Regulating Over the Counter Financial Markets: Implications for Inflation and Unemployment Dynamics*

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Abstract

This paper studies the impact of over the counter (OTC) financial regulation on inflation and unemployment while monetary and fiscal policies are enacted by the central bank and the fiscal authority. We show that the impact of OTC financial regulation on unemployment critically depends on the set of agents being taxed as well as the combinations of assets that are able to satisfy the liquidity needs of OTC-traders. When firms, workers and financial traders face non ad-valorem taxes, unemployment and the private and public provision of liabilities are affected by financial regulation and fiscal and monetary policies. This is the case as all government policies directly impact the behavior of firms who intimately link labor and asset markets by hiring workers and issuing equity. Moreover, traditional stabilization policies do not irk properly.

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1 Introduction

In 1977 the United States Congress amended the 1913 Federal Reserve Act establishing a "dual mandate" for the central bank to maintain stable prices and full employment. This amendment is not only explicitly stating two distinct objectives but also highlights the importance of the underlying links between these two goals. The relative importance of these two objectives has changed over time depending on the economic conditions faced by central bankers.[1]

In 2007, during the onset of the global financial crisis (GFC), unemployment quickly rose and core inflation dramatically dropped. In response to these macroeconomic conditions, the U.S. Federal Reserve System aggressively eased monetary policy by lowering the federal funds and carried out unconventional monetary policies as to provide further accommodation, stabilize financial markets and reduce unemployment.[2] At the

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[1]During the Volcker era the main priority was lowering inflation even if it was at the expense of rising unemployment. On the other hand, Greenspan tried to achieve low and stable inflation. To achieve the goals of the dual mandate, the main policy tool used has been the manipulation of the federal funds target by purchasing and selling of U.S. Treasuries. However, these traditional operating procedures for monetary policy changed after the global financial crisis (GFC).

[2]To implement these policies the central bank has been increasingly intervening in financial markets through the purchase and sale of public and private assets and closely monitoring its effects on unemployment. The Committee has provided guidance in the statement about how it would conduct monetary policy: *"In setting monetary policy, the Committee seeks to mitigate deviations of inflation from its longer-run goal and deviations of employment from the Committee's assessments of its maximum level. These objectives are generally complementary. However, under circumstances in which the Committee judges that the objectives are not complementary, it follows a balanced approach in promoting them, taking into account the magnitude of the deviations and the potentially different time horizons over which employment and inflation are projected to return to levels judged consistent with its mandate."* Federal Open Market Committee, January 2012, 2013, and 2014.

same time unprecedented financial market reforms were enacted.[3] There is consensus that private provision of liquidity, collaterized debt obligations, and the subsequent trading over the counter (OTC) financial markets as being major contributors to the GFC.[4] These OTC financial markets have been growing over the last three decades and have been mainly unregulated.[5] OTC financial markets are decentralized, trade is bilateral, prices and quantities are negotiated, traded products do not have to be standardized and traders can withdraw from the market at any time.[6] These features are in sharp contrast from those observed in centralized financial exchanges which are typically analyzed when thinking about macroprudential policies.[7] This different financial architecture is likely to change the effects of monetary and fiscal policies explored in centralized financial markets.

During the onset of the GFC, financial markets with centralized trading functioned rather well when compared to OTC markets. In particular, in OTC markets collateralized debt obligations, asset and mortgage backed securities were traded only sporadically or not at all.[8] Thus it is not surprising that authorities around the world have sought to oversee the functioning of these markets and provide them with adequate liquidity.[9] These policies have been enacted while monetary and fiscal authorities are also trying to deal with unemployment pressures.[10] Here we analyze how the various policies interact with each other and affect the dual mandate.

This paper studies the impact of OTC regulation on inflation and unemployment while monetary and fiscal policies are enacted by the central bank and the fiscal authority. To determine how financial regulation affects the central bank's dual mandate, we consider a frictional environment that builds on Rocheteau and Rodriguez-Lopez (2014). These authors consider an environment with unemployment and where public and private assets are traded in OTC markets. They find that when unemployment is inefficiently high and agents have access to real bonds, it is optimal to keep liquidity scarce to lower interest rates and promote job creation. Building on these insights, this paper considers nominal government bonds and studies how all government policies (financial, monetary and fiscal) interact with each other and affect inflation, unemployment and interest rate spreads. To explicitly capture the key objectives of the dual mandate, the underlying environment has a labor market *a la* Mortensen and Pissarides (1994) so that unemployment is an equilibrium outcome. To incorporate OTC financial markets, we consider a financial market *a la* Duffie, Garleanu, and Pedersen (2005), where trades by private firms are collateralized with private and public assets. This structure allows us to explicitly analyze the inherent links between liquidity and unemployment. In particular, we can examine how the private provision of liquidity is affected by government policies that regulate financial markets, specify tax liabilities and the evolution of the money supply. This frictional environment delivers an endogenous interest rate that critically depends on labor

[3]On July 21, 2010, the Dodd-Frank Wall Street Reform and Consumer Protection Act was signed into law and brought the most significant changes to financial regulation in the United States since the regulatory reform that followed the Great Depression.

[4]We refer more the reader to Brunnermeier (2009) and Gorton and Metrick (2012a) for discussions on the main contributors to the GFC.

[5]According to the Bank for International Settlements, the total notional amount (measure of market activity) of all the outstanding positions at the end of June 2004 stood at $220 trillion. By the end of 2007 this figure had risen to $596 trillion, in 2009 was $615 trillion and by June 2013 rose to $693 trillion. Relative to other financial markets, the interest rate, foreign exchange and equity derivatives, in December 2011, accounted over 90% of all trading.

[6]The specific terms of trade are not necessarily made public to all market participants

[7]We refer to Leeper and Nason (2014) for more on this issue.

[8]We refer to Gorton and Metrick (2012) for an analysis of the different financial markets during the GFC.

[9]Key provisions of the the Dodd-Frank Act –including clearing, trading, capital, margining, reporting and record-keeping requirements –are going to fundamentally alter the OTC derivatives market. Under Title VII of the the Dodd-Frank Act, swap dealers and major swap participants are subject to capital and margin requirements. The law requires initial and variation margin (also referred to as collateral posting) for all OTC derivatives that are not cleared.

[10]Yellen (2014) has stressed the importance of considering a variety of measures for assessing short and long run employment and unemployment when designing and thinking about monetary policy.

market conditions, a key aspect not previously emphasized. As noted by Friedman (1956), Tobin (1961) and Brunner and Meltzer (1972), the equilibrium price level is determined by the valuation of all assets jointly which emphasizes the importance of the notion of asset liquidity. These different asset liquidity properties critically depend on the underlying frictions and the financial architecture where these assets are traded.

Once OTC financial markets and unemployment are explicitly taken into account, the supply of liquidity –all public and private assets– matters for the equilibrium interest rate spreads as well as the dynamics of prices, debt and unemployment. Assets in this frictional economy serve a role as a store of value and a settlement object in financial markets. This is a direct consequence of the underlying frictions that prevent trading of complete state contingent claims, thus generating a demand for liquidity.

The impact of OTC financial regulation on unemployment critically depends on the set of agents being taxed as well as the combinations of assets that are able to satisfy the liquidity needs of OTC-traders. When taxes are pure lump sum (taxes are only levied to OTC-traders) and government liabilities are enough to satisfy the liquidity needs of financial market participants, financial regulation does not impact unemployment nor inflation. The stabilization policies are the same as the ones can obtain in the FTPL with frictionless labor and financial markets. Similarly, once private and public assets are required to satisfy the liquidity needs of OTC-traders, financial regulation does not affect unemployment. However, interest rate spreads are observed and depending on the strength of fiscal policy multiple steady states are observed. Moreover, traditional stabilization policies obtained from the FTPL do not operate in this environment as all government policies can affect the degree of substitution between real bonds and private assets.

Finally, once all agents in the economy face non ad-valorem taxes, unemployment and the private and public provision of liabilities are affected by financial regulation and fiscal and monetary policies. This is the case as all government policies directly impact the behavior of firms who intimately link labor and asset markets by hiring workers and issuing equity. In particular, government policies affect the ability of firms to hire workers and make profits. As a result, the value of assets and their liquidity properties as well as the equilibrium unemployment rate are intimately shaped by all government policies. Moreover, there is an expectational channel through which government policies (financial, monetary and fiscal) affect the equilibrium price level. This is the case as they change expected returns to both nominal and real assets. Thus the evolution of nominal prices critically depend on the dynamic interactions between current and expected future government policies. By considering alternative approaches to modelling financial markets (that emphasize different frictions) and unemployment, this paper tries to improve our understanding of the inherent links between the goals of the dual mandate and how they change with financial regulation.

2 Related Literature

Since the GFC the literature has studied how various government policies affect the economy when financial frictions in centralized exchanges are present. Departures from complete financial markets are abundant and complex which emphasize different financial frictions. Some of these departures include asymmetric information, liquidity constraints, moral hazard, costly state verification and pecuniary externalities just to name a few frictions.[11] Even though substantial progress has been made in understanding how financial frictions affects on the macroeconomy, much less attention has been devoted to the study of policy interactions in frictional financial markets with unemployment. Notable exceptions are the various works that have

[11] We refer to Quadrini (2011) and Brunnermeier, Eisenbach and Sannikov (2013) for a recent survey of the literature that deals with macroeconomics and financial frictions.

analyze the dual mandate of the central bank under different liquidity notions. The early contribution of Cooley and Quadrini (2004) studies optimal monetary policy in a model that integrates the search theory of unemployment with firms facing cash-in-advance constraints to purchase intermediate inputs. These authors show that when the economy is subject to productivity shocks, the optimal policy is procyclical, and with commitment, the optimal inflation rate is inversely related to the bargaining power of workers. Within a cashless framework with nominal bonds, Ravenna and Walsh (2012) consider a frictional labor market and show that when wages are rigid and fixed, the optimal tax correcting for inefficient hiring is small but very volatile over the business cycle. Gains from deviating from price stability are larger in economies with more volatile labor flows. Building on this framework, Arseneau and Chugh (2012) consider a calibrated matching model that generates empirically relevant labor-market fluctuations conditional on exogenous fiscal policy. The authors find that tax volatility induces dramatically smaller, but efficient, fluctuations of labor markets by keeping distortions constant over the business cycle. Once financial markets are incomplete so that fiat money has a role, Berentsen et al. (2007) show that the same frictions that give fiat money a positive value generate an inefficient quantity of goods in each trade and an inefficient number of trades. The Friedman rule eliminates the first inefficiency and the Hosios rule the second. Finally, Gomis-Porqueras et al (2013) show how a production subsidy in frictional goods market and a vacancy subsidy, financed by a dividend tax, can achieve efficiency even when the Hosios condition does not hold.

