un)employment,

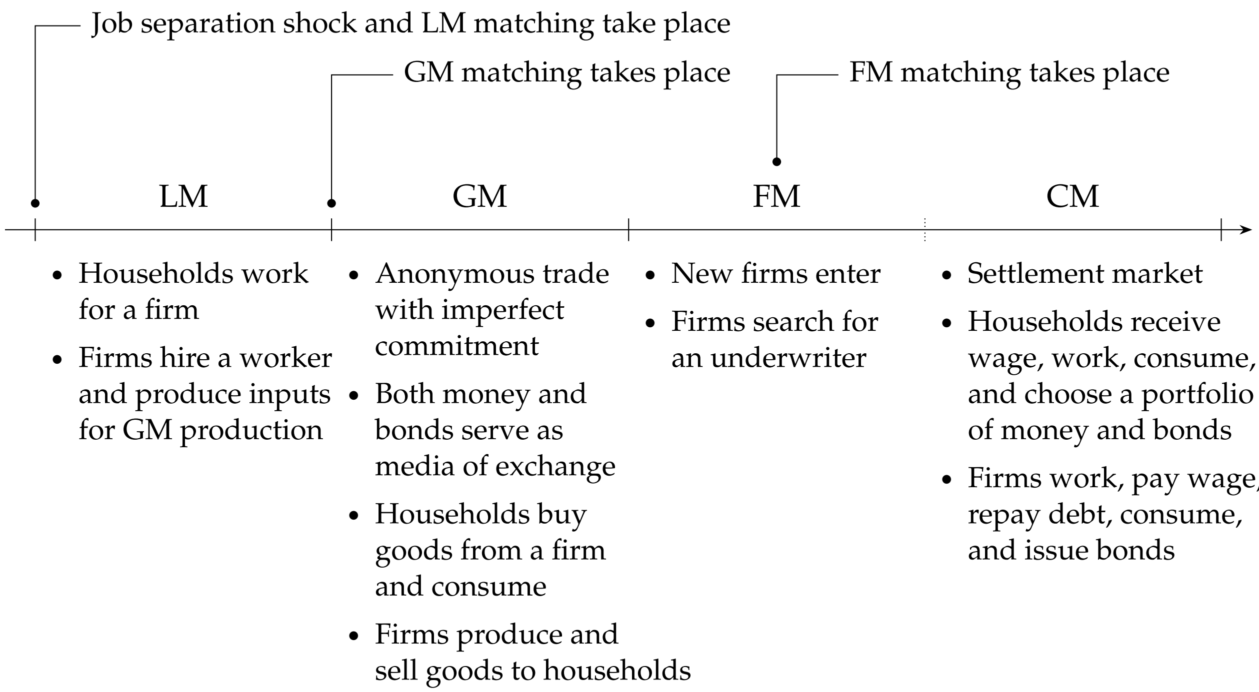

Figure 1: Timing of Events.

Following Berentsen et al. (2011), we assume that w is paid in numeraire good in the CM. Unemployed workers enjoy an unemployment benefit b also delivered in the CM.

Figure 1 summarizes the main economic activities in our model and clarifies the timing of the various shocks. Notice that the exogenous job separation shock and the LM matching take place at the very end of each period (or, equivalently, at the very beginning of the next period). Let us point out that a worker/household who just lost their job cannot search for a new job right away; they need to spend one period in unemployment.

3 Analysis of the Model

3.1 Value functions

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

we think it is best to shut down debt default altogether, rather than introducing it in an uninteresting way.

function is

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

where m' and a' are money and bond holdings for the next period, and U_e^h is the next period's LM value function. The next period's employment status depends on the job separation shock δ as well as the FM matching outcome of the firm employing the household. The household will still be employed if the firm finds an underwriter in the FM (so that it can issue bonds in the CM) *and* if the match does not get destroyed. Otherwise, the household will be unemployed in the next period. The household also receives the monetary lump-sum transfer T. Moving on to the CM value function of an unemployed household, we have

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

Notice that in the last expression whether the household will be employed or unemployed in the next period depends on the outcome of the LM matching process. Also, note that the value function W_e^h is linear, that is, $W_e^h(m,a) = \varphi m + a + W_e^h(0,0)$, as is standard in models that build on LW. This result follows from (quasi-)linear preferences.

We now move to the LM value functions. For a household at state e, we have

$$U_e^h(m,a) = V_e^h(m,a), \quad e = 0,1,$$

where V_e^h denotes this household's GM value function and is given by

$$V_e^h(m,a) = \frac{f_G}{b_G}\left(u(q) + W_e^h(m-\xi, a-\chi)\right) + \left(1 - \frac{f_G}{b_G}\right)W_e^h(m,a), \quad e = 0,1.$$

If matched with a firm in the GM (with probability f_G/b_G), the household gets the opportunity to consume in the GM. The household pays the firm ξ units of money and χ units of bonds to purchase q units of the GM good. If not matched, the household proceeds to the CM without trading.

Firms Consider first a firm that wants to open a vacancy. Opening a vacancy requires covering the recruiting and operating costs, and the firm must finance these costs by selling bonds. To do so, the firm must look for an underwriter in the FM who will help with issuing and selling bonds. As we have already explained, the FM can be viewed as the first stage of the CM, where bonds are effectively issued and sold. (See Footnote 5.) Thus, we start by describing the consolidated FM-CM value function of the typical firm, which is given by

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

Looking for an underwriter in the FM incurs the entry costs κ_F, and the firm can find one with probability f_F/b_F. If successfully matched with one, the firm issues and sells bonds in the CM to cover the recruiting and operating costs. Specifically, the firm must finance the total cost $\kappa_R + \kappa_O$ by selling bonds at the price ψ. Hence, its resulting debt, denoted d', is $(\kappa_P + \kappa_O)/\psi$. After that, the firm continues to the LM, opens a vacancy, and looks for a worker. The LM value function is denoted U_e^f, which depends on whether the firm is matched with a worker ($e = 1$) or not ($e = 0$).

The FM-CM value function of a firm that is currently matched with a worker is

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

where n is the amount of the LM output leftover after GM production has concluded (that is, $n = y - q$), m and a are the amounts of money and bonds the firm received in the GM, and d is the debt from issuing bonds in the previous period. This firm must raise funds to cover the operating costs. To do so, it again needs to look for an underwriter in the FM, which incurs the entry costs κ_F. If the firm finds an underwriter *and* the existing match with a worker survives (with probability $f_F/b_F \cdot (1-\delta)$), it issues bonds and proceeds to the LM.[9] Note that the value function W_1^f is linear, that is, $W_1^f(n, m, a, d) = n + \varphi m + a - d + W_1^f(0, 0, 0, 0)$, as was the case for the consumer's CM value functions.

Inspection of these value functions highlights the *first channel* discussed in the introduction: a higher pledgeability of bonds leads to a higher issue price (ψ), which, in turn, allows firms to raise funds at more favorable rates, thus increasing profitability and encouraging entry.

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

[9] If the firm cannot find an underwriter or the current match gets destroyed, it will exit the market and get a payoff of 0, which is why the term U_0^f does not appear.

must still repay its debt, and therefore 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 move on to the LM. The LM value function of a matched firm is

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

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

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

Finally, the GM value function of a firm (matched with a worker) is

$$V_1^f(d) = \frac{f_G}{s_G} W_1^f(y - q, \xi, \chi, d) + \left(1 - \frac{f_G}{s_G}\right) W_1^f(y, 0, 0, d).$$

If matched with a household/customer (with probability f_G/s_G), the firm sells q units of the GM good and receives ξ units of money and χ units of bonds. If not matched, the firm proceeds to the CM without trading.

3.2 Terms of trade

Terms of trade in the GM Consider a meeting between a household with m units of money and a units of bonds and a matched firm with y units of LM output. The two parties bargain over the quantity of the GM good q to be produced by the firm and the cash payment ξ and the bond payment χ to be made by the household. The household's surplus from a successful trade is

$$S^h = u(q) + W_e^h(m - \xi, a - \chi) - W_e^h(m, a) = u(q) - \varphi\xi - \chi,$$

and the firm's surplus is

$$S^f = W_1^f(y - q, \xi, \chi, d) - W_1^f(y, 0, 0, d) = -q + \varphi\xi + \chi,$$

where, in both cases, the second equalities have exploited the linearity of W_e^h and W_1^f. The terms of GM trade (q, ξ, χ) are determined by proportional bargaining, where the firm's bargaining power is η_G:

$$\max_{q,\xi,\chi} S^f \quad \text{s.t.} \quad S^f = \frac{\eta_G}{1-\eta_G} S^h, \;\; \xi \leq \lambda_m m, \;\; \chi \leq \lambda_a a, \;\; \text{and} \;\; q \leq y.$$

The constraints $\xi \leq \lambda_m m$ and $\chi \leq \lambda_a a$ state that the household's cash and bond payment cannot exceed the pledgeable amount of money and bond holdings. The constraint $q \leq y$ states that GM production uses LM output as an input and that the firm cannot leave with a negative amount of LM output. We assume, as in Berentsen et al. (2011), that y is sufficiently large and that $q \leq y$ does not bind. The Kalai constraint implies

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

where $\sigma(q)$ is the real value of payment (ξ, χ) needed to purchase q units of the GM good. If the real value of the household's portfolio (m, a) is sufficient to purchase q^* units of the GM good, the optimal quantity will be traded with any payment $(\tilde{\xi}, \tilde{\chi})$ whose real value equals $\sigma(q^*)$. Otherwise, the household will spend all the pledgeable amount of money and bond holdings. That is, the bargaining solution is given by

$$q(m,a) = \begin{cases} q^*, & \text{if } \lambda_m \varphi m + \lambda_a a \geq \sigma(q^*) \\ \sigma^{-1}(\lambda_m \varphi m + \lambda_a a), & \text{otherwise,} \end{cases}$$

$$\big(\xi(m,a), \chi(m,a)\big) = \begin{cases} (\tilde{\xi}, \tilde{\chi}) \;\; \text{s.t.} \;\; \varphi\tilde{\xi} + \tilde{\chi} = \sigma(q^*), & \text{if } \lambda_m \varphi m + \lambda_a a \geq \sigma(q^*) \\ \qquad\qquad\quad \tilde{\xi} \leq \lambda_m m, \;\; \tilde{\chi} \leq \lambda_a a, & \\ (\lambda_m m, \lambda_a a), & \text{otherwise.} \end{cases}$$

The bargaining solution reflects the *second channel* discussed in the introduction: a higher pledgeability of bonds increases the consumers' effective liquidity (and purchasing power in the GM), which, in turn, increases the firms' profitability and encourages entry.

