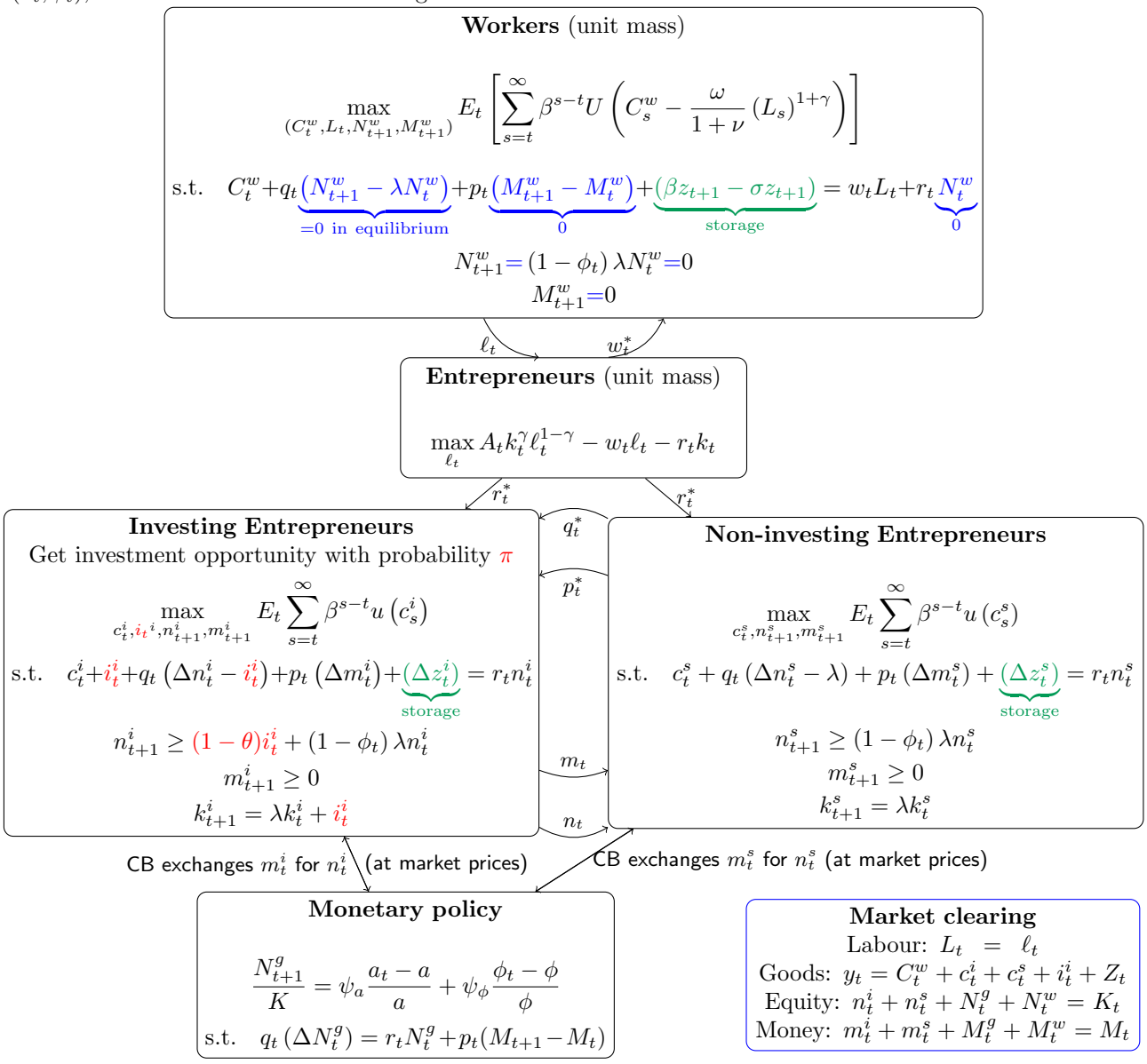
EC539 - REFEREE REPORT

ARNAUD DYÈVRE

Referee report of the journal article:
Kiyotaki, N., & Moore, J. (2019). "Liquidity, business cycles, and monetary policy". *Journal of Political Economy*, 127(6), 2926-2966.