Even though the previous literature has explored how monetary and fiscal policies affect the dual mandate of the central bank, much less work has been focused on the private provision of liquidity for OTC markets and its subsequent impact on nominal prices and unemployment. This paper complements the previous literature by exploring the channels through which policies affect the economy when agents trade public and private liabilities in OTC markets and households face unemployment.

3 Environment

We build on Rocheteau and Rodriguez-Lopez (2014). Time is continuous where three types of private agents (a large measure of workers, a large measure of firms and a unit measure of OTC-traders) participate in goods, labor and financial OTC markets. Other than these private agents, there is a government that needs to finance some exogenous expenditures through non ad-valorem taxes and the issuance of fiat money and nominal bonds.

Workers and firms participate in a frictional labor market *a la* Mortensen and Pissarides (1994). In this market workers sell their time in exchange for a wage when producing a perishable numèraire good that is consumed by all private agents. Firms in order to finance their wage bill, they issue and sell their securities to financial market participants. These claims to firms' profits can be used as collateral in OTC markets as in Duffie, Garleanu and Pedersen (2005). Other than this private provision of liquidity, public liabilities can also be used as collateral in these financial markets.

In contrast to other private agents, OTC-traders can produce and consume the numèraire good. They are also able to produce and consume a perishable financial service which only they value. In order to generate a role for liquidity, the underlying economic environment has to have some frictions. In this environment, OTC-traders lack commitment (so credit can not be used as a means of payment) and the technology to consume/produce the numèraire good available to OTC-traders is not always available. The lack of commitment, the technological restriction and the fact that the numèraire good is perishable generates a need for OTC-traders to accumulate liquid assets.

OTC-traders' portfolio is comprised of three assets: fiat money, nominal bonds and private securities. These assets serve as a store of value as well as a collateral object in OTC transactions. When all government liabilities can not meet the collateral requirements of OTC traders, we observe interest rate spreads between bonds and private equity. In particular, the degree of substitution between private and public asset as s store of value is affected by government policies. This is the case as the spread depends on real bonds outstanding as well as monetary and OTC regulations. As a result, these interest rate spreads between public and private assets affects the dynamics of prices, interest rate spreads and unemployment. This is the case as it has first order effects on the fiscal backing of bonds.

In the next subsection we describe the behavior of private agents in the economy.

3.1 Government

The government can issue fiat money and nominal bonds in order to finance exogenous government expenditures. Money is a pure fiat object as it is intrinsically useless asset that pays no dividend. Nominal bonds, on the other hand, are pure discount bonds that yield one unit of fiat money at a Poisson rate equal to one. The government has also an additional source of revenue via non ad-valorem taxes. In the benchmark model these taxes are levied only to OTC-traders. The resulting government budget constraint is then given by

$$\mathcal{G} + \nu^m \mathcal{B} = \mathcal{T} + \nu^m \dot{\mathcal{M}} + \nu^b \dot{\mathcal{B}}$$

where $\mathcal{G}$ are exogenous government expenditures, $\mathcal{M}$ is the monetary base, $\mathcal{B}$ represents nominal bonds, ν^m (ν^b) denotes the real value of a unit of fiat money (a nominal bond) in terms of the numèraire good and $\mathcal{T}$ represents the non ad-valorem tax. It is convenient to write the government budget constraint in terms of real government liabilities which is given by

$$\dot{m} + \dot{b} = \mathcal{G} + \frac{\dot{\nu^m}}{\nu^m} m + \left(\frac{\nu^m}{\nu^b} + \frac{\dot{\nu^b}}{\nu^b} \right) b - \mathcal{T} \tag{1}$$

where $m = \nu^m \mathcal{M}$ represents real balances and $b = \nu^b \mathcal{B}$ denotes real bonds.

Following the 2010 Dodd-Frank Act, we consider regulation in OTC financial markets that restrict the set of securities that can be used as collateral when trading in OTC financial markets.[12] Public liabilities are considered more safe and liquid than private ones. Among public liabilities, fiat money is universally accepted and government bonds have a role as collateral in financial trades.[13] Thus, for a fraction μ^m of matches only fiat money is acceptable, and in a fraction μ^g of matches fiat money and government bonds can only be used to settle OTC trades.[14] In the remaining fraction of matches, $\mu^p = 1 - \mu^m - \mu^g$, all public and private assets are acceptable.[15] These collateral requirements influence the value of the various assets in the economy as they serve also a store of value role.

To describe the particulars of fiscal policies, we follow those suggested by the proponents of the Fiscal Theory of the Price Level (FTPL).[16] Consistent with the FTPL and the current fiscal reality, the fiscal

[12] The Dodd-Frank Act of 2010 requires a larger fraction of derivatives transactions to be cleared in centralized exchanges with higher collateral requirements.

[13] This is in the spirit of Woodford (1990).

[14] We refer to Rocheteau and Rodriguez-Lopez (2014) for the financial interpretation and other alternative interpretations.

[15] As in Canzoneri and Diba (2005), government bonds can also provide liquidity services. In this environment, private claims can also provide such services.

[16] The Fiscal Theory of the Price Level (FTPL) was developed primarily by Leeper (1991), Sims (1994), Woodford (1994) and Cochrane (2001). This literature emphasizes that bonds are denominated in nominal terms so that they may be fully backed by real resources or backed only by nominal cash flows. For more details, we refer to Canzoneri et al (2011) who provide a

authority chooses a fiscal rule whereby taxes depends on the quantity of real government debt so that:[17]

$$\mathcal{T} = \eta_0 + \eta_1 b,$$

where $\eta_0(\eta_1)$ are constant policy parameters.[18]

For the operating procedure for monetary policy, we consider a constant money growth rate, ζ, rule so that the money supply evolves according to $\dot{\mathcal{M}} = \zeta\mathcal{M}$. We follow this rule as this economy delivers interest rate spreads. In such an environment the choice of the which interest rate should be used when considering a Taylor rule is not as innocuous as it may seem.[19]

Having specified the three different types of regulation we are able to analyze how financial regulation in OTC financial markets interact with monetary and fiscal policies and ultimately affect inflation and unemployment dynamics. Moreover, by considering the proposed fiscal and monetary policy rules we can determine the robustness of the policy prescriptions obtained in environments with frictionless financial and labor market in the FTPL.

3.2 Workers and Firms

Workers are endowed with one indivisible unit of labor per unit of time. They are risk-neutral and they discount future consumption at rate $\rho > 0$. Thus their lifetime expected utility is given by

$$\mathbb{E}\int_0^\infty e^{-\rho t} dC(t)$$

where $C(t)$ is their cumulative net consumption of the numèraire good and $\mathbb{E}$ is the expectation operator.

Each firm can be thought as a technology that produces the numèraire good using a worker's indivisible labor as input. As in Mortensen and Pissarides (1994), workers and firms are matched bilaterally. The flow of hires is equal to $h(u, v)$, where u denotes the measure of unemployed workers and v represents the measure of vacancies. The matching function, $h(\cdot, \cdot)$, has constant returns to scale, is strictly concave with respect to each of its arguments, and satisfies Inada conditions. Given this matching function the job finding rate of a worker is $p(\theta) \equiv h(u, v)/u = h(1, \theta)$ where $\theta = v/u$ represents the labor market tightness. Similarly, the vacancy filling rate is $q(\theta) \equiv h(u, v)/v = h(\theta^{-1}, 1)$.

Each successful match, of a worker and a firm, produces a constant flow of numèraire output equal to Φ. A match is exogenously destroyed with a Poisson arrival rate of $\delta > 0$. The wage of an employed worker is a constant fraction of output which we denote by w.[20]

In order to fill a job a firm must open a vacancy which has associated a cost flow in terms of the numèraire good equal to $\gamma > 0$. Firm's recruiting expenses are paid by OTC-traders in exchange for claims to their future profits which can then securitize.[21] Claims on firms' revenue are not subject to informational

recent survey of the findings in the FTPL.

[17] According to the IMF, in early 2009 there were 80 countries with national and/or supranational fiscal rules: 21 advanced, 33 emerging markets, and 26 low-income countries. In contrast, in 1990, only seven countries had fiscal rules. Some consensus has emerged among policymakers about the desirability of fiscal rules to help deter fiscal crises and facilitate implementing more countercyclical fiscal policies. The use of a debt sustainability framework (see Ghosh et al. (2011) and the references therein) is commonly used for policy analysis as emphasized by IMF Article IV country reports.

[18] We abstract from fiscal rules enforcement issues and focus on the effects that a fiscal rule would have if the government could commit to enforce it.

[19] In this paper we sidestep this interesting issue.

[20] This type of wage formation is consistent with proportional Bargaining.

In the benchmark case, we assume that the government does not provide unemployment benefits.

[21] Securitization is a process in which different assets or portfolios of cash flow generating securities are pooled together and then sold to third parties.

asymmetries and they can be partially used as collateral in μ^p of the OTC trades as dictated by the financial policy. The rate of return of a share of a firm is denoted r.