3.3 Optimal portfolio choice

Households choose their optimal portfolio in the CM independently of their trading histories in previous markets, as is standard in models that build on LW. To analyze the households' optimal behavior, we substitute their LM and GM value functions into their CM value function, collect the terms relevant to choice variables, and obtain the objective function in the CM:

$$J(m', a') = -(\varphi - \beta\varphi')m' - (\psi - \beta)a' + \beta\,\frac{f_G}{b_G}\Big[u(q(m', a')) - \varphi\xi(m', a') - \chi(m', a')\Big].$$

The interpretation is straightforward. The first two negative terms represent the cost of choosing a portfolio (m', a'), net of their payout in the next period's CM. The portfolio also offers certain liquidity benefits, but these will only be relevant if the household gets the opportunity to consume in the GM; thus, the rest of the terms are multiplied by f_G/b_G. The term in the square bracket represents the surplus of the household from GM trade.

3.4 Equilibrium

In our economy, the money growth rate μ affects the economy via the transformation $i \equiv (1+\mu)/\beta - 1$, which can be interpreted as opportunity cost of holding money, or as a benchmark 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.) But while using i makes the following equations easier to read, the exogenous monetary policy instrument is still the money growth rate μ.

Money and bond market equilibrium The equilibrium price of money clears the money market, and the real balances are given by

$$z = \varphi M.$$

The bond market clears ($a = A$) and the bond supply is endogenously determined by

$$A = b_L \frac{\kappa_R + \kappa_O}{\psi} + (1 - s_L)\frac{f_F}{b_F}(1 - \delta)\frac{\kappa_O}{\psi}. \tag{1}$$

In the GM, the following quantity of the GM good is traded:

$$q = \min\{q^*,\, \sigma^{-1}(\lambda_m z + \lambda_a A)\}. \tag{2}$$

The households' optimal portfolio choice characterizes the demands for money and bonds. The money demand is given by

$$i \geq \lambda_m \frac{f_G}{b_G}\left[\frac{u'(q)}{\sigma'(q)} - 1\right], \tag{3}$$

where the equality holds if $z > 0$. The left-hand side, $i > 0$, represents the cost of carrying money, whereas the right-hand side is the marginal benefit of bringing one more unit of money. If the cost of carrying money is too high, that is, if i exceeds the right-hand side evaluated at $z = 0$, households will not carry any money and we have a non-monetary equilibrium where $\varphi = 0$ and $z = 0$, with the inequality holding strictly. If i is not too high, we have a monetary equilibrium where $z > 0$ equates both sides of the inequality.[10]

Given supply, the households' bond demand determines the equilibrium bond price:

$$\psi = \beta\left(1 + \lambda_a \frac{f_G}{b_G}\left[\frac{u'(q)}{\sigma'(q)} - 1\right]\right). \tag{4}$$

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 a product of three terms: first, the pledgeability of bonds λ_a; second, the probability of GM matching f_G/b_G; and third, the marginal surplus of the match, that is, the net utility gain in the GM from bringing one more real unit of the pledgeable amount of portfolio. Thus, there are two cases where the liquidity premium is zero: the pledgeability of bonds becomes 0 ($\lambda_a = 0$), or bonds are so plentiful that spending one more unit of the GM good does not create any additional surplus ($q = q^*$ and $u'(q^*)/\sigma'(q^*) = 1$). In the latter case, bonds are still "liquid", but their liquidity is inframarginal and does not affect the price.

Labor and financial market equilibrium Free entry to the FM implies $W_v^f = 0$; that is,

$$\kappa_F = \beta\,\frac{f_F}{b_F}\left[\frac{f_L}{b_L}\,U_1^f\left(\frac{\kappa_R + \kappa_O}{\psi}\right) + \left(1 - \frac{f_L}{b_L}\right)U_0^f\left(\frac{\kappa_R + \kappa_O}{\psi}\right)\right].$$

Notice that $U_0^f(d) = -d$ and that

$$\begin{aligned}
U_1^f(d) &= \frac{f_G}{s_G}W_1^f(y - q, \xi, \chi, d) + \left(1 - \frac{f_G}{s_G}\right)W_1^f(y, 0, 0, d) \\
&= W_1^f(y, 0, 0, d) + \frac{f_G}{s_G}\left(W_1^f(y - q, \xi, \chi, d) - W_1^f(y, 0, 0, d)\right)
\end{aligned}$$

[10] This result is quite intuitive. In this type of environment, money has a direct competitor as a means of payment: bonds. Thus, if the monetary authority pushes inflation (or the interest rate i) above a certain threshold, agents will choose to carry out their transactions using bonds exclusively, which is to say that the equilibrium becomes non-monetary. As for the value of that threshold, it depends on the bond supply and the degree of substitutability between money and bonds (which here depends on the terms λ_m and λ_a. For more details, see Geromichalos et al. (2007) and Lester, Postlewaite, and Wright (2012).

$$= y - d - w - \kappa_F + \beta \frac{f_F}{b_F}(1-\delta) U_1^f\left(\frac{\kappa_O}{\psi}\right) + \frac{f_G}{s_G}\,\eta_G(u(q)-q).$$

We define

$$R \equiv y + \frac{f_G}{s_G}\,\eta_G(u(q)-q),$$

which represents the firm's expected revenue, net of production costs. From above, we can solve for $U_1^f(\frac{\kappa_O}{\psi})$:

$$U_1^f\left(\frac{\kappa_O}{\psi}\right) = \frac{R - w - \frac{\kappa_R}{\psi} - \kappa_F}{1 - \beta\frac{f_F}{b_F}(1-\delta)}.$$

The linearity of $U_1^f(d)$ implies $U_1^f(\frac{\kappa_R+\kappa_O}{\psi}) = U_1^f(\frac{\kappa_O}{\psi}) - \frac{\kappa_R}{\psi}$. Plugging $U_1^f(\frac{\kappa_R+\kappa_O}{\psi})$ back to the free entry condition yields

$$\frac{\kappa_R+\kappa_O}{\psi} + \frac{f_L}{b_L}\,\frac{\beta\frac{f_F}{b_F}(1-\delta)}{1-\beta\frac{f_F}{b_F}(1-\delta)}\,\frac{\kappa_O}{\psi} + \left(\frac{1}{\beta\frac{f_F}{b_F}} + \frac{f_L}{b_L}\frac{1}{1-\beta\frac{f_F}{b_F}(1-\delta)}\right)\kappa_F = \frac{f_L}{b_L}\,\frac{R-w}{1-\beta\frac{f_F}{b_F}(1-\delta)}. \tag{5}$$

This equation plays the role of the job creation curve in the economy. On the left-hand side are the expected costs a firm faces when contemplating entry. The first term is the cost of creating and operating the vacancy for the initial period the firm is created. The second term is the present discounted value of the operating costs the firm expects to pay over the lifetime of the job. The third term is the expected discounted sum of costs the firm will incur to search for financing. Since the first two terms represent costs that the firm pays through the means of issuing bonds, the bond price ψ affects them directly. In particular, as the bond liquidity increases and the price goes up, firms can cover their recruiting and operating costs with fewer bonds (i.e., with a lower future debt), a channel that encourages more firms to enter the market.

The wage curve is determined through wage bargaining in the LM. The worker's surplus from successful bargaining is $U_1^h(m,a) - U_0^h(m,a)$, and the firm's surplus is $U_1^f((\kappa_R+\kappa_O)/\psi) - U_0^f((\kappa_R+\kappa_O)/\psi)$. Proportional bargaining, where the worker's bargaining power is η_L, implies

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

Observe, on the left-hand side, that

$$U_1^f\left(\frac{\kappa_R+\kappa_O}{\psi}\right)-U_0^f\left(\frac{\kappa_R+\kappa_O}{\psi}\right)=U_1^f\left(\frac{\kappa_O}{\psi}\right)+\frac{\kappa_O}{\psi},$$

and, on the right-hand side, that

$$U_1^h(m,a)-U_0^h(m,a)=w-b+\beta\left(\frac{f_F}{b_F}(1-\delta)-\frac{f_L}{s_L}\right)\Big[U_1^h(m',a')-U_0^h(m',a')\Big].$$

From above, using the fact that $U_1^h(m,a)-U_0^h(m,a)=U_1^h(m',a')-U_0^h(m',a')$ in steady state, we can solve for $U_1^h(m,a)-U_0^h(m,a)$. With these two observations, from the bargaining solution, we can derive the wage curve:

$$w=\frac{(1-\eta_L)\big(1-\beta\frac{f_F}{b_F}(1-\delta)\big)b+\eta_L\big(1-\beta\big(\frac{f_F}{b_F}(1-\delta)-\frac{f_L}{s_L}\big)\big)\big(R-\beta\frac{f_F}{b_F}(1-\delta)\frac{\kappa_O}{\psi}-\kappa_F\big)}{1-\beta\frac{f_F}{b_F}(1-\delta)+\eta_L\,\beta\,\frac{f_L}{s_L}}. \tag{6}$$

Finally, the Beveridge curve is given by

$$(1-s_L)\left(1-\frac{f_F}{b_F}(1-\delta)\right)=f_L. \tag{7}$$

Measures of sellers and buyers We close the model with the accounting identities for the sellers and buyers at different markets. The measures of successful matches in the LM, GM, and FM are determined, respectively, by the matching technologies $f_L=f_L(b_L,s_L)$, $f_G=f_G(b_G,s_G)$, and $f_F=f_F(b_F,s_F)$, where $s_G=1-s_L$, $b_G=1$, $s_F=1$, $b_F=\epsilon+1-s_L$, $b_L=\epsilon\cdot f_F/b_F$, and ϵ denotes the measure of new entrants to the FM.