Summary of the paper. This article is an ambitious theoretical exploration of how liquidity constraints can explain co-movements in asset prices and real quantities. Its main contribution is the introduction of a limit on the sale of equity in the budget constraint of investing entrepreneurs. The model is able to generate a rich set of (large) responses in capital utilisation, in output and in the price of assets in spite of its simplicity. The most sophisticated environment presented in the paper simply consists of entrepreneurs-investors, entrepreneurs-savers, workers, and a rule-based central banker. Workers consume their wage. Entrepreneur-savers produce outputs, do not have an investment opportunity and lend to entrepreneurs-investors. Entrepreneur-investors liquidate equity and borrow funds from entrepreneur-savers to finance investment opportunities, subject to a liquidity+borrowing constraint. Finally, the central bank exchanges illiquid equity for liquid equity (=money). One may describe their model as "LBC"–liquidity business cycle. I summarise the model graphically below.

Summary of the full model. Given an aggregate state $(K_t, Z_t, N_t^g, a_t, \phi_t)$, and an exogenous law of motion for (a_t, ϕ_t), the model satisfies the following conditions:



Main takeaways. In a "monetary economy" described above, the liquidity constraint has five important consequences: (i) it prevents the economy to reach its first best allocation of capital, (ii) there is a gradient of

rates of return,[1] (iii) it leads entrepreneurs to hold precautionary money for no other reason than weathering times when they are illiquid, (iv) a cheap storage technology will divert resources away from capital investment, and (v) monetary policy of the Quantitative Easing type reduces the impact of an illiquidity shock on consumption, investment, output, and the price of equity.

Two parameters and two types of assets lie at the heart of the model. With regards to parameters; θ is the share of future earnings from the new capital an entrepreneur can credibly pledge, and ϕ is the share of equity they can convert into investable funds. Low θ and ϕ mean tight asset-based borrowing and liquidity constraints, respectively. The important assets are money, which is liquid but provide a low return, and equity, whose liquidity is determined by ϕ and which provides a return r_t.

The authors provide numerical examples of dynamic impulse responses to liquidity and productivity shocks. They compare models without storage or monetary policy to the full model.

Major comments.

Theoretical relevance. The paper is an important effort to explicitly include liquidity constraints in a business cycle model. Until the Great Recession, most RBC models ignored the impact of liquidity constraints on aggregate economic activity (Gertler and Kiyotaki, 2010). The traditional approach to credit friction has been to model entrepreneurs as being able to credibly pledge only a limited share of their future gains, or to collateralise only part of their current capital. For instance, canonical models such as Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) endogenise financial market frictions faced by actors in the real economy by creating an agency problem between lenders and borrowers. As a borrower's balance sheet deteriorates, their access to external finance becomes limited and they must bear most of the risk of the investment project with internal funds. The two-way interaction between investment and capital on the one hand, and access to credit on the other amplifies credit shocks. With the notable exception of Holmstrom and Tirole (1997), no macro-finance paper had thoroughly studied the theoretical implication of liquidity shortages in the financial sector before this one.

Its second notable theoretical contribution is to generate substantial and long-lived responses in output, consumption, investment, equity price and capital utilisation without relying on implausibly large exogenous shocks like standard RBC models. In the seminal Kiyotaki and Moore (1997) paper, the asset price moves little after a technology shock: it rises by 0.37% following a 1% increase in productivity. In comparison, the price of money and the price of equity in Kiyotaki and Moore (2019) rise by 1.6 and 0.9% respectively after the same shock. The liquidity constraint also plays a key role in generating large response in consumption. without it binding, consumption would depend on permanent income rather than current income.