New firms are financed as long as the flow cost of opening a vacancy, γ, is no greater than the flow expected value of a vacancy, which is the product of the vacancy filling rate and the value of a filled job, $q(\theta)V_F$. Free entry then implies that

$$\gamma = q(\theta)V_F \tag{2}$$

and the total supply of private liquidity corresponds to the total capitalization of firms which is given by

$$L^p = nV_F. \tag{3}$$

The resulting value of a filled job solves the following Bellman equation

$$rV_F = \Phi - w - \delta V_F + \dot{V}_F \tag{4}$$

while the law of motion for employment is given by

$$\dot{n} = p(\theta)(1-n) - \delta n. \tag{5}$$

As we can see, the firm is key in this environment as it links the labor and financial market by hiring workers and supplying assets. These asset will compete with government liabilities both as a store of value as well as collateral instruments.

3.3 OTC-traders

OTC-traders derive linear utility from the numèraire good, which they can consume and produce, and from a perishable financial service. In order to derive utility from financial services they need to accumulate different assets that can be traded in the frictional financial market. These agents exchange financial services in an OTC market as in Duffie, Garleanu and Pedersen (2005). This frictional and decentralized financial market is characterized by bilateral matching and bargaining. The lifetime expected utility of an OTC trader is then given by

$$\mathbb{E}\left[\sum_{n=1}^{\infty} e^{-\rho T_n}[f(y(T_n)) - x(T_n)] + \int_0^{\infty} e^{-\rho t} dC(t)\right],$$

where the first term represents the utility associated with OTC trades, while the second terms denotes the utility from net consumption of the numèraire good. T_n represents a Poisson process with arrival rate $\beta > 0$, indicating the times at which the trader is matched bilaterally with another trader. OTC-traders can not produce the numèraire when $t \in \{T_n\}_{n=1}^{\infty}$. OTC financial services could be settled with a loan to be repaid after the match. However, given that unsecured loans are not credible due to a lack of commitment and that OTC-traders can not always produce the numèraire good to purchase financial services, there is a demand for public and private assets. Thus the loan issued by an OTC-trader is always secured with some collateral.[22] It is important to note that since workers are risk-neutral (no need for consumption smoothing), the demand

[22]When buying assets from firms, OTC-traders can fully diversify their portfolio of different equities via securitization of large pools of assets which can turn these private claims into safe and liquid assets.

for liquid assets is entirely driven by OTC-traders.

Upon a bilateral match being formed, a trader is chosen at random, with equal probability, to be either a supplier or a user of financial services. The utility from consuming y units of financial services is $f(y)$, where $f(\cdot)$ is strictly concave while the disutility from producing x units of financial financial services is x. The exact terms of trade in this OTC financial market are determined by a buyer take it or leave it offer. A contract in the OTC market is then a pair, (y, d) that specifies a production of services, y, in exchange for a transfer of assets, d. This could also be interpreted as a market where the buyer is paying with assets so that the trade is final. Alternatively, it can be viewed as a collateralized loan where the buyer promises to repay d units of numéraire as soon as he exits the OTC market, and the repayment of the loan is secured by the deposit of d units of liquid assets.

Let $W(A_0)$ denote the lifetime expected discounted utility of an OTC-trader holding units of liquid assets (claims on firms' profits, government bonds and fiat money). The problem of the OTC-trader is to decide her asset holdings, $A(t)$=$(a(t),\ b(t),\ m(t))$, and consumption path, $c(t)$ and discrete jumps Δ_j, so as to maximize her discounted cumulative consumption until T_1 plus the present continuation value of a trading opportunity in the OTC market at time T_1 with $A(T_1)$ units of liquid assets, $Z\left[A(T_1)\right]$. Formally, the OTC-trader's problem can be written recursively as follows:

$$W(A_0) = \max_{a(t),b(t),m(t),c(t),k,\{\Delta_j,t_j\}} \left\{ \mathbb{E} \int_0^{T_1} e^{-\rho t} c(t) dt - \sum_{j=1}^{k} e^{-\rho t_j} \Delta_j \mathbb{I}_{\{t_j \leq T_1\}} + e^{-\rho T_1} Z\left[A(T_1)\right] \right\} \tag{6}$$

$$\text{s.t.} \quad \dot{a} + \dot{m} + \dot{b} = r^m m + r^g b + ra - c - \mathcal{T} \quad \text{for all } t \neq t_j \tag{7}$$

$$\Delta_j \equiv C(t_j^+) - C(t_j^-) \text{ for all } j = 1, ..., k \tag{8}$$

where A_0=(a_0, b_0, m_0) are the initial liquid asset conditions, T_1 is the random time at which the trader is matched with another trader, $r^m(r^g)$ represents the return on real balances (real bonds) and $\mathbb{I}_{\{t_j \leq T_1\}}$ is an indicator function that is equal to one if $t_j \leq T_1$ (and zero otherwise). The second term on the right side of (6) represents lumpy consumption (production if $\Delta_j < 0$) financed by discrete jumps in asset holdings. The trader chooses both the sizes of these discrete adjustments, Δ_j, and their timing, t_j, with k denoting the number of adjustments.

Using results from Seierstad and Sydsaeter (1987), Rocheteau et al (2014) show that the recursive OTC-problem is equivalent to that of a portfolio problem with an initial portfolio of real money balances, real bonds and private assets (m_0, g_0, a_0) which is given by

$$\max_{m(t),\dot{m},\dot{b},b(t),a(t),c(t)} \mathbb{E}\left[\int_0^{T_1} e^{-\rho t} c(t) dt + e^{-\rho T_1} Z[A(T_1)) \right] \text{ s.t. } \dot{a} + \dot{m} + \dot{b} = r^m m + r^g b + ra - c - \mathcal{T} \tag{9}$$

where the continuation value of an OTC trader upon being matched, $Z(A)$ is given by

$$Z(A) = \frac{\mu^p}{2} \max_{y^p \leq m+b+a} [f(y^p) - y^p] + \frac{\mu^g}{2} \max_{y^g \leq m+b} [f(y^g) - y^g] + \frac{\mu^m}{2} \max_{y^m \leq m} [f(y^m) - y^m].$$

This value function captures the fact that the terms of trade are given by a buyer take it or leave it offer, that an OTC trader has equal probability to be a buyer or a seller and that not all assets can be used as collateral in all states of the world, as stipulated by the financial regulation. The OTC-trader views the various assets in his portfolio as a store of value as well as collateral to facilitate financial transactions. These different functions give rise to an equlibrium notion of liquidity that is shaped by all government policies.

The OTC trader's optimal portfolio solves the following system of equations that links the return of the available assets with the liquidity needs of OTC-traders. Formally, we have that the rate of return on the various assets satisfy the following conditions

$$\frac{\rho - r}{\sigma} = \mu^p[f'(y^p) - 1];$$

$$\frac{\rho - r^g}{\sigma} = \mu^g[f'(y^g) - 1];$$

$$\frac{\rho - r^m}{\sigma} = \mu^m[f'(y^m) - 1];$$

where $y^p = \min\{m + b + L^p, y^*\}$, $y^g = \min\{m + b, y^*\}$, $y^m = \min\{m, y^*\}$, $f'(y^*) = 1$ and $1/\sigma$ denotes the expected time before the trader receives an opportunity to purchase OTC financial services. It is important to note that value of assets are also impacted by monetary and fiscal policies as they affect the degree of substitution between these assets by altering interest rate spreads.

Private assets dominate government bonds in their rate of return ($r > r^g$) provided that $\mu^g > 0$ and $y^g < y^*$. Similarly, government bonds dominate fiat money in their rate of return ($r^g > r^m$) if $\mu^m > 0$ and $y^m < y^*$. Recall that since fiat money yields no dividend its rate of return is given by

$$r^m = \frac{\dot{\nu}^m}{\nu^m}$$

while the price of bonds solves the following asset pricing condition,

$$r^g \nu^b = \nu^m - \nu^b + \dot{\nu}^b$$

which rules out any arbitrage opportunity.

As noted by Friedman (1956), Tobin (1961) and Brunner and Meltzer (1972), the equilibrium price level is determined by the valuation of all assets jointly. The different uses that assets can have, as store of value or collateral objects, and how they are traded have a direct impact on their value. Thus in order to understand inflation dynamics one has to pay attention to the financial architecture and the financial frictions that agents face when trading assets as these features affect their portfolio decision. Finally, it is also important to determine the beliefs about future inflation which are affected by current and future tax as well as financial policies.[23] All these features are going to shape the relative prices between these assets.

4 Monetary Equilibrium

In this section we study the equilibrium properties of an economy with trades in OTC financial markets and in which workers face unemployment.

Definition 1 *Given some exogenous government expenditures, a constant money growth rate and a fiscal policy rule where taxes are linked with government debt, a monetary equilibrium is an allocation of real assets,* $\{m, b, a\}$*, labor market outcomes,* $\{\theta, n\}$*, goods and services,* $\{C, y\}$*, as well as interest rates,* $\{r^m, r^g, r\}$*, that satisfies the optimality conditions of workers, firms and OTC-traders while labor and financial markets clear.*

[23] Initially Leeper (1991) emphasized the role of expectations when just analysing monetary and fiscal policy in frictionless centralized environments.