We now define the steady state equilibrium of the model. An equilibrium out of steady state can be analogously defined using the equations derived in Appendix A.

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

4 Calibration

We calibrate the model at a monthly frequency. Several parameters are set exogenously to their direct empirical counterparts or following the literature. The discount factor 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) and Herrenbrueck (2019). Regarding the annual nominal rate, we cannot use any observed interest rate since 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).[11] 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 as well as the pledgeability of money λ_m to 1. The former is standard in New Monetarist models; see Kiyotaki and Wright (1993) and Berentsen et al. (2011), among others. Regarding the latter, in Section 5, we explore a moneyless version of our model by setting λ_m to 0. 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 of the New Monetarist literature, e.g., Berentsen et al. (2011) or Bethune et al. (2020), we work with 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 for which we need to specify matching functions. We parameterize all matching functions symmetrically with 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 $j \in \{L, G, F\}$. Matching probabilities f_j/b_j (for buyers) and f_j/s_j (for sellers) are truncated at 1.

In total, this leaves us with eleven parameters to be calibrated through the lens of the model: the households' utility function parameters, B and γ; the job separation shock, δ; the matching efficiency in the labor and financial market, α_L and α_F; the bargaining shares of sellers in the labor and product market, η_L and η_G; the firms' recruiting and operating costs, κ_R and κ_O; the firms' entry costs in the financial market, κ_F; and, finally, the pledgeability of bonds, λ_a.

To pin down these parameters, we employ various labor, monetary, and financial moments. To begin with, we use two moments on separations to pin down δ and α_F. First, Shimer (2005) estimates a monthly separation rate for the US economy of 3%. The model corresponding expression for this rate is given by $1-(1-\delta)f_F/b_F$. Second Gabrovski, Kospentaris, and Lebeau (2023) estimate that 77.67% of separations are due to non-financial reasons. The model counterpart of this rate is δ. Together these two moments imply $\delta = 2.33\%$ and $1-(1-\delta)f_F/b_F = 3\%$, which in turn pins down α_F. Given the values of δ and α_F, the matching efficiency in the labor market α_L adjusts to match the long-run average of the unemployment rate in the US economy (Petrosky-Nadeau, 2013). Furthermore, the firm's entry costs κ_F are pinned down by matching the long-

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

Parameter	Description	Value
	Externally Calibrated Parameters	
β	Discount Rate	0.9975
i	Nominal Interest Rate (Annual)	7%
y	Match Output in the LM	1
b	Unemployment Flow Value	0.71
λ_m	Pledgeability of Money	1
α_G	Matching Efficiency in the GM	1
	Internally Calibrated Parameters	
B	Household's Utility Coefficient	0.9368
γ	Household's Utility Elasticity	0.1483
δ	Job Separation Shock	0.0233
α_L	Matching Efficiency in the LM	1.41
α_F	Matching Efficiency in the FM	1.9567
η_L	Worker's Bargaining Power in the LM	0.3333
η_G	Firm's Bargaining Power in the GM	0.9329
κ_R	Firm's Recruiting Costs	0.1030
κ_O	Firm's Operating Costs	0.0593
κ_F	Firm's Entry Costs in the FM	0.1688
λ_a	Pledgeability of Bonds	0.5304

Table 1: Calibrated Parameters.

run average of the labor market tightness from the Job Openings and Labor Turnover Survey (JOLTS).[12]

Next, to pin down η_G, we follow Bethune et al. (2020) and target the average markup of 1.39 in the product market, whose model counterpart is given by $\sigma(q)/q$. Moreover, the firm's operating costs κ_O are informed by the corporate bond supply data. To pin down κ_O, we match the average issuance level of investment-grade bonds as a fraction of GDP from Refinitiv (which is equal to $\psi A/((1-s_L)R)$ in the model).[13] Given this,

[12] One might wonder why the financial market parameters, α_F and κ_F, are used for the labor market moments. The reason is that, in our model, financial frictions are an important cause for firm-worker match dissolution. Thus, the likelihood of finding financing is tightly linked to separations. Moreover, vacancies in the labor market can only be opened if the firm has first secured financing. Thus, barriers to entry into the financial market are a key determinant of the labor market vacancy mass.

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

Target	Data	Source
Job Separation Rate	3%	Shimer (2005)
Separations due to Non-financial Reasons	77.67%	Gabrovski et al. (2023)
Unemployment Rate	6%	Petrosky-Nadeau (2013)
Labor Market Tightness	0.5	JOLTS
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.

the pledgeability of bonds λ_a adjusts 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, while Friewald, Jankowitsch, and Subrahmanyam (2012) estimate the spread of investment-grade bonds to be around 1%. These two numbers together give us an estimate of the liquidity premium of corporate bonds.

Regarding the utility function parameters, we follow the standard practice of the New Monetarist literature. The model object for the ratio of money holdings relative to GDP is given by $z/((1-s_L)R)$. We pin down B and γ by targeting the average money holdings as a fraction of GDP (Bethune et al., 2020) and the elasticity of money holdings with respect to the return on AAA bonds (Berentsen et al., 2011), respectively, using the data shared by Lucas and Nicolini (2015). Furthermore, to pin down the firm's recruiting costs κ_R, we use the estimation of Silva and Toledo (2009) that the hiring cost is 12.9% of the monthly compensation of a newly hired worker. Finally, for 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 at the equilibrium tightness).

The flexibility of the model allows to exactly pin down the parameters that make the model consistent with the empirical targets of our calibration. The calibrated parameter

considered practically default-free.

values are collected in the bottom panel of Table 1, while Table 2 summarizes the empirical targets and their sources. We use the calibrated model as a laboratory for various quantitative exercises in the following section. Before doing so, however, we provide further evidence regarding the model's external validity by looking at an important untargeted moment: the behavior of aggregate money holdings in response to financial turbulence.

Figure 2 plots the deviations from trend of three time series that express aggregate monetary holdings as a fraction of nominal GDP, a fraction of monetary, debt and equity holdings, as well as a fraction of all financial assets. Our definition of monetary aggregates is the sum of currency, checkable deposits, time and saving deposits, as well as money market shares and we use household balance sheet data from the Board of Governs of the Federal Reserve System. Moreover, both the recessions of 2001 and 2007-2009 were periods of intense financial turbulence due to the burst of the dot-com and the housing bubble, respectively. The first important point of Figure 2 is to provide direct empirical evidence in favor of the core model mechanism: in times of financial disruptions money holdings increase and agents substitute away from financial assets and towards money. Furthermore, the model-implied magnitude of this substitution is not far from the empirical one shown in Figure 2: during the Great Recession, for example, money holdings increased by 4 to 8 percentage points, depending on the money holdings measure of choice. As can be seen in Figure 3, reducing the pledgeability of corporate bonds from its calibrated value of 0.53 to 0 (the analogue of an extended financial crisis in the model in which assets lose their value), results in an increase of monetary holdings from 0.21 to 0.25 (the equivalent of four percentage points). Hence, the magnitude of asset substitution in the aggregate data and in the model is of similar magnitude, even though we did not include it in the calibration targets. This makes the model a reliable laboratory for the quantitative experiments conducted in Section 5.

To sum up, the core mechanism of the model seems absolutely in accord with the aggregate data. The literature has also provided further empirical support for the substitution between money and other financial assets by looking directly at evidence from investor portfolios. In a recent empirical contribution, Gabaix et al. (2023) examine monthly security-level data on U.S. household portfolio holdings from a wealth management platform to analyze asset demand across an extensive range of financial assets. Several of their findings are informative about the mechanism in our model: first, they find that, on average, investors sell risky assets during turbulent times. Second, in their sample, the average flows to liquid risky assets and cash are strongly negatively correlated with the time-series correlation being -71.0% (see Figure 10 on page 19 of their paper). Finally, portfolio flows toward liquid risky assets fall during times of financial turmoil (in their

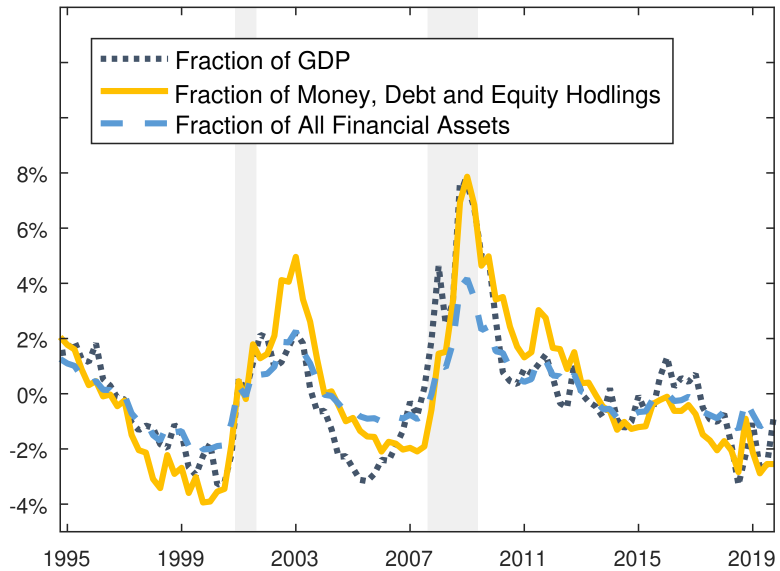

Figure 2: Money Holdings.
Deviations from Trend of Aggregate Monetary Holdings as a Fraction of GDP and Financial Assets.

sample, these are periods such as the last quarter of 2018 or the first quarter of 2020), while portfolio flows towards cash are positive during those same periods. As Gabaix et al. (2023) explain, the economic reason behind these results is that money is both a safe financial asset and a liquidity buffer used to smooth liquidity shocks (page 20). Hence, the role played by money in our model is supported by the micro data on investor portfolios.