Need for justifications of some modelling choices. However, while the responses to shocks are large, some authors have stressed that the choices of functional forms for utility and production matter a great deal to determine the magnitude of these responses. Cordoba and Ripoll (2004), for instance, find that under concave preferences, concave technology and collateralised debt, borrowing constraints can indeed amplify shocks, but these amplifications are relatively small. Large amplifications can be obtained under implausible parameter values, or worse, the equilibrium is not saddle path. More sensitivity analyses would have been welcome to assess wether these criticisms apply to liquidity constraints as well.

Lastly, more justification about the specific magnitude of the drop in liquidity in the numerical exercise would have been helpful. The authors use a drop in resaleability of equity from 20% to 6%. It is hard for the reader to know if this drop is large or small. Back-of-the-envelope calculations can help putting these results in perspective: a 20% resaleability constraints means that it takes 3.1 quarters for an entrepreneur to liquidate half of their equity (conditional on them having investment opportunties in every period). It takes 11.2 quarters when $\phi = 0.06$ instead. As this seems to be a very long period for liquidation (longer than

[1] Money provides a higher return than equity if one has an investment opportunity next period, but less if one does not.

the Great Recession in the U.S.), some comparison with real data would have helped to put this number in context.

Empirical/policy relevance. Quantitatively, the unorthodox policies carried out by Central Banks in Europe, America and England in the wake of the 2008 crisis amounted to a lot of liquidities. The Fed for instance added US$1.5 trillion worth of assets to its balance sheet in early 2009 (see Figure 1). In this respect, having a clear theoretical understanding of how new liquidity helped keep the financial sector afloat is paramount. It is worth noting, that when the thought of injecting money into the economy by buying off illiquid asset was first formulated by Kiyotaki and Moore as part of Moores's 2001 *Clarendon Lectures*, the idea was deeply unconventional (Kiyotaki and Moore, 2001). The Great Recession has been a spectacular confirmation of their vision. The policy implications are evident with the hindsight of the Great Recession: the liquidity of assets being traded by banks matter, and fluctuations in liquidity may trigger economic recessions.

Modelling the financial sector/endogenising the liquidity constraint. A notable omission of the paper is the absence of the financial sector as an optimising agent. In Kiyotaki and Moore's model, the liquidity shock is simply an exogenous Markov process λ_t. Modelling the mechanisms through which liquidity constraints emerge would have been an engaging addition to the paper. This would understandably complicate the model as the shocks generating tighter liquidity constraints could take multiple forms; a sudden drop in trust in the inter-bank market, the removal of a particular class of assets from the market, or regulatory changes for instance. Modelling liquidity contractions as a stochastic risk allows them to remain agnostic about their origin. Yet, putting some behavioural structure on how the financial sector would react to these underlying shocks could have painted a more comprehensive picture of liquidity-induced recessions. See He and Krishnamurthy (2013); Angeloni and Faia (2013); Gertler and Kiyotaki (2010) for recent work doing just this.

Minor comments.

Making sense of the entrepreneur-savers. While the model is impressive in capturing many aspects of the last economic crisis, the assumption that funds used by entrepreneurs-investors come from entrepreneurs who do not have an investment opportunity would have deserved more justification. It does not seem to fit in with the way corporate credit works. A more credible assumption would have been to make workers lend to firms, as depositors. The authors could have accommodated this aspect by using overlapping generations for the workers: the first generation consumes its wage, while the second saves. Here again, modelling the endogenous response of the financial sector to the supply of funds could have helped.

Distributional consequences of QE. The model's parsimony is one of its strengths, but I wonder how much interesting heterogeneity is hidden behind the representative agent assumption. A critique of the QE-type policies carried out by the ECB and the Fed after the 2008 crisis was that it surely helped financial institutions and kept the banking system afloat, but it also increased the gap between the wealthiest and the poorest.[2]

Suggested extension.

Benchmarking. I believe the paper would have benefited from a model more directly applicable to monetary policy. Considering the importance of the liquidity channel in explaining important recent crises (Great Recession, the Greek debt crisis), a comparison of the model performance with that of the the New Keynesian canon (Galí, 2015) would have helped the reader to assess its merits.

The model clearly describes the channel through which unorthodox monetary policy can dampen illiquidity