After imposing market clearing and private agents' optimality conditions, the resulting monetary dynamic equilibrium is given by a system of non-linear differential equations that specify the evolution of the real value of fiat money and nominal bonds, firm's value, the measure of employed workers and nominal bonds. The resulting dynamic equilibrium is given by

$$\dot{m} = m\left(\zeta + \frac{\dot{\nu}^m}{\nu^m}\right) \tag{10}$$

$$\dot{m} + \dot{b} = \mathcal{G} + \frac{\dot{\nu}^m}{\nu^m}m + \left[\frac{\nu^m}{\nu^b} + \frac{\dot{\nu}^b}{\nu^b}\right]b - (\eta_0 + \eta_1 b) \tag{11}$$

$$\dot{V}_F = rV_F - (\Phi - (\eta_0 + \eta_1 b) - w - \delta V_F) \tag{12}$$

$$\dot{n} = h(1,\theta)(1-n) - \delta n \tag{13}$$

$$r - \left[\frac{\nu^m}{\nu^b} - 1 + \frac{\dot{\nu}^b}{\nu^b}\right] = \mu^g \sigma(f'(y^g) - 1) \tag{14}$$

$$\left[\frac{\nu^m}{\nu^b} - 1 + \frac{\dot{\nu}^b}{\nu^b}\right] - \frac{\dot{\nu}^m}{\nu^m} = \mu^m \sigma(f'(y^m) - 1) \tag{15}$$

where $V_F = \frac{\gamma}{h(\theta^{-1},1)}$, $r = \rho - \sigma\mu^p[f'(y^p) - 1]$, $y^m = \min\{m, y^*\}$, $y^g = \min\{m + b, y^*\}$, $y^p = \min\{m + b + nV_F, y^*\}$ and $f'(y^*) = 1$. From now on, to simplify exposition, we assume specific functional forms so that the labor matching function is $h(1,\theta) = A\theta^{1-\alpha}$ and the pay off to liquidity services is given by $f(x) = Dx^\phi$.

Depending on the underlying fundamentals of the economy and all government policies, different type of equilibria can emerge depending whether the various collateral constraints bind or not. This will in turn determine the degree of substitution between the private and public assets as store of value. In particular inflation dynamics in this economy critically depend on what sort of liquidity services fiat money delivers as it is intimately linked to the return on fiat money, r^m.

In the next sections we characterize the monetary equilibrium where private and public liquidity provision is plentiful to satisfy the collateral needs of OTC-traders. We analyze two cases. One where total government liabilities, fiat money and nominal bonds alone can meet the liquidity needs of OTC-traders and one in which they can not and private assets are needed.

5 Not Enough Fiat Money

In this environment fiat money alone is not sufficient to satisfy the liquidity needs of OTC-traders but all government liabilities can. As a result, the interest rate on private claims equals the rate of time preference, $r = \rho$, and government bonds pay the same return as private liabilities so that $r^g = r = \rho$. Thus in this economy private assets and nominal bonds are perfect substitutes as store of value. It is easy to show that the corresponding dynamic monetary equilibrium is given by

$$\dot{m} = m\left(\zeta + \rho + \mu^m\sigma - \mu^m\sigma\phi D m^{\phi-1}\right) \tag{16}$$

$$\dot{m} + \dot{b} = \mathcal{G} + m\left(\rho + \mu^m\sigma - \mu^m\sigma\phi D m^{\phi-1}\right) + (1 + \rho - \eta_1)\, b - \eta_0 \tag{17}$$

$$\dot{\theta} = \frac{\theta}{\alpha}\left[(\rho + \delta) - (\Phi - w)\frac{\theta^{-\alpha}}{A\gamma}\right] \tag{18}$$

$$\dot{n} = \theta^{1-\alpha}(1-n) - \delta n \tag{19}$$

where $m < y^*$ and $m + b \geq y^*$ which simply reflects the fact that private assets are not really needed to satisfy the collateral needs of OTC-traders.

As we can see from equations (16)-(19), the non ad-valorem taxes to OTC-traders are pure lump sum as they do not affect any margins. Moreover, since all government liabilities are enough to cover the liquidity needs of OTC-traders there are no interest rate spreads. These two properties are key in generating the stabilization policies advocated by the FTPL. Thus, in principle our benchmark economy that has pure lumps sum taxes and there are no interest rate spreads between government bonds and private assets could deliver the standard FTPL policy prescriptions to stabilize the economy. The emerging stabilization policies from FTPL based on frictionless Walrasian labor and financial markets are those where fiscal and monetary authorities have to conduct active/passive policies.[24] We now explore such possibility.

Steady States

We now study a monetary steady state where real money balances, real bonds, new employment and labor market tightness are constant over time. This implies that $\dot{m} = \dot{b} = \dot{n} = \dot{\theta} = 0$. It is easy to show that in this new environment there exists a unique monetary steady state where real balances and labor market tightness are given by

$$m = \left(\frac{D\phi\mu^m\sigma}{\rho + \zeta + \mu^m\sigma} \right)^{\frac{1}{1-\phi}}; \quad \theta = \left(\frac{\Phi - w}{A\gamma(\rho + \delta)} \right)^{\frac{1}{\alpha}};$$

while real bonds and employment are given by

$$b = \frac{\zeta m + \eta_0 - \mathcal{G}}{1 + \rho - \eta_1}; \quad n = \frac{\theta^{1-\alpha}}{\theta^{1-\alpha} + \delta};$$

and the steady state inflation is exactly equal to the money growth rate. Given the close form nature of the monetary steady state, we can now establish the following properties.

Lemma 2 *An increase in the fiat money collateral requirement (μ^m) increases steady state real balances.*

This result is quite intuitive as raising the collateral value of fiat money increases its demand. This is the case as potential consumption possibilities of financial services when no other assets can be used as collateral are increased.

Lemma 3 *The impact of an increase in the fiat money collateral requirement (μ^m) on real bonds depends on the stance of both fiscal (η_1) and monetary (ζ) policies. Real bonds will increase whenever we satisfy*

$$\frac{\zeta}{1 + \rho - \eta_1} > 0.$$

This lemma stresses the fact that monetary policy, through changes in the money growth rate, can affect the attractiveness of real balances as a medium of exchange while financial regulation can alter the usefulness of fiat money as collateral when trading in OTC markets.

[24] Leeper's (1991) money in the utility function model or Woodford's (1998) cashless economy with frictionless financial and labor markets show that it is possible for fiscal policies to stabilize the price level. This fiscal result is robust to different monetary and cashless environments. Both monetary and fiscal policy parameters do not affect the magnitude of any of the eigenvalues.

Lemma 4 *Monetary (ζ), fiscal and OTC policies (μ^m, μ^g, μ^p) do not affect the steady state level of unemployment. Moreover, changes in job separation rates (δ), in matching efficiency (A), and vacancy costs (γ) do not affect real balances nor real bonds.*

These results highlight the fact that as taxes in the economy are pure lump sum and do not affect the entry decision of the firm. Moreover, as OTC-traders do not really need private assets to satisfy the collateral needs to trade in financial markets characteristics of the labor market do not affect the demand for private assets. As a result, OTC nor monetary policies can not affect the attractiveness of private assets as useful collateral objects nor as a store of value.

Summarizing, when all government liabilities are able to satisfy the liquidity needs of OTC-traders, the potential impact of OTC regulation on real balances is quite limited and can be replicated through appropriate monetary policy actions. However, to undo the effect of OTC regulation on real bonds requires coordination of monetary and fiscal policy.

Local Dynamics

In order to study local dynamics we analyze the Jacobian implied by the system of differential equations (16)-(19) that describe the monetary equilibrium. It is worth highlighting that this economy delivers a dynamic dichotomy between real government liabilities and labor market outcomes. As a result, one can study the dynamic properties in two separate blocks as in Leeper (1991). These features are not too surprising as OTC-traders face pure lump sum and there are no interest rate spreads between private assets and government bonds. The unique monetary steady state then has the following eigenvalues associated with the asset market

$$\lambda_1 = (1-\phi)(\mu^m \sigma + \rho + \zeta); \;\; \lambda_2 = 1 + \rho - \eta_1;$$

while the labor market eigenvalues are

$$\lambda_3 = \rho + \delta, \;\; \lambda_4 = -\left(\delta + \left(\frac{\Phi - w}{(\rho+\delta)A\gamma}\right)^{\frac{1-\alpha}{\alpha}}\right).$$

As we can see, the corresponding eigenvalues for the labor market only depend on labor market fundamentals while the eigenvalues corresponding to the asset market has one associated with *fiscal* and one with *monetary and financial* policies. Given the close form nature of our results we can establish the following results.

Lemma 5 *Changes in OTC regulation (μ^m) nor monetary policy (ζ) are not able to alter the local determinacy properties of the steady state.*

Note that this is the case as μ^m can only take values between zero and one, the first eigenvalue can not be negative even when we impose substantial deflation episodes, even at the zero lower bound; i.e, $\zeta{=}-\rho$. Monetary and financial policy can only affect the rate of convergence/divergence towards the steady state. Similar effects are found in the FTPL when the central bank follows a money growth rate rule.

Lemma 6 *In order for the equilibrium to be locally determinate fiscal policy has to be aggressive; i.e, $\eta_1 > 1 + \rho$.*

Under this *aggressive* fiscal regime, unemployment and inflation will monotonically converge to their corresponding steady states. Monetary, fiscal and financial regulation stabilization policies can not alter labor market outcomes nor can help stabilize potential disruptions in such market. This result highlights the inability of monetary and financial policy to potentially stabilize the economy whenever the fiscal authority does not follow an aggressive policy. Thus, we recover the standard stabilization policy prescriptions from the FTPL.

As we can see, when the government can provide enough liquidity and firms and workers are not being taxed, the particulars of the financial architecture, centralized o decentralized, nor the details of the labor market, frictional or frictionless, do not change the fiscal requirements for price stability suggested by the FTPL.

5.1 Unemployment Benefits

In this section we analyze the consequences of introducing unemployment benefits that are funded from general government revenues. It is easy to show that the only difference relative to the previous dynamic equilibrium is the evolution of real bonds which is now given by

$$\dot{b} = \mathcal{G} - \eta_0 - m\zeta + (1 + \rho - \eta_1)\, b - \eta_0 + (1 - n)\kappa_u \tag{20}$$

where $(1-n)\kappa_u$ is the total unemployment benefits paid out and κ_u is the benefit in per capita terms.