5 Quantitative Analysis

In this section, we present the implications of the model for the relationship between monetary, financial, and real economic variables. To do so, we analyze how much unemployment and output change in response to shocks in: i) the pledgeability of corporate bonds λ_a ("liquidity shocks"), and ii) the FM matching efficiency α_F ("funding shocks").[14] We present results both for comparisons between steady states (which we use to lay out the model mechanisms), and the impulse response functions for one-time unanticipated ("MIT") financial shocks (which are more realistic). Finally, we show how the effects of these shocks vary for different levels of inflation in order to understand the interaction

[14] This terminology echoes the "market" and "funding" liquidity terms used by Brunnermeier and Pedersen (2009). In particular, their market liquidity refers to the ease with which an asset is traded, which is what our concept of bond pledgeability intends to capture in a reduced-form way. Moreover, when Brunnermeier and Pedersen (2009) refer to funding liquidity, they mean the ease with which financial traders can obtain funding. This is directly connected with how many borrowers they can serve, which is what the number of meetings in our FM market captures.

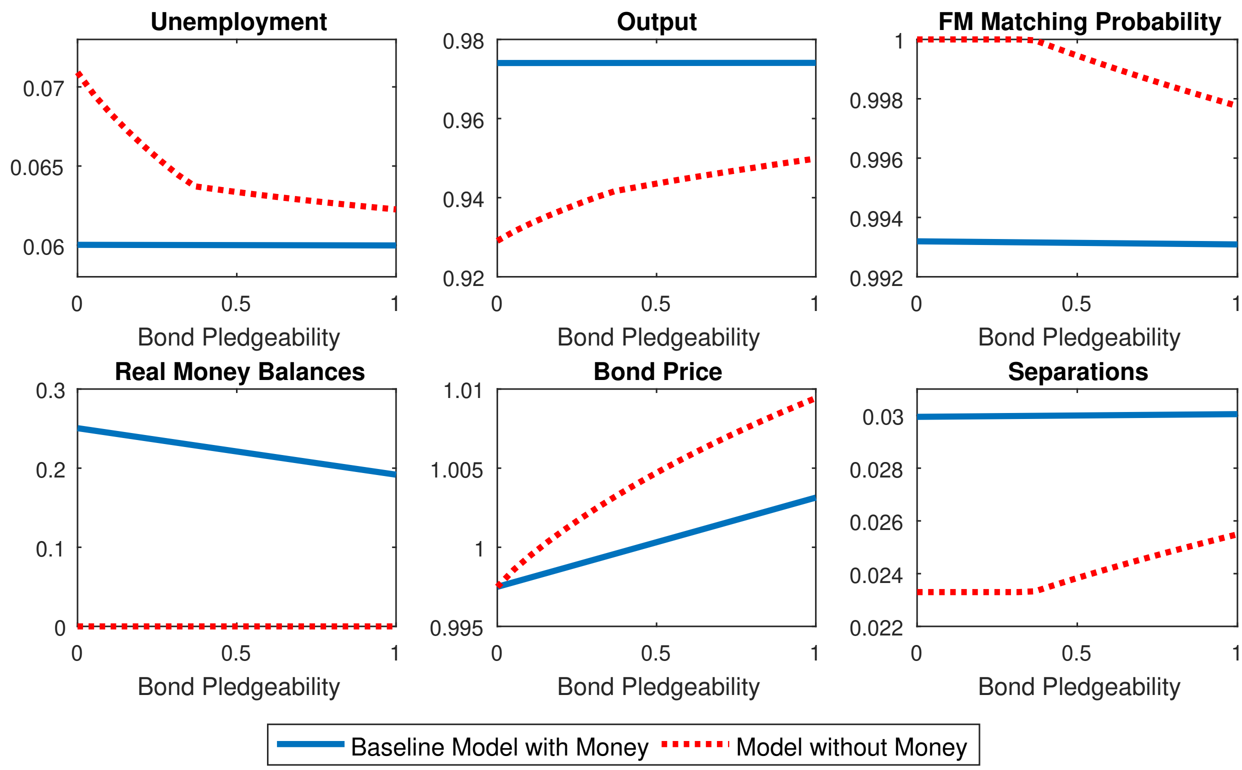

Figure 3: Liquidity Shocks.
Steady-state responses to changes in the pledgeability of corporate bonds.

between financial conditions and inflation levels, both of which are measures of interest to policymakers.

5.1 The Effects of Financial Shocks

We begin with the analysis of the impact of liquidity shocks on the real economy. That is, we consider the effects of varying the bond pledgeability parameter, λ_a, from 0 to 1 (its calibrated value lies roughly in the middle) on the unemployment rate, u, and aggregate output, $(1-u)R$. Effectively, for $\lambda_a = 0$ bonds become useless for liquidity purposes and just operate as saving vehicles priced at their fundamental value. To understand how the existence of money changes the impact of liquidity shocks, we perform the experiment in the baseline model with money, as well as a version of the model without a role for money (we achieve this by setting $\lambda_m = 0$, which implies zero real money balances).

As can be seen in Figure 3 (top left and middle panels), the impact of liquidity shocks strongly depends on the role of money in the model. To begin with, the model with money features lower unemployment and higher output for all levels of λ_a. This is intuitive: the more liquidity instruments agents have access to, the more the GM trade and the higher the firm entry. As a result, the economy's output is higher and unemployment is lower in the model with money. Moreover, reducing the level of bond pledgeability raises unemployment and lowers aggregate output in the model without money. There are two channels behind this effect. First, a lower level of λ_a reduces GM trade, firm revenue and firm entry, and thus raises unemployment. This is the case because, since there is no money in the economy, lower bond pledgeability reduces the total amount of liquid assets held by households, $\lambda_a a$. We dub this the *portfolio channel* because it captures the impact of changes in the household's asset portfolio. Second, a lower level of λ_a reduces the liquidity premium and, as a result, the corporate bond price (bottom middle panel of Figure 3). This, in turn, raises firms' borrowing costs, reduces firm entry, and raises unemployment; we dub this the *asset price channel* because it captures the impact of changes in the price of corporate bonds. Both the portfolio and asset price channel push unemployment up and output down in response to drops in bond pledgeability in the economy without money.

In the model with money, however, unemployment and output barely respond to changes in λ_a. The reason can be seen in the bottom left panel of Figure 3: agents increase their money holdings to cope with lower bond liquidity. As a result, the portfolio channel is muted in the model with money, because the aggregate liquidity of households' portfolio remains virtually constant. This leaves firm profit, firm entry, and aggregate unemployment practically unaffected by the value of λ_a. Notice that the asset price channel is still at work (bottom middle panel of Figure 3) but its effect on real variables is quantitatively insignificant: the magnitude of the bond liquidity premium is not strong enough to have a large effect on real variables. To sum up, the existence of money neutralizes negative liquidity shocks in the model by allowing agents to substitute away from bonds towards money as bonds become less liquid. Even though negative liquidity shocks lower the liquidity premium, which raises firms' borrowing costs, the effect of this asset price channel on real economic variables is quantitatively small.

In the model without money, the magnitude of the effect of bond pledgeability on real economic variables is sizeable: lowering λ_a from 1 to 0 raises the unemployment rate by almost a percentage point and reduces output by 2.1%. Additionally, we observe that there is a kink in the slope of the responses of real economic variables to changes in λ_a when the value of λ_a drops below 0.38. This kink arises from a kink in the FM matching probability, as can be seen in the top right panel of Figure 3. In general, there is a countervailing force to the profit channel triggered by drops in λ_a: since firm entry decreases, it is easier for firms that enter to match with an underwriter in FM. Hence, as shown in Figure 3 (top and bottom right panels), the probability to match in FM is greater and endogenous separations (due to lack of FM matches) are lower, which mitigates the negative effect of lower values of λ_a and tends to lower unemployment. This countervailing force, however, stops operating when firms match with underwriters in the FM with probability one, and after this point the slope of the responses of real economic variables to liquidity shocks becomes even larger. Hence, the response of the economy to liquidity shocks in the model is *state-dependent*: it depends on the state of primary financial markets, that is, how easily firms' borrowing needs can be accommodated.

Figure 4 depicts the responses of the economy to funding shocks: changes in the matching efficiency of the FM market, α_F. Following the logic of the liquidity shocks analysis, we perform the experiments in the baseline economy, as well as in an economy where money is absent, i.e., $\lambda_m = 0$. A lower α_F implies a larger number of firms that cannot issue bonds in the primary market. As a result, these firms will exit the market at the end of the period, which has a direct negative impact on output and unemployment. Moreover, since there are fewer corporate bonds available, the households' portfolio has lower liquidity, which lowers GM trade and further reduces output and increases unemployment. Effectively, funding shocks are a combination of both real firm-destruction shocks *and* liquidity shocks, which explains why their impact on the real economy is an order of magnitude larger than the impact of liquidity shocks. Liquidity shocks operate through firm entry but do not change the measure of operating firms directly; hence, their impact is bound to be smaller than that of funding shocks that operate through both margins. The fact that funding shocks combine real and liquidity elements also explains why the baseline model's response is not flat: although agents can mitigate the effects of the portfolio channel through rebalancing, they cannot do anything about the increased separation rate.

The main lessons of funding shocks parallel those from the analysis of liquidity shocks. First and foremost, the economy without money responds more strongly following a decrease in α_F from its calibrated steady state value than the economy with money. The reason for this is again the portfolio channel identified above: money offers a liquidity substitute to the reduction of bonds due to the α_F shock. As a result, in the economy with money total liquidity in the households' portfolio is greater, the impact of the shock on GM trade is less pronounced, and the effects on output and unemployment are smaller than in the economy without money. In effect, the existence of money again dampens the propagation of financial shocks to the real economy as in the case of liquidity shocks.