Under this new scenario we now have that only the steady state real bonds are different and are given by

$$b = \frac{\zeta m + \eta_0 - \mathcal{G} - (1-n)\kappa_u}{1 + \rho - \eta_1};$$

where $m = \left(\frac{D\phi\mu^m\sigma}{\rho+\zeta+\mu^m\sigma}\right)^{\frac{1}{1-\phi}}$; $\theta = \left(\frac{\Phi - w}{A\gamma(\rho+\delta)}\right)^{\frac{1}{\alpha}}$ and $n = \frac{\theta^{1-\alpha}}{\theta^{1-\alpha}+\delta}$.

Given the close form nature of the monetary steady state, we can now establish the following properties.

Lemma 7 *Changes in job separation rates (δ), in matching efficiency (A), and vacancy costs (γ) affect real bonds.*

This result is very natural as part of the government expenditures directly depends on the equilibrium unemployment rate. Thus changes in the labor market directly affect the total government expenditures has to finance by issuing government liabilities and collecting taxes. In particular, the more generous are the unemployment benefits the more real bonds outstanding are going to be observed in the economy.

Let us now run into the study of the local dynamics. It is easy to show that the unique monetary steady state then has exactly the same eigenvalues as in the previous case with no unemployment benefits. As a result we recover the previous result regarding stabilization policies.

Lemma 8 *In order for the equilibrium to be locally determinate fiscal policy has to be aggressive; i.e, $\eta_1 > 1 + \rho$.*

This result is not too surprising as introducing unemployment benefits does change the fact that taxes are lump sum and there are no interest rate spreads which are the two keys ingredients to deliver the stabilization policies in the FTPL.

6 Not Enough Government Liabilities

Here we study an economy where all assets are required to satisfy the liquidity needs of OTC-traders. This new scenario can help highlight the consequences for stabilization policies of having different degrees of plentiful assets to meet the collateral requirements of OTC-traders. In particular, in this new environment the return on government bonds is lower than the one obtained with private assets; i.e, $r = \rho > r^g$. Thus private assets and government bonds are not perfect substitutes both as a store of value nor as collateral objects. The resulting dynamic equilibrium is given by economy is given by

$$\dot{m} = m\left(\zeta + \rho + \mu^m\sigma - \mu^m\sigma\phi D m^{\phi-1}\right) \tag{21}$$

$$\dot{m} + \dot{b} = \mathcal{G} + m\left(\rho + \mu^m\sigma - \mu^m\sigma\phi D m^{\phi-1}\right) + \left(1 + \rho + \mu^g\sigma - \eta_1 - \mu^g\sigma(m+b)^{\phi-1}\right)b - \eta_0 \tag{22}$$

$$\dot{\theta} = \frac{\theta}{\alpha}\left[(\rho+\delta) - (\Phi - w)\frac{\theta^{-\alpha}}{A\gamma}\right] \tag{23}$$

$$\dot{n} = \theta^{1-\alpha}(1-n) - \delta n \tag{24}$$

where $m + b < y^*$ and $m + b + n\gamma\theta^\alpha \geq y^*$ which simply reflects the fact that private assets are essential to satisfy the liquidity needs of OTC-traders.[25]

Steady States

It is easy to show that the steady state real bonds for this economy are implicitly given by

$$b(1 + \rho + \mu^g\sigma - \eta_1 - \sigma\mu^g D\phi(m+b)^{\phi-1}) = \zeta m - \mathcal{G} + \eta_0; \tag{25}$$

where $m = \left(\frac{D\phi\mu^m\sigma}{\rho+\zeta+\mu^m\sigma}\right)^{\frac{1}{1-\phi}}$ and the steady state labor market observables are given by

$$\theta = \left(\frac{\Phi - w}{A\gamma(\rho+\delta)}\right)^{\frac{1}{\alpha}}; \;\; n = \frac{\theta^{1-\alpha}}{\theta^{1-\alpha} + \delta}.$$

After having characterized the steady state equilibria, we can now establish some properties of this stationary equilibria. All proofs can be found in the Appendix.

Proposition 9 *The monetary steady state equilibria is generically not unique.*

Multiplicity of steady state is possible as interest rate spreads between government bonds and private equity explicitly depend on the steady state level of real bonds. In particular we have that

$$\rho - r^b = \mu^g\sigma(\phi D(m+b)^{\phi-1} - 1).$$

As a result the repayment component of the government budget constraint is non-linear. This feature allows multiple steady states to exist. This multiplicity is in sharp contrast to the previous case where there were no interest rate spreads. The different degrees of plentiful liquidity are critically important in determining the properties of the stationary equilibria.

Lemma 10 *Monetary (ζ), fiscal and OTC policies (μ^m, μ^g, μ^p) do not affect the steady state level of unemployment. Moreover, changes in job separation rates (δ), in matching efficiency (A), and vacancy costs*

[25] Recall that the private provision of liquidity is given by $L^p = n\gamma\theta^\alpha$.

(γ) do not affect real balances nor real bonds.

Taxes here are pure lump sum and do not affect the entry decision of the firm. Since the return on private assets is the natural interest rate in the economy, OTC nor monetary policies can not further increase the attractiveness of private assets as useful collateral nor as a store of value.

Dynamic Equilibrium

The corresponding characteristic equation of the Jacobian associated with an economy where all assets are required to meet the liquidity needs of OTC-traders is given by

$$p(\lambda) = (\psi_1 - \lambda)(\psi_3 - \lambda)(\psi_6 - \lambda)(-\psi_8 - \lambda);$$

where the different elements of the Jacobian are given by

$$\psi_1 = (1-\phi)(\rho + \zeta + \mu^m\sigma); \;\; \psi_6 = \frac{\theta^{-\alpha}(\Phi - w)}{A\gamma}; \;\; \psi_8 = (\theta^{1-\alpha} + \delta);$$

$$\psi_3 = 1 + \rho + \mu^g\sigma - \mu^g\sigma\phi D(m+b)^{\phi-1} - \eta_1 + \mu^g\sigma\phi(1-\phi)D(m+b)^{\phi-2};$$

where b is the solution to equation (25), m are the steady state real balances, θ is the labor market tightness and n represents the steady state equilibrium employment.

It is easy to show that the asset market eigenvalues are given by

$$\lambda_1 = \psi_1; \;\; \lambda_2 = \psi_3;$$

while the labor market eigenvalues are

$$\lambda_3 = -\left(\delta + \left(\frac{\Phi - w}{(\rho+\delta)A\gamma}\right)^{\frac{1-\alpha}{\alpha}}\right); \;\; \lambda_4 = \rho + \delta.$$

It is now easy to establish the following results.

Lemma 11 *The eigenvalues associated with the labor market are not affected by monetary, fiscal nor financial regulation policies.*

As in the previous equilibria, there is decoupling of the dynamic properties associated with the eigenvalues of the labor and financial markets. This is the case as government policies are not affecting the entry decisions of firms. Moreover, the return on private assets is the natural interest rate in the economy, OTC nor monetary policies can not further increase the attractiveness of private assets as useful collateral nor as a store of value

Lemma 12 *Both of the eigenvalues associated with the asset market depend on the specifics of monetary, fiscal and financial regulation policies.*

When private assets are required to provide the desired liquidity, the effects of all government policies jointly affect the stability properties of the eigenvalues associated with the asset market. This is not surprising as all policies alter the spread between private and public assets. As a result, the traditional prescription of stabilization properties of the FTPL are not going to generally be effective in this environment with interest rate spreads.

By comparing the results of the last two sections, we can conclude that the precise composition of assets that deliver plentiful market liquidity is key in determining the properties of monetary equilibria. The crucial feature that can deliver different stabilization results lies in the existence of interest rate spreads between government bonds and private assets. The existence of spreads allows for all government policies to affect the degree of substitution between private and public assets. This new channel through which policies affect the portfolio decision of agents alters the conventional prescriptions stabilization policies.

6.1 Unemployment Benefits

In this section we analyze the consequences of introducing unemployment benefits. It is easy to show that the only difference relative to the previous dynamic equilibrium is the evolution of real bonds which is now given by

$$\dot{b} = \mathcal{G} - \eta_0 - m\zeta + \left(1 + \rho + \mu^g\sigma - \eta_1 - \mu^g\sigma D\phi(m+b)^{\phi-1}\right) b - \eta_0 + (1-n)\kappa_u \tag{26}$$

where κ_u is the unemployment benefit in per capita terms.

Under this new scenario we now have that only the steady state real bonds are different and are given by

$$b(1 + \rho + \mu^g\sigma - \eta_1 - \sigma\mu^g D\phi(m+b)^{\phi-1}) = \zeta m - \mathcal{G} - (1-n)\kappa_u + \eta_0; \tag{27}$$

where $m = \left(\frac{D\phi\mu^m\sigma}{\rho+\zeta+\mu^m\sigma}\right)^{\frac{1}{1-\phi}}$; $\theta = \left(\frac{\Phi-w}{A\gamma(\rho+\delta)}\right)^{\frac{1}{\alpha}}$ and $n = \frac{\theta^{1-\alpha}}{\theta^{1-\alpha}+\delta}$.

Relative to the case with no unemployment benefits, we find that real bonds in steady state are higher. We can also establish the following properties.

Lemma 13 *Changes in job separation rates (δ), in matching efficiency (A), and vacancy costs (γ) affect real bonds.*

As in the case where there were all government liabilities were enough to satisfy the liquidity needs of OTC-traders, changes in the labor market directly affect the total government expenditures has to finance by issuing government liabilities and collecting taxes.

Let us now run into the study of the local dynamics. It is easy to show that the asset market eigenvalues are given by

$$\lambda_1 = \psi_1; \;\; \lambda_2 = \psi_3;$$

while the labor market eigenvalues are

$$\lambda_3 = -\left(\delta + \left(\frac{\Phi - w}{(\rho+\delta)A\gamma}\right)^{\frac{1-\alpha}{\alpha}}\right); \;\; \lambda_4 = \rho + \delta.$$

where the different elements of the Jacobian are given by

$$\psi_1 = (1-\phi)(\rho + \zeta + \mu^m\sigma); \;\; \psi_3 = 1 + \rho + \mu^g\sigma - \mu^g\sigma\phi D(m+b)^{\phi-1} - \eta_1 + \mu^g\sigma\phi(1-\phi)D(m+b)^{\phi-2};$$

where b is the solution to equation (27).