Second, the economy's response to funding shocks is state-dependent and hinges on the state of the FM market, as with liquidity shocks. Specifically, as long as the FM market operates at capacity, with the probability of matching with underwriters for firms

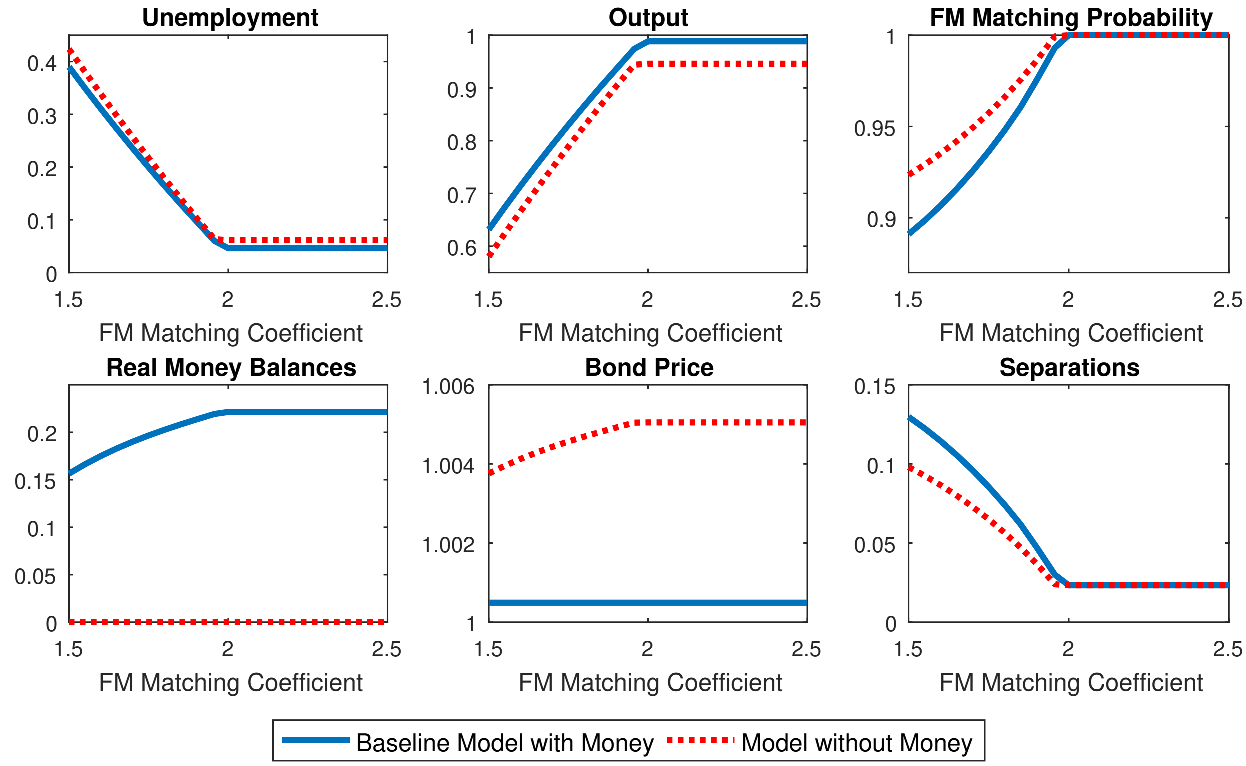

Figure 4: Funding Shocks.
Steady-state responses to changes in the matching efficiency of the financial market.

being equal to one, then the level of α_F does not matter for the slope of the responses of real and monetary variables. In this case, the model just predicts a difference in levels between the economy with and without money and the responses to changes in α_F are parallel in the two models. For the values of α_F below roughly 2, the FM market operates below capacity and the level of α_F affects the models with and without money through the mechanisms described above.

Finally, Figure 5 depicts percentage deviations from steady state for unemployment and output for one-time ("MIT") liquidity and funding shocks (for the responses of other variables, see Appendix B). The shocks are unexpected changes in the level of λ_a and α_F that take place at the end of the CM market, after the agents' decisions for next period have been made. After the shock, λ_a and α_F follow an AR(1) process with 90% persistence and slowly return to their initial steady state levels. In terms of magnitude, λ_a drops from its steady state value to zero (left and middle panels) and α_F drops by 1% (right panel) at the time of the shock. Given that the effects of shocks are state-dependent, we show the impulse responses of liquidity shocks from the calibrated steady state of $\lambda_a = 0.53$ (left panel), as well as the lower steady state of $\lambda_a = 0.3$ (middle panel), at which the FM matching probability binds.

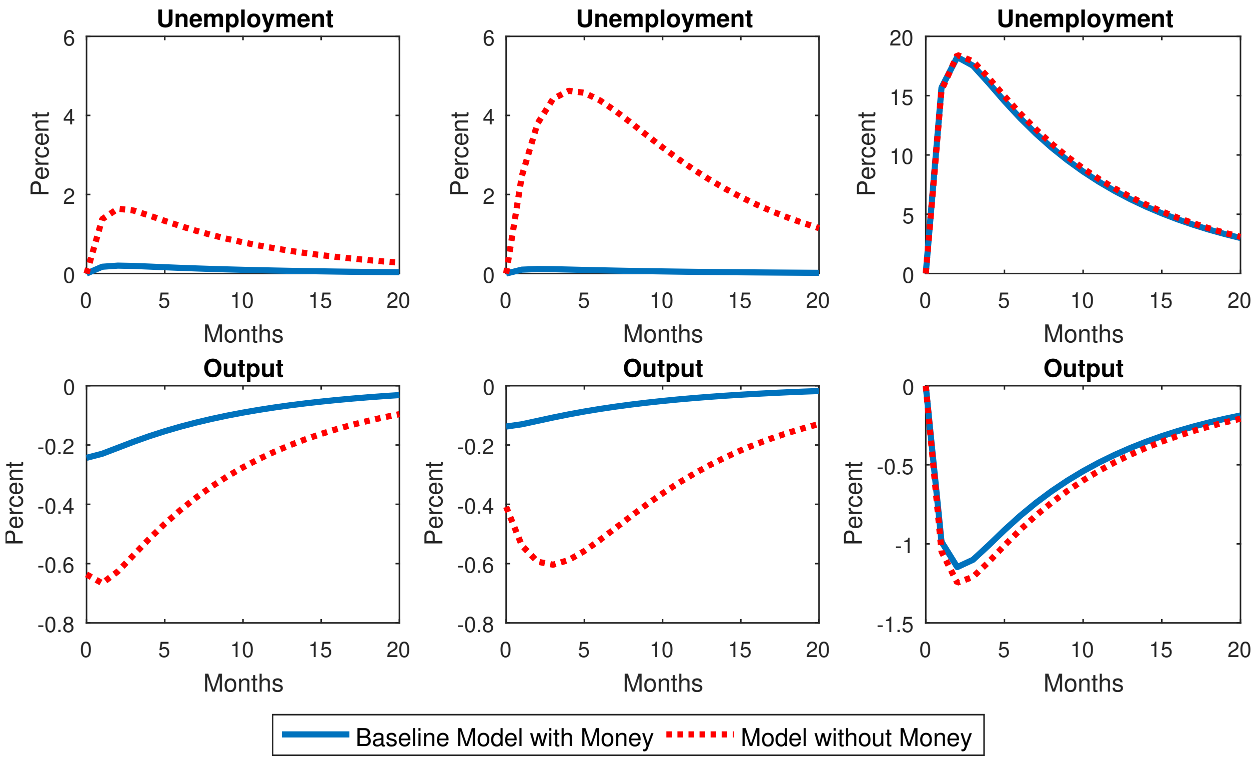

Figure 5: Impulse Responses for Liquidity and Funding Shocks.
The left panel presents percentage deviations from steady state for unemployment and output for a 100% drop in the level of λ_a from the value of 0.53 (calibrated value); the middle panel shows the same variables for a 100% drop in the level of λ_a from the value of 0.3; and the right panel shows the same variables for a 1% drop in the level of α_F from the value of 1.96. For the responses of other variables, see Appendix B.

The results of Figure 5 reveal essentially the lessons learned from the steady state experiments. First and foremost, real variables respond less to both liquidity and funding shocks in the economy with money than in the model without money. Second, shocks of the same size are expected to have larger real effects when they hit financial markets in turbulent times (low λ_a, low α_F) than in good times (high λ_a, high α_F). Third, the impact of funding shocks is an order of magnitude larger than the impact of liquidity shocks. To sum up, our steady-state results regarding the dampening effect of money through agents' portfolios, as well as the state-dependency of financial shocks and the differences in their magnitude, go through in the more realistic case of one-time shocks in our model.

5.2 The Impact of Inflation

The level of inflation matters for the propagation of financial shocks to the real economy. To highlight this result, we investigate the impact of bond pledgeability shocks under

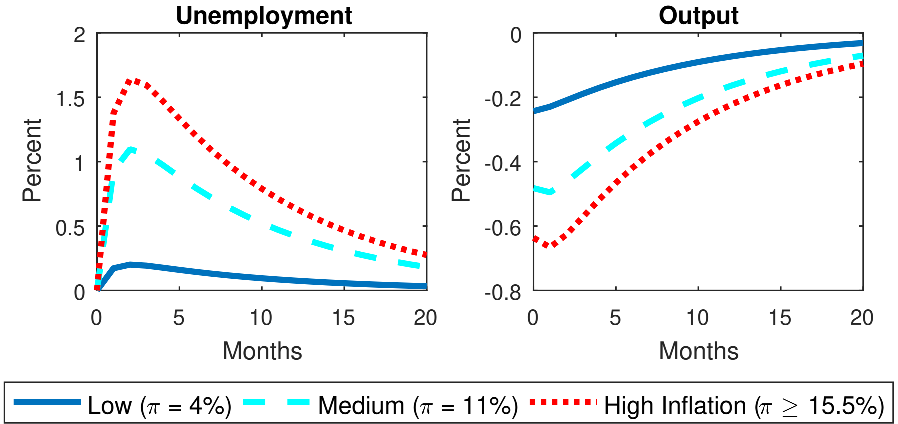

Figure 6: Impulse Responses for Liquidity Shocks at Various Inflation Levels.
Percentage deviations from steady state for unemployment and output for a 100% drop in the level of λ_a from the calibrated value of 0.53 for different levels of annual inflation.

various inflation regimes. We focus on liquidity shocks for brevity; the results for funding shocks are similar (see Appendix C). Figure 6 presents the impulse responses for a one-time unexpected 100% drop in λ_a from its calibrated steady state level and Figure 7 presents the steady state results.

We begin with Figure 6 which depicts the real variables' response under three levels of inflation: low, $\pi = 4\%$; medium, $\pi = 11\%$; and high, $\pi \geq 15.5\%$. Intuitively, higher inflation makes the propagation of financial shocks stronger due to the higher associated cost of carrying money. As inflation rises, agents pick a portfolio allocation that is more bond heavy. Thus, they are more exposed to negative liquidity shocks. When such a shock hits, it affects a larger fraction of their portfolio which leads to a greater decrease in their spending power. The corresponding decrease in output is thus greater, as seen in the right panel of Figure 6. A larger decrease in output corresponds to lower incentives for firms to enter and consequently higher unemployment. For levels of inflation above 15.5% the economy is at a non-monetary equilibrium, so the propagation of financial shocks is quantitatively identical to the propagation when $\lambda_m = 0$ that we studied in the previous subsection (Figure 5). In particular, when inflation is too high, even if agents have access to money, they choose not to use it for transactions and the equilibrium becomes non-monetary (see Footnote 10).

Next, we turn our attention to the impact of steady state shocks. Figure 7 shows the real economic impact of changes in the level of bond pledgeability for $\lambda_a \in [0, 1]$. We graph the economy's response under four levels of inflation: low, $\pi = 4\%$; medium, $\pi = 11\%$; high, $\pi = 18\%$; and very high, $\pi = 43\%$. The case of low inflation is our baseline case, hence the results are identical to the monetary case from the previous subsec-

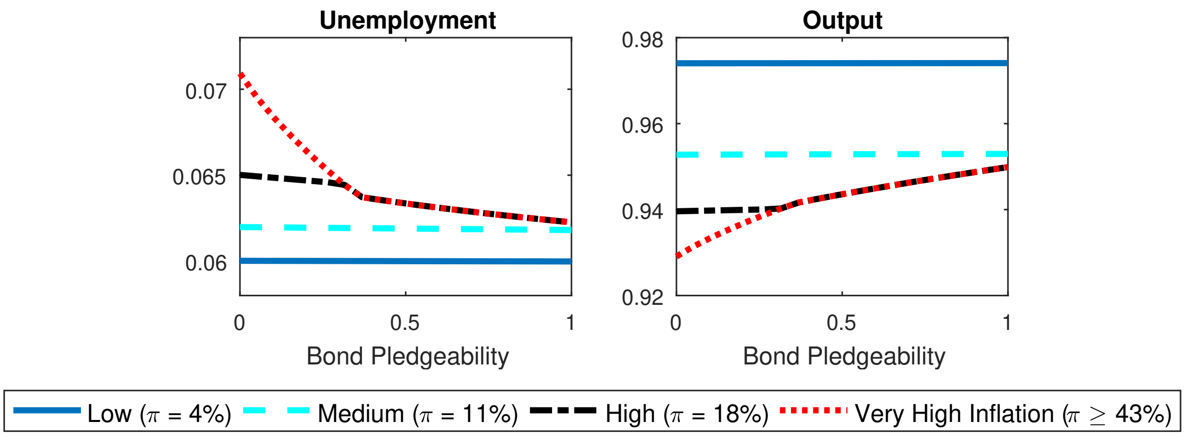

Figure 7: Liquidity Shocks at Various Inflation Levels.
Steady-state responses of unemployment and output to changes in the pledgeability of corporate bonds for different levels of annual inflation.

tion (Figure 3). The case of very high inflation coincides with the non-monetary case of $\lambda_m = 0$. The responses under medium inflation are in between those under low and very high inflation. This is because higher inflation suppresses real money balances, which leads to lower GM trade, lower firm entry, higher unemployment, and lower output. In this case, inflation is high but not too high, so the equilibrium is monetary at all λ_a. On the contrary, for high inflation, the economy may find itself in a monetary or non-monetary equilibrium depending on the value of λ_a. Specifically, at low λ_a (roughly below 0.3) the equilibrium is monetary and in between those under medium and very high inflation, whereas at high λ_a (roughly above 0.3) it is non-monetary and coincides with that under very high inflation.

The slope of the responses of unemployment and output depend on levels of inflation. Higher inflation makes it more costly to substitute away from bonds towards money, and thus the portfolio channel is more powerful. As a result, higher inflation increases the impact of financial shocks on the economy, as can be seen in the responses under high inflation at low λ_a (where the economy is still monetary). When inflation is altogether too high, the economy becomes non-monetary, substitution between money and bonds stops, the portfolio channel operates at full force, and the responses to shocks become maximal, as can be seen in the responses under high inflation at high λ_a or very high inflation.

Finally, Figure 8 shows the percentage deviations from steady state for unemployment following a 1% (left panel) and a 100% (right panel) negative shock in λ_a for various levels of inflation. Looking at the right panel, we see a generalized version of the intuition behind Figure 7: as inflation increases, the economy responds more strongly to financial shocks. The effects of inflation are highly non-linear, however. For low levels of inflation,

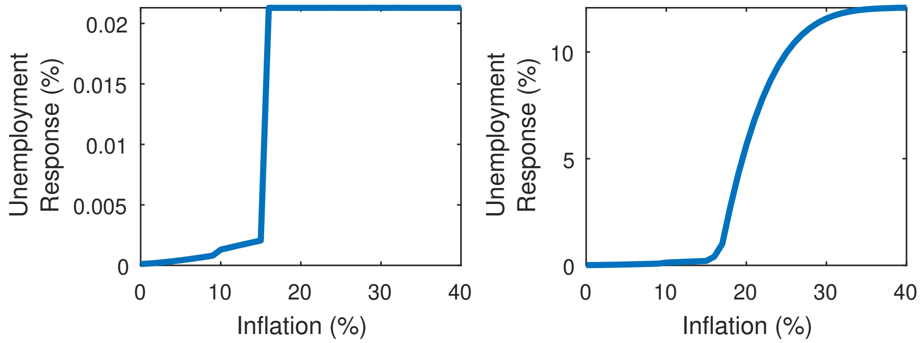

Figure 8: Liquidity Shocks of Different Magnitude at Various Inflation Levels.
Percentage deviations from steady state for unemployment to 1% (left panel) and 100% (right panel) drops in λ_a from the calibrated value of 0.53 for various levels of annual inflation.

the impact of shocks is small because the economy is monetary at all λ_a and the existence of money weakens the portfolio channel. The response increases in π due to the portfolio channel in action, but the slope is still minimal as can be seen from the responses under low and medium inflation in Figure 7. For high levels of inflation, the economy is non-monetary at all λ_a, the portfolio channel operates at full force, and the impact of shocks is maximal. The slope of the response is flat since inflation does not affect the non-monetary economy with zero real money balances. For moderate levels of inflation, however, the slope of the response is steep. At this range of inflation, the economy is non-monetary when λ_a is high, but once λ_a becomes sufficiently low, the economy shifts to a monetary equilibrium, like in the case of high inflation in Figure 7. The response increases in π continuously, as the threshold level of λ_a, below which the economy is monetary, decreases in π.

The left panel of Figure 8 graphs the same response in unemployment under various levels of inflation, but for a 1% shock. Unlike the right panel, there is a discontinuity in the response. To understand this, first note that under this scenario, both steady states before and after the shock feature a monetary (non-monetary) equilibrium when inflation is low (high). This lets us investigate the economy's response near the "cashless limit". In particular, as inflation increases towards a threshold level of roughly 15%, real money balances approach 0 but are nonetheless positive. Below this threshold, the portfolio channel is mitigated and the impact of shocks is small even when real money balances are close to zero — as long as agents have access to money, however small its use in equilibrium, the economy's response to financial shocks is small. However, as soon as inflation gets above the threshold level, the economy transitions to a non-monetary equilibrium and the portfolio channel starts operating at full force, which creates the jump in the response to shocks. It is worth highlighting that this discontinuity in the economy's behavior is similar in spirit to the results in Lagos and Zhang (2022).

6 Conclusion

An extensive literature in macroeconomics studies the real effects of disruptions in financial markets. Although the papers under consideration come from different strands of the literature, they all share a common feature: they employ frameworks where money is not explicitly modeled. Our paper contributes to the literature by revisiting this research question within the context of an economy where money plays an essential role. We argue that the absence of money may limit a model's ability to accurately evaluate the real effects of financial disruptions, since it deprives agents of a payment instrument that they *could* have used to cope with the resulting liquidity disruption.

To study the question at hand, we build on the work of Berentsen et al. (2011), which contains two of the essential ingredients our analysis should incorporate: a frictional labor market that gives rise to equilibrium unemployment, and a frictional product market that gives money an essential liquidity role. We extend this framework by assuming that firms face recruiting and operating costs, which they must cover by issuing corporate bonds. In our model, corporate bonds serve alongside money as means of payment or collateral, so their price includes a liquidity premium. This bond liquidity is crucial, as it determines the ultimate rate at which firms can borrow funds and the consumers' effective liquidity. Thus, our model captures *all* the salient features of the question we are after: equilibrium unemployment, an essential role for money, but also a liquidity channel that is crucial to the firms' ability to cover recruiting and operating costs and, thus, create jobs. We capture financial disruptions in our model in two ways: varying the (i) degree of bond pledgeability and (ii) the ability of firms to issue corporate bonds.