Similar properties are obtained to economies with no unemployment benefits. This result is not too surprising as introducing unemployment benefits does change the fact that all government policies can affect interest rate spreads between nominal bonds and private assets.

7 Alternative Tax Structure

So far we have analyzed a situation where only OTC-traders are taxed and their decisions are not affected at the margin. In this section we explore the consequences of an alternative tax scheme. In particular, we now consider an environment where all active agents are taxed. Thus after paying workers and taxes, the resources available to a firm are $\Phi - w - \mathcal{T}$, while workers are able to consume $w - \mathcal{T}$. **This alternative taxing structure is quite important as it implies a different fiscal backing of the nominal government bonds. Note that current fiscal choices are necessarily linked to future fiscal decisions. Thus any change in policy today, tax different sectors in the economy, that alters the real value of debt held by the public must bring forth changes in future policies to support the new value of debt. Thus we expect that this new tax scheme will have drastic implications for the value of the real debt and the subsequent stabilization policies.**

In the next subsections we analyze the resulting equilibrium when all government liabilities are sufficient to meet the liquidity needs of OTC-traders and the equilibrium where all private and public assets are required.

7.1 Not Enough Fiat Money

When all government liabilities are enough to satisfy the collateral needs of OTC-traders, it is easy to show that the monetary equilibrium is given by

$$\dot{m} = m\left(\zeta + \rho + \mu^m\sigma - \mu^m\sigma\phi D m^{\phi-1}\right)$$

$$\dot{m} + \dot{b} = \mathcal{G} + m\left(\rho + \mu^m\sigma - \mu^m\sigma\phi D m^{\phi-1}\right) + (1 + \rho - (1+2n)\eta_1)\, b - (1+2n)\eta_0$$

$$\dot{\theta} = \frac{\theta}{\alpha}\left[(\rho+\delta) - (\Phi - w - (\eta_0 + \eta_1 b))\frac{\theta^{-\alpha}}{A\gamma}\right]$$

$$\dot{n} = \theta^{1-\alpha}(1-n) - \delta n.$$

As we can see with this new tax scheme, the evolution labor market tightness explicitly depends on the evolution of real bonds. Moreover, fiscal policies directly impact the dynamics of labor market tightness while financial and monetary policies indirectly affect it through the evolution of real bonds. Unemployment on the other hand, is indirectly affected by financial, fiscal and monetary policies through the evolution labor market tightness. This is the case as taxes affect the entry decisions of firms. Once the entry costs can be covered, the level of taxes affect the firm's ability to issue private claims. The overall value of these private claims is further affected by the government's ability to issue assets that are substitutes to these private claims. In particular, financial and monetary policies directly affect the liquidity value of private claims as it can change their collateral value in the OTC market.

It is also important to note that in this monetary equilibrium labor market tightness and unemployment also affect asset market dynamics. This fact simply reflects that labor market conditions, the costs of posting vacancies and the severity of labor market frictions, directly affect the value of the firm which in turn affects

their ability to provide private liquidity to financial markets. These features of the monetary equilibrium are consistent with the findings of Gatti et. al (2012) who show that for 18 OECD countries over the pre-crises period, 1980-2004, the impact of financial variables depend strongly on the labor market context while the impact of labor market characteristics on financial markets appears to be less significant.[26]

Steady States

After imposing the steady state conditions, we have that the steady state market tightness is implicitly given by

$$(\rho+\delta)A\gamma\theta^{\alpha}=\left(\varepsilon_1-\eta_1\frac{\varepsilon_0+2n\eta_0}{1+\rho-\eta_1(1+2n)}\right) \tag{28}$$

where ε_0=$\zeta m+\eta_0-\mathcal{G}$, ε_1=$\Phi-w-\eta_0$, n=$\frac{\theta^{1-\alpha}}{\theta^{1-\alpha}+\delta}$, $\frac{\nu^m}{\nu^b}=1+\rho+\zeta$, b=$\frac{\varepsilon_0+2n\eta_0}{1+\rho-\eta_1(1+2n)}$ and m=$\left(\frac{D\phi\mu^m\sigma}{\rho+\zeta+\mu^m\sigma}\right)^{\frac{1}{1-\phi}}$.

Next, we establish sufficient conditions for the existence of a unique monetary steady state.

Proposition 14 *A monetary steady state is unique whenever the underlying parameters of the economy satisfy the following sufficient conditions*

$$\eta_0(1+\rho)+\eta_1\varepsilon_0>\eta_1\eta_0 \quad \& \quad \varepsilon_1>\frac{\eta_1\varepsilon_0}{1+\rho-\eta_1}.$$

In contrast to the case where only OTC-traders were taxed, here multiple steady states can not be ruled out. This is not surprising as now non-advalorem taxes are able to affect marginal decisions of firms. In particular, the level of taxes affect the entry decisions of firms, directly impacting their subsequent hiring and provision of private liquidity. As a result, the tax base stemming from the firms will respond to changes in taxes.

Having established conditions for uniqueness of monetary steady states, we now explore its properties in terms of fiscal, monetary and financial policies.

Proposition 15 *When the economy has a unique monetary steady state and the fiscal authority follows a fiscal policy such that $\eta_1>1+\rho$, the value of the firm increases with η_0 and μ^m while the value of the firm decreases with the money growth rate, ζ.*

When fiscal policy is *aggressive* ($\eta_1>1+\rho$) nominal bonds tend to be more abundant, making private liabilities more scarce which in turn increases the value of the firm. Once agents can trade with public and private assets in decentralized markets, monetary and fiscal policy directly affect the endogenous supply of private liquidity. Government policies other than financial regulation can change the usefulness of private assets as store of value.

The importance of the labor market in policy design has been emphasized by Kocherlakota (2010), Plosser (2010) and Lacker (2012) during the onset of the financial crises. These policy markers have suggested that the high unemployment rate during the global financial crises is due to a reduction in the matching efficiency between vacant and unemployed. Consistent with the view of the importance of the labor market for

[26]These authors show that increased market capitalization as well as decreased banking concentration reduce unemployment if the level of labour market regulation, union density, and coordination in wage bargaining is low. Increasing intermediated credit and banking concentration is beneficial for employment when the degree of labor market regulation, union density, and wage coordination is high. These results suggest that the respective virtues of intermediated and market-based finance are crucially tied to the labour market context.

monetary policy, this equilibrium has also the property that labor market conditions have important effects for the provision of both private and public liabilities. This is summarised in the following Proposition.

Proposition 16 *When the economy has a unique monetary steady state, an increase in the rate at which jobs are destroyed, in vacancy costs and in the labor matching efficiency always reduces the demand for real government bonds.*

According to this Proposition, the drop in the matching efficiency during the GFC, argued by Kocherlakota (2010), Plosser (2010) and Lacker (2012), would be associated with an increase in the demand for real government bonds. Changes in labor market conditions directly affect the tax base which can be used to finance nominal government bonds ultimately affecting its supply. This in turn alters the attractiveness of private assets relative to public liabilities for a given OTC market regulation. This is the case as the firm provides private liquidity, which is directly affected by fiscal policies, that competes with public assets in the portfolio of OTC-traders.

Summarizing, financial regulation (μ^m), monetary (ζ) and fiscal (η_0 and η_1) policies affect the steady state values of real assets and labor market observables. We can conclude then that the burden of the tax base is crucial in determining the monetary properties even when tax are non ad-valorem.

Local Dynamics

Now the evolution of labor market outcomes are not independent of the real value of government debt. This feature has important implications for the design of stabilization policies. The associated Jacobian evaluated is given then by

$$J_{ss} = \begin{bmatrix} \Omega_1 & 0 & 0 & 0 \\ -\Omega_2 & \Omega_3 & 0 & -\Omega_4 \\ 0 & \Omega_5 & \Omega_6 & 0 \\ 0 & 0 & \Omega_7 & -\Omega_8 \end{bmatrix}.$$

The corresponding characteristic equation of this Jacobian is given by

$$p(\lambda) = (\Omega_1 - \lambda)[(\Omega_3 - \lambda)(\Omega_6 - \lambda)(-\Omega_8 - \lambda) - \Omega_4\Omega_5\Omega_7];$$

where the different elements of the Jacobian are

$$\Omega_1 = (1-\phi)(\rho + \zeta + \mu^m\sigma);\ \ \Omega_3 = 1 + \rho - (1+2n)\eta_1;\ \ \Omega_4 = 2\left(\eta_0 + \eta_1 b\right);\ \ \Omega_5 = \frac{\eta_1\theta^{1-\alpha}}{\alpha A\gamma}$$

$$\Omega_6 = \frac{\theta^{-\alpha}(\Phi - w - \eta_0 - \eta_1 b)}{A\gamma}; \Omega_7 = (1-\alpha)(1-n)\theta^{-\alpha};\ \ \Omega_8 = (\theta^{1-\alpha} + \delta);$$

where θ is the solution to equation (28), b is the steady state real bonds and n is the steady state equilibrium employment.

Lemma 17 *Eigenvalues will typically depend on the specifics of monetary, fiscal, financial regulation policies as well as the characteristics of the labor market.*

As in the previous monetary equilibrium where only OTC-traders were taxed, there exist an eigenvalue that only depends on monetary and financial policies. These policies are not able to change the nature

of this eigenvalue. However, in contrast to the previous monetary equilibrium, the rest of the eigenvalues depend on monetary, fiscal and financial policy parameters. In particular, the steady state tax revenues and the money growth rate affect the magnitude of the eigenvalues.

Lemma 18 *Eigenvalues will generically display endogenous volatility.*

The dynamic properties of the monetary equilibrium are characterized by a cubic characteristic polynomial. The generic solution to these type of polynomials exhibits complex roots. As a result, unemployment and inflation are going to fluctuate over time even when there are no exogenous shocks hitting the economy. **intuition.....**

7.1.1 Numerical Exploration

Since there is no close form solution for the steady state equilibrium, a numerical analysis is required to determine the local determinacy properties. To determine reasonable parameter values for the labor market, we closely follow Shimer (2005) who considers US data from 1951 until 2003.[27] The unit of time represents one quarter and we set $\rho = 0.012$ so that the annual real interest rates is around 5%. The job destruction rate is set such that δ=0.1 which is consistent with Shimer's (2005) observation that on average jobs last about two and a half years. He also estimates that job finding rates are 0.45 per month. Following Shimer (2005), we normalize labor market tightness, θ=1, so that the worker-finding rate is equal to the job-finding rate. Therefore, we have that α= 0.72 and A=1.35. Arseneau and Chugh (2012) find that the cost of advertising a vacancy is 3% of total firm's output, which yields a γ=0.03 when we normalize firm's output to one so that Φ=1. We then set w= 0.6 as to be consistent with the labor share and set $\mathcal{G}$=0.15 so that government expenditures over the period equal 13%. For the OTC market, we follow Chiu and Koppel (2014) assume that traders become buyers at Poisson rate σ= 2.27.[28] Finally, we set D=1 and ϕ=0.5 so that the average contribution of financial services to GDP from 1951 until 2005 is 16%.

With this parametrization, we consider various fiscal, monetary and financial regulation policies.[29] When computing equilibria we only consider policy parameters that yield steady state equilibria with positive real government liabilities; positive after tax wages as well as market tightness; profits are positive and all government liabilities are enough, but not fiat money alone, to meet the liquidity needs to OTC-traders. Table 2 reports some monetary equilibria with the corresponding fiscal parameters values, steady state asset and labor market outcomes and eigenvalues with the alternative tax scheme.

As we can see from Table 1, the monetary equilibrium has a unique steady state that is dynamically indeterminate when the fiscal authority follows a *passive* fiscal policy, $\eta_1 < 1 + \rho$. This occurs regardless of the monetary policy stance. This property is consistent with the policy prescriptions obtained by the FTPL in economies with frictionless labor and financial markets.[30] However, once the fiscal authority follows an *aggressive* fiscal policy, $\eta_1 > 1 + \rho$, multiple steady states exist.[31] In particular, the steady state associated with a higher unemployment rate, is dynamically indeterminate and exhibits endogenous volatility. As a

[27] We refer to Hornstein, Krusell and Violante (2005) for a detailed discussion of the calibration.

[28] Bao, Pan and Wang (2008) give turnover rates between one and two years for corporate bonds, while Goldstein, Hotchkiss and Sirri (2007) annual rate in the range of 0.8-1.2 (see also Edwards, Harris and Piwowar, 2007). Data for structured products are not readily available.

[29] For instance, when the growth rate of the money supply is ζ=0.005, it corresponds to a 2% annual inflation rate

[30] As in Leeper's (1991) money in the utility function model or Woodford's (1998) cashless economy, a Taylor rule that responds more than one to one to inflation makes prices determinate as long as fiscal policy adjusts to stabilize government debt. In terms of policy rules, the fiscal requirement for price stability delivers an easy rule: taxes should be set to at least cover principal and interest rates on bonds.

[31] Such phenomena is typically not obtained in FTPL with non ad-valorem taxes.

η_0	-0.45	-0.45	-0.45	-0.45	0.3	0.3
η_1	1.013	1.013	1.013	1.013	0.1	0.1
ζ	0.005	0.005	-0.005	-0.005	0.005	-0.005
θ	0.013	65.07	0.014	63.8	1.01	1.068
n	0.748	0.97	0.751	0.97	0.91	0.911
m	0.24	0.24	0.246	0.246	0.24	0.246
b	0.84	0.749	0.838	0.75	0.954	0.952
λ_1	0.416	0.416	0.411	0.411	0.416	0.411
λ_2	-3.086	-3.325	-3	-3.307	-1.133	-1.147
λ_3	0.615-1.977 i	-1.955	0.67- 1.922 i	-1.954	0.213	0.207
λ_4	0.615+1.977 i	0.108	0.67 + 1.922 i	0.107	0.659	0.663

Table 1: Equilibrium outcomes when all agents are taxed when μ^m=0.3.

result, unemployment and inflation will exhibit fluctuations that are not going to dampen over time moving away from the steady state. On the other hand, the other monetary steady state, which has associated a lower unemployment rate, is dynamically determinate. Thus, in a neighbourhood of this steady state, unemployment and inflation will monotonically converge.

Finally, irrespective of the fiscal stance, aggressive or passive, the steady state values critically affect the speed of convergence (divergence) of the economy. In the case where the economy is dynamically indeterminate, the steady state values impact the size of the endogenous fluctuations. These equilibrium properties are in sharp contrast to the case where OTC-traders are the only private agents being taxed. Finally, the qualitative properties highlighted in Table 2 are robust to environments where fiat money is not important in OTC financial markets; i.e, μ^m is very small. **This highlights the important distinction between the notion of cashless and liquidity (*moneyness*) as the former does not imply the latter.**

As expected the properties of the monetary equilibria are quite different as considering differences in policy today that alters the real value of debt must bring forth changes in future policies to support the new value of debt. Monetary, fiscal and financial policies are more intimately intertwined critically affecting the evolution of inflation and unemployment whenever all agents are taxed. The fact that non ad valorem taxes affect the entry decisions of firms is key in generating different stabilization results relative to the FTPL policy prescriptions.

7.2 Not Enough Government Liabilities

When all private and public assets can satisfy the collateral needs of OTC-traders to obtain their financial services and taxes are levied to all agents, it is easy to show that the monetary equilibrium is given by

$$\dot{m} = m\left(\zeta + \rho + \mu^m\sigma - \mu^m\sigma\phi D m^{\phi-1}\right) \tag{29}$$

$$\dot{b} = \mathcal{G} - m\zeta + \left(1 + \rho + \mu^g\sigma - (1+2n)\eta_1 - \mu^g\sigma(m+b)^{\phi-1}\right)b - (1+2n)\eta_0 \tag{30}$$

$$\dot{\theta} = \frac{\theta}{\alpha}\left[(\rho+\delta) - (\Phi - w - (\eta_0 + \eta_1 b))\frac{\theta^{-\alpha}}{A\gamma}\right] \tag{31}$$

$$\dot{n} = \theta^{1-\alpha}(1-n) - \delta n \tag{32}$$

As in the case with enough liquidity provided by government liquidities, labor market tightness dynamics depend on the evolution of real bonds. Similarly, unemployment dynamics are indirectly affected by the

evolution of real bonds through labor market tightness. In contrast, to taxing just OTC-traders the evolution of real bonds depends on the employment rate. As a result, fiscal policies can affect the effective tax base as it changes the entry decisions of firms.

Steady States

After imposing the steady state conditions, the monetary steady state solves the following fixed point equation for real bonds

$$b\left[\Sigma_2 - \mu^g \sigma D \phi (m+b)^{\phi-1}\right] = \eta_0 + \eta_1 b + \zeta m - \mathcal{G} + \frac{2(\eta_0+\eta_1 b)(\varepsilon_1 - \eta_1 b)^{\frac{1-\alpha}{\alpha}}}{(\varepsilon_1 - \eta_1 b)^{\frac{1-\alpha}{\alpha}} + \Sigma_1} \tag{33}$$

where $\varepsilon_1 = \Phi - w - \eta_0$, $\Sigma_1 = \delta((\rho+\delta)A\gamma)^{\frac{1-\alpha}{\alpha}}$, $\Sigma_2 = 1 + \rho + \mu^g\sigma$, and $m = \left(\frac{D\phi\mu^m\sigma}{\rho+\zeta+\mu^m\sigma}\right)^{\frac{1}{1-\phi}}$.

Since there is no close form solution for real bonds and we have already calibrated the model, we do not provide conditions that deliver existence of a unique monetary equilibria. Next, we establish some properties of the interest rate spread in terms of labor market conditions.

Proposition 19 *An increase in the rate at which jobs are destroyed, the vacancy costs and the labor matching efficiency always increases the interest rate spread between private assets and government bonds.*

These results simply highlight that when the rate at which jobs are destroyed, the vacancy costs and the labor matching efficiency increase, firms become more valuable as their assets become more scarce. As we can see, not only government policies are key in affecting the degree of substitution between private and public assets, the characteristics of the labor market matter.

Local Dynamics

The associated Jacobian evaluated at the steady state for this new equilibrium is given by

$$J_{ss} = \begin{bmatrix} \psi_1 & 0 & 0 & 0 \\ -\psi_2 & \psi_3 & 0 & -\psi_4 \\ 0 & \psi_5 & \psi_6 & 0 \\ 0 & 0 & \psi_7 & -\psi_8 \end{bmatrix}$$

with the corresponding characteristic given by

$$p(\lambda) = (\psi_1 - \lambda)[(\psi_3 - \lambda)(\psi_6 - \lambda)(-\psi_8 - \lambda) - \psi_4\psi_5\psi_7];$$

where the different elements of the Jacobian are

$$\psi_1 = (1-\phi)(\rho + \zeta + \mu^m\sigma); \;\; \psi_4 = 2\left(\eta_0 + \eta_1 b\right); \;\; \psi_5 = \frac{\eta_1\theta^{1-\alpha}}{\alpha A\gamma}; \;\; \psi_6 = \frac{\theta^{-\alpha}(\Phi - w)}{A\gamma};$$

$$\psi_3 = 1 + \rho + \mu^g\sigma - \mu^g\sigma\phi D(m+b)^{\phi-1} - (1+2n)\eta_1 + \mu^g\sigma\phi(1-\phi)D(m+b)^{\phi-2};$$

$$\psi_7 = (1-\alpha)(1-n)\theta^{-\alpha}; \;\; \psi_8 = (\theta^{1-\alpha} + \delta);$$

where b is the solution to equation (33), m are steady state real balances, θ is the market tightness and n represents the steady state equilibrium employment.

Lemma 20 *Eigenvalues will typically depend on the specifics of monetary, fiscal, financial regulation policies as well as the characteristics of the labor market and will generically display endogenous volatility.*

As in the previous monetary equilibrium, there exist an eigenvalue that only depends on monetary and financial policies. These policies are not able to change the nature of this eigenvalue. However, in contrast to the previous monetary equilibrium, the rest of the eigenvalues depend on monetary, fiscal and financial policy parameters.

7.2.1 Numerical Exercise

In order to evaluate the impact of financial, monetary and fiscal policies in this new equilibrium, we borrow the parametrization in the previous section. However, in order for all government liabilities to not be able to provide the liquidity needs of OTC-traders, liquidity services have to be different. In particular, we consider a one time *permanent liquidity shock* so that the level of utility per unit per liquidity service, D, goes from 1 to 2. This captures *disruptions* in the financial market relative to *normal* times.

Table 2 and 3 report the resulting monetary equilibria consistent with an economy where only OTC-traders are taxed and one where all agents are taxed, respectively.

η_0	0.18	0.01	0.01	-0.01	-0.12	-0.12
η_1	0.16	0.4	0.4	1.013	1.013	1.013
μ^m	0.001	0.001	0.001	0.001	0.001	0.001
μ^g	0.3	0.4	0.4	0.4	0.4	0.4
ζ	0.005	0.005	0.005	0.005	0.005	0.005
θ	505	505	505	505	505	505
n	0.983	0.983	0.983	0.983	0.983	0.983
m	0.019	0.019	0.019	0.019	0.019	0.019
b	0.428	0.16	0.077	0.052	0.218	0.426
$\rho - r^g$	0.545	1.48	2.42	3.01	1.14	0.545
λ_1	0.01	0.01	0.01	0.01	0.01	0.01
λ_2	-5.81	-5.81	-5.81	-5.81	-5.81	-5.81
λ_3	0.112	0.112	-0.4	-1.61	-0.210	0.112
λ_3	0.837	0.28	0.112	0.112	0.112	0.142

Table 2: Equilibrium outcomes when only OTC traders are taxed.

In contrast to the case where all government liabilities were able to meet the liquidity needs of OTC-traders, there can exist multiple steady states irrespective of the fiscal stance. In particular, the steady state associated with a larger interest rate spread is dynamically determinate while the steady state with the lower spread is dynamically indeterminate. This is sharp contrast to the case where there are no interest rate spreads.

Table 2 also shows that the particulars, of the fiscal and financial policy parameters $(\eta_0, \eta_1, \mu^m \mu^g)$ are critically important in determining the degree of substitution between private and public (interest rate spreads) assets as well as the rate of convergence to the steady state. Finally, it is worth mentioning that the equilibrium notion of *moneyness* or liquidity is extremely important in determining the properties of monetary equilibrium.

To have a better understanding of the implications of having different taxing schemes under interest rate spreads, we consider the environment where all agents are taxed. The resulting monetary equilibria are reported in Table 3.

As in the FTPL, the equilibrium is dynamically determinate when the fiscal authority follows an aggressive policy. This monetary equilibrium is such that inflation and unemployment monotonically converge to

η_0	0.18	- 0.18	-0.01	-0.01	-0.01	-0.01
η_1	0.16	1.013	0.4	0.4	0.4	0.4
μ^m	0.001	0.001	0.001	0.001	0.001	0.001
μ^g	0.3	0.3	0.4	0.4	0.3	0.3
ζ	-0.005	-0.005	0.005	0.005	0.005	0.005
θ	66.91	351.7	24.35	474.3	33.71	436.9
n	0.97	0.981	0.961	0.982	0.964	0.982
m	0.078	0.078	0.01903	0.019	0.019	0.019
b	0.788	0.267	0.911	0.0615	0.881	0.11
$\rho - r^g$	0.06	0.573	0.004	2.746	0.044	1.452
λ_1	0.005	0.005	0.001	0.001	0.001	0.001
λ_2	-3.345	-5.263	-2.548	-5.714	-2.78	-5.587
λ_3	0.114	-2.025	0.162	-1.46	0.167 - 0.064 i	- 0.658
λ_4	0.879	0.112	0.31	0.113	0.167 + 0.064 i	0.113

Table 3: Equilibrium outcomes when all agents are taxed.

the steady state. However, when the fiscal authority is not aggressive, $1 + \eta_1 < 1$, multiplicity of equilibria can be observed. The equilibrium associated with the steady state with largest unemployment is dynamically indeterminate and endogenous volatility can be observed. Under these circumstances, inflation and unemployment diverge from the steady steady with fluctuations that grow over time. In contrast the equilibrium associated with the steady state with lowest unemployment is dynamically determinate and converges monotonically to the steady state.

It is important to highlight that when all agents are taxed the particulars, of the fiscal and financial policy parameters $(\eta_0, \eta_1, \mu^m \mu^g)$ are critically important in determining the degree of substitution between private and public (interest rate spreads) assets as well as the rate of convergence to the steady state. Moreover, we observe that changes in financial regulation, a reduction in the collateral requirements for government liabilities, can induce endogenous volatility when the fiscal authority does not follow an aggressive policy.

Summarizing, our results clearly highlight the importance of modelling frictional decentralzied financial markets as the implied equilibrium liquidity notion resulting from these models drastically change the kind of stabilization policies even when there is no distortionary taxation. **It is important to note that any statement about the impacts of monetary (fiscal and financial) policy necessarily carries assumptions about fiscal (monetary and financial) policy behavior. Thus understanding of the inflation consequences of any policy action requires specifying all current and expected future monetary, fiscal and financial policies. These critically depend on the underlying frictions in the environment which in our environment are reflected in the portfolio decision of agents. Departures from the frictionless labor and financial market are key in delivering alternative stabilization policies.**

8 Conclusions

Since the onset of the global financial crises there has been renewed interest in the study of financial frictions, provision of private liquidity and trading in OTC markets. Policies have been enacted to reduce unemployment while trying to stabilize financial markets. These policy actions taken by government around the world, clearly highlight the need to better understand the potential channels through which governments, by managing their liabilities, affect the price, debt and unemployment dynamics.

This paper studies the impact of over the counter (OTC) financial regulation on inflation and unemploy-

ment while monetary and fiscal policies are enacted by the central bank and the fiscal authority. We find that the impact of OTC financial regulation on unemployment critically depends on the tax base. In particular, once OTC-traders are the only agents being taxed financial regulation does not affect unemployment. However, once interest rate spreads are observed multiple steady states are observed.

Once all agents in the economy face non ad-valorem taxes, unemployment and the private and public provision of liabilities are affected by financial regulation and fiscal and monetary policies. This is the case as all government policies directly impact the behavior of firms who intimately link labor and asset markets by hiring workers and issuing equity. As a result, the value of assets and their liquidity properties as well as the equilibrium unemployment rate are intimately shaped by all government policies.

Finally, we show that traditional policy prescriptions to stabilize the economy in frictionless financial and labor markets are not robust. Once decentralzied labor and financial markets are taken into account the nature of the stabilization policies critically depend on the liquidity needs of financial markets. By explicitly modelling exchange and explicitly considering financial, monetary and fiscal policies, we can have a better understanding of how policy design affects the liquidity and unemployment, the two basic pillars of the central bank's dual mandate.

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Appendix

Proof Proposition 9

Let us define the LHS as the left hand side and RHS as the right hand side of equation (25), respectively. It is easy to show that LHS is independent of b while the RHS is non-monotonic. In particular we have that for $\eta_1 < 1 + \rho + \sigma\mu^g$ the slope is given by negative for $0 < b < \frac{-m+\sqrt{m^2+4(1-\phi)}}{2(1-\phi)}$ while it is positive for $b > \frac{-m+\sqrt{m^2+4(1-\phi)}}{2(1-\phi)}$. Thus two steady states will exist whenever $\mathcal{G} + (1-n)\kappa_u > \eta_o m\zeta$.

Proof Proposition 14 The left hand side of equation (28) is always increasing in θ while the right hand side is monotonically decreasing in θ whenever $\eta_0(1+\rho) + \eta_1\varepsilon_0 > \eta_1\eta_0$. The steady state is unique whenever the left hand side evaluated at $\theta = 0$ is smaller than the right hand side, which is the second condition stated in the proposition.

Proof Proposition 15 Note that the value of the firm is an increasing function of θ. It is easy to show that the left hand side of equation (28) does not depend on μ^m, η_0 nor ζ. In contrast the right hand side of equation depends on μ^m, η_0 and ζ. It is easy to show that when $\eta_1 > 1 + \rho$ the right hand side of equation (28) is always increasing with μ^m and η_0. In contrast, the right hand side of equation (28) is always decreasing in ζ.

Proof Proposition 16 The demand for real bonds increases with employment which is reduced with increases in the job destruction rate, vacancy costs and matching efficiency.

Proof Proposition 19

The interest rate spread between the return to private assets and public liabilities is given by

$$r - r^g = \rho - r^g = \mu^g\sigma[D\phi(m+b)^{\phi-1} - 1]$$

where $m=\left(\frac{D\phi\mu^m\sigma}{\rho+\zeta+\mu^m\sigma}\right)^{\frac{1}{1-\phi}}$. The properties of this spread depend on how real government liabilities are affected by labor market conditions and monetary policy.

It is easy to show that the left hand side of (33) is independent of labor market conditions while the right hand side is always increasing in the rate at which jobs are destroyed and an increase in the vacancy costs and efficiency in the matching in the labor market. These properties imply the labor market results of the proposition.