In this environment, we find that, depending on the nature of the shock, the existence of money dampens or even eliminates the effects of financial shocks. Our main result stems from the fact that in our *monetary* model, agents are able to increase their money holdings and *substitute* the liquidity forgone due to the financial market disruption, a channel for which we also provide empirical support. Thus, we argue, working with a moneyless model does not come without loss of generality. We also find that high inflation regimes raise the likelihood of a financial *shock* turning into a financial *crisis*, which can be viewed as an additional argument in favor of a framework where money is explicitly modeled.

Appendix

A Equilibrium Out of Steady State

Money and bond market equilibrium The bond supply is endogenously determined by

$$A_t = b_{Lt}\frac{\kappa_R + \kappa_O}{\psi_t} + (1 - s_{Lt})\frac{f_{Ft}}{b_{Ft}}(1 - \delta)\frac{\kappa_O}{\psi_t}.$$

At a monetary equilibrium, the GM trade is given by

$$q_t = \min\{q^*,\ \sigma^{-1}(\lambda_{mt}z_t + \lambda_{at}A_{t-1})\},$$

and the money demand is characterized by

$$\varphi_t = \beta\varphi_{t+1}\left(1 + \lambda_{mt+1}\frac{f_{Gt+1}}{b_{Gt+1}}\left[\frac{u'(q_{t+1})}{\sigma'(q_{t+1})} - 1\right]\right),$$

which can be expressed as

$$z_t = \beta\frac{z_{t+1}}{1+\mu}\left(1 + \lambda_{mt+1}\frac{f_{Gt+1}}{b_{Gt+1}}\left[\frac{u'(q_{t+1})}{\sigma'(q_{t+1})} - 1\right]\right).$$

At a non-monetary equilibrium, $\varphi_t = 0$, $z_t = 0$, and $q_t = \min\{q^*,\ \sigma^{-1}(\lambda_{at}A_{t-1})\}$. Given the supply, the households' bond demand determines the equilibrium bond price:

$$\psi_t = \beta\left(1 + \lambda_{at+1}\,\frac{f_{Gt+1}}{b_{Gt+1}}\left[\frac{u'(q_{t+1})}{\sigma'(q_{t+1})} - 1\right]\right).$$

Labor and financial market equilibrium First note that, from

$$U^f_{1t}(d_t) = R_t - d_t - w_t - \kappa_F + \beta\frac{f_{Ft}}{b_{Ft}}(1-\delta)U^f_{1t+1}\left(\frac{\kappa_O}{\psi_t}\right),$$

where

$$R_t \equiv y + \frac{f_{Gt}}{s_{Gt}}\,\eta_G(u(q_t) - q_t),$$

we have

$$U^f_{1t}\left(\frac{\kappa_R+\kappa_O}{\psi_{t-1}}\right)+\frac{\kappa_R+\kappa_O}{\psi_{t-1}}=U^f_{1t}\left(\frac{\kappa_O}{\psi_{t-1}}\right)+\frac{\kappa_O}{\psi_{t-1}} \tag{A.1}$$

$$=R_t-w_t-\kappa_F+\beta\frac{f_{Ft}}{b_{Ft}}(1-\delta)U^f_{1t+1}\left(\frac{\kappa_O}{\psi_t}\right). \tag{A.2}$$

Free entry to the FM implies

$$\kappa_F=\beta\,\frac{f_{Ft}}{b_{Ft}}\left[\frac{f_{Lt+1}}{b_{Lt}}\,U^f_{1t+1}\left(\frac{\kappa_R+\kappa_O}{\psi_t}\right)-\left(1-\frac{f_{Lt+1}}{b_{Lt}}\right)\frac{\kappa_R+\kappa_O}{\psi_t}\right],$$

which is, due to (A.1), equivalent to

$$\kappa_F=\beta\,\frac{f_{Ft}}{b_{Ft}}\left[\frac{f_{Lt+1}}{b_{Lt}}\left(U^f_{1t+1}\left(\frac{\kappa_O}{\psi_t}\right)-\frac{\kappa_R}{\psi_t}\right)-\left(1-\frac{f_{Lt+1}}{b_{Lt}}\right)\frac{\kappa_R+\kappa_O}{\psi_t}\right],$$

where

$$U^f_{1t}\left(\frac{\kappa_O}{\psi_{t-1}}\right)=R_t-\frac{\kappa_O}{\psi_{t-1}}-w_t-\kappa_F+\beta\frac{f_{Ft}}{b_{Ft}}(1-\delta)U^f_{1t+1}\left(\frac{\kappa_O}{\psi_t}\right).$$

The wage bargaining implies

$$\eta_L\left[U^f_{1t}\left(\frac{\kappa_R+\kappa_O}{\psi_{t-1}}\right)+\frac{\kappa_R+\kappa_O}{\psi_{t-1}}\right]=(1-\eta_L)\Big[U^h_{1t}(m_t,a_t)-U^h_{0t}(m_t,a_t)\Big],$$

which is, due to (A.2), equivalent to

$$\eta_L\left[R_t-w_t-\kappa_F+\beta\frac{f_{Ft}}{b_{Ft}}(1-\delta)U^f_{1t+1}\left(\frac{\kappa_O}{\psi_t}\right)\right]$$
$$=(1-\eta_L)\left[w_t-b+\beta\left(\frac{f_{Ft}}{b_{Ft}}(1-\delta)-\frac{f_{Lt+1}}{s_{Lt}}\right)\Big(U^h_{1t+1}(m_{t+1},a_{t+1})-U^h_{0t+1}(m_{t+1},a_{t+1})\Big)\right].$$

Solving this for w, utilizing (A.1), the bargaining solution, and the free entry condition, gives us

$$w_t=(1-\eta_L)b+\eta_L R_t-\eta_L\kappa_F$$
$$-\eta_L\beta\frac{f_{Ft}}{b_{Ft}}(1-\delta)\frac{\kappa_O}{\psi_t}+\eta_L\beta\frac{f_{Lt+1}}{s_{Lt}}\left(\kappa_F\frac{1}{\beta}\frac{b_{Ft}}{f_{Ft}}+\frac{\kappa_R+\kappa_O}{\psi_t}\right)\frac{b_{Lt}}{f_{Lt+1}}.$$

Measures of sellers and buyers The matching functions in the LM, GM, and FM are given by $f_{Lt}=f_L(b_{Lt-1},s_{Lt-1})$, $f_{Gt}=f_G(b_{Gt},s_{Gt})$, and $f_{Ft}=f_F(b_{Ft},s_{Ft})$, where $s_{Gt}=$

$1-s_{Lt}$, $b_{Gt}=1$, $s_{Ft}=1$, $b_{Ft}=\epsilon_t+1-s_{Lt}$, $b_{Lt}=\epsilon_t\cdot f_{Ft}/b_{Ft}$, and

$$s_{Lt}=\left(1-\frac{f_{Lt}}{s_{Lt-1}}\right)s_{Lt-1}+\left(1-\frac{f_{Ft-1}}{b_{Ft-1}}(1-\delta)\right)(1-s_{Lt-1}).$$

B The Impulse Responses for Financial Shocks

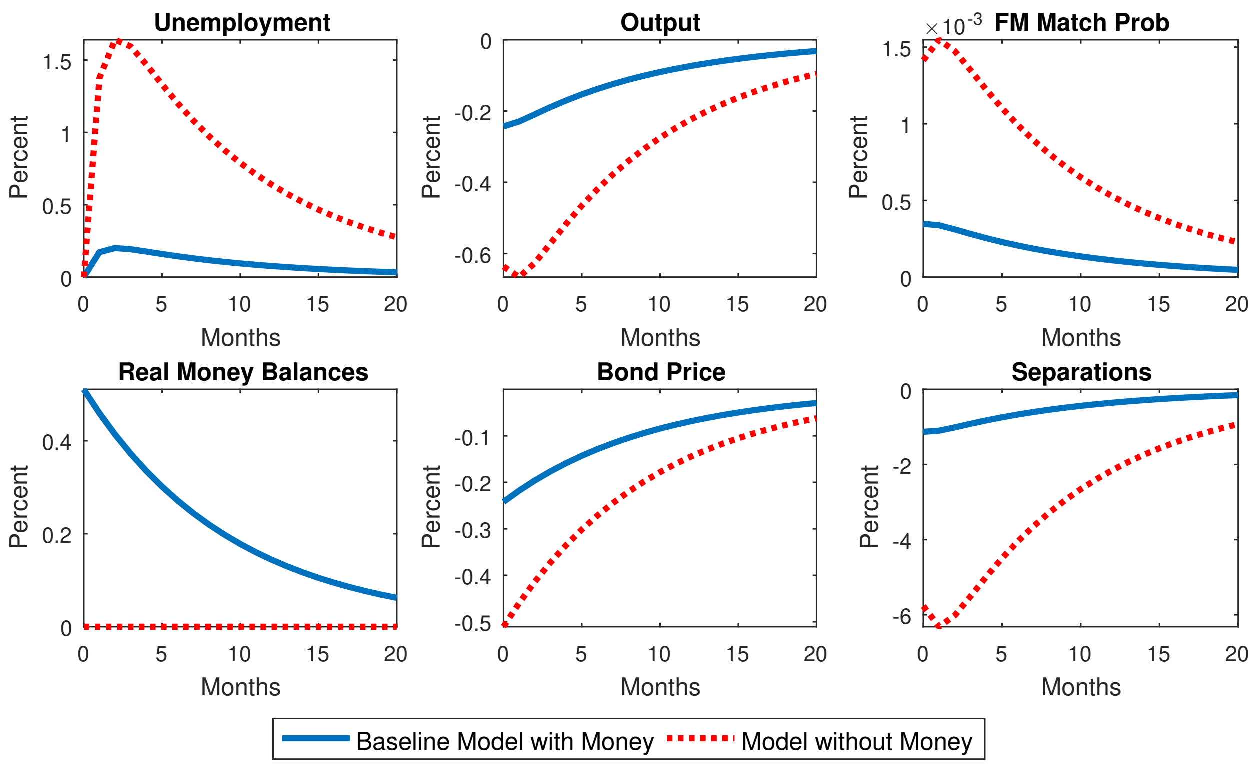

Figure 9: Impulse Responses for Liquidity Shocks.
Percentage deviations from steady state for a 100% drop in the level of λ_a from the value of the calibrated value of 0.53.

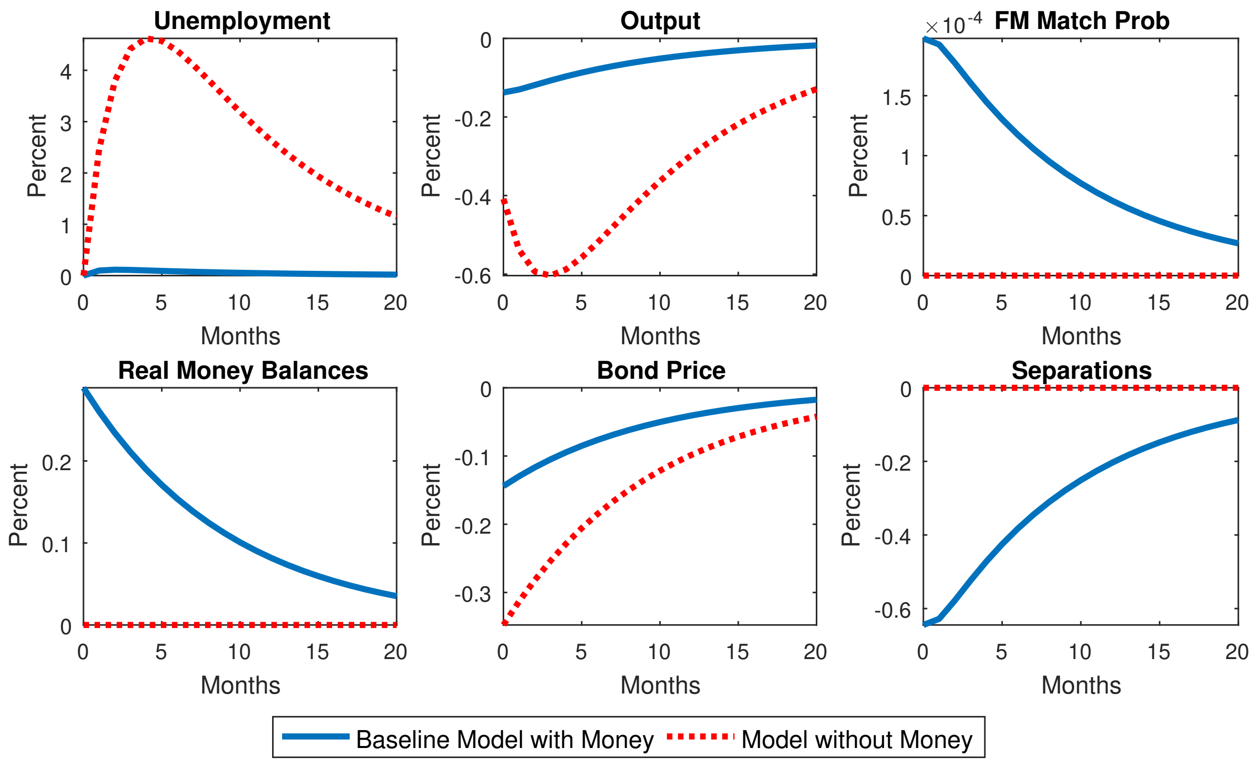

Figure 10: Impulse Responses for Liquidity Shocks.
Percentage deviations from steady state for a 100% drop in the level of λ_a from the value of 0.3.

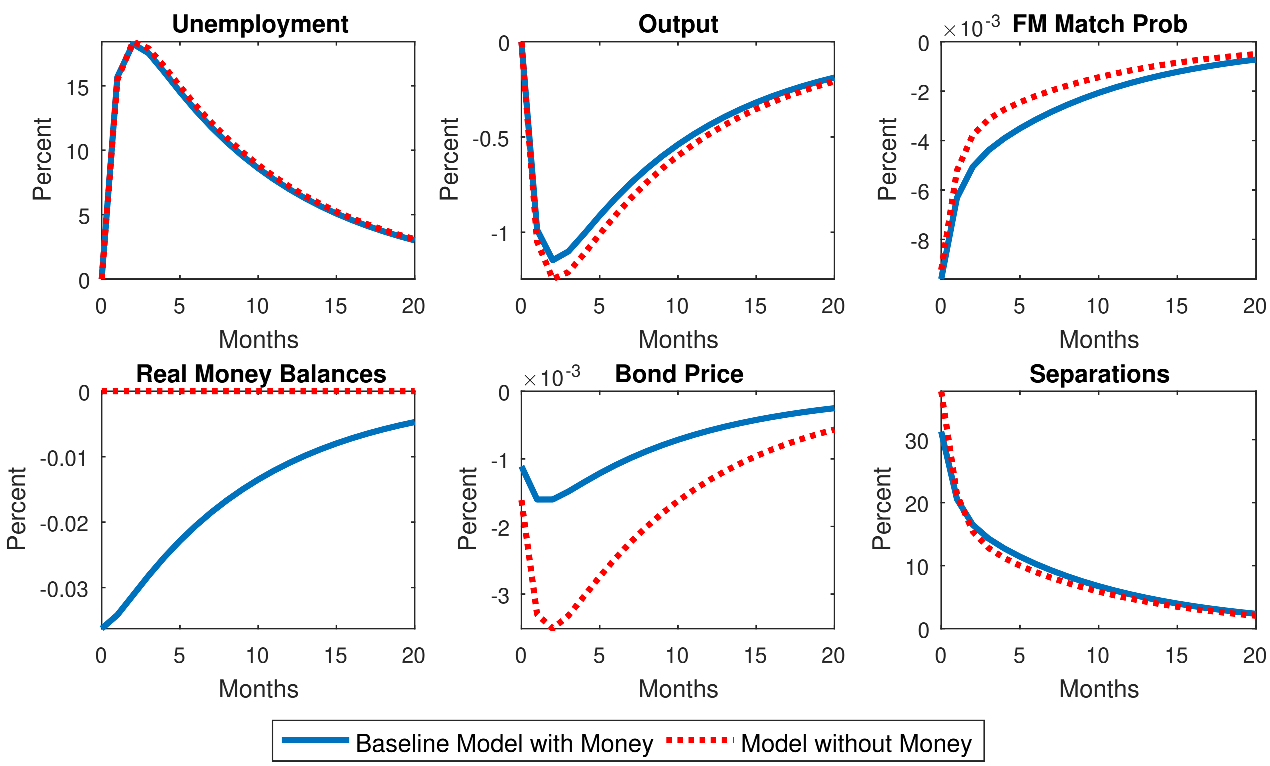

Figure 11: Impulse Responses for Funding Shocks.
Percentage deviations from steady state for a 1% drop in the level of α_F from the value of 1.96.

C The Impact of Inflation for Funding Shocks

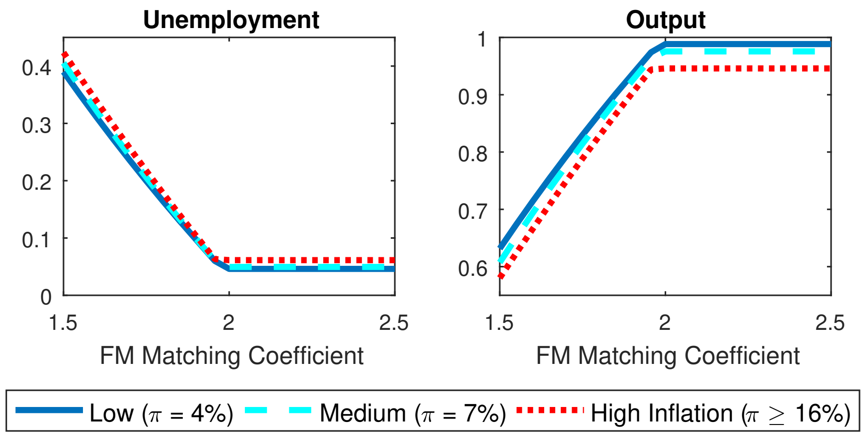

Figure 12: Funding Shocks at Various Inflation Levels.
Steady-state responses of unemployment and output to changes in the matching efficiency of the financial market for different levels of annual inflation.

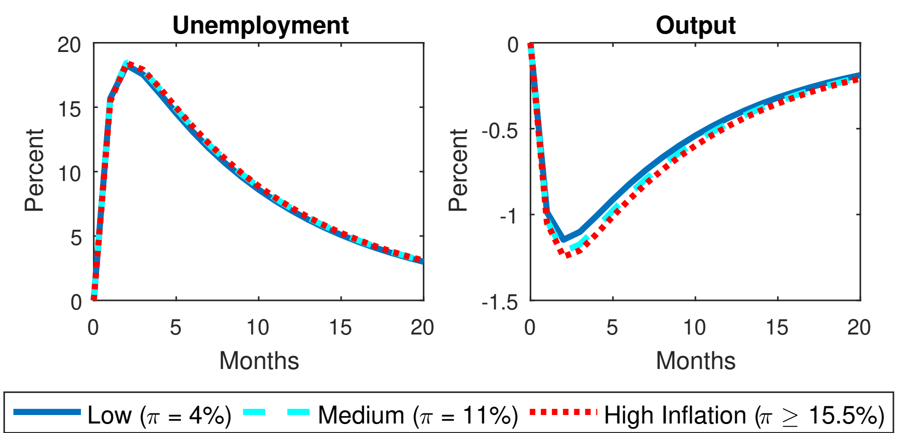

Figure 13: Impulse Responses for Funding Shocks at Various Inflation Levels.
Percentage deviations from steady state for unemployment and output for a 1% drop in the FM matching coefficient for different levels of annual inflation.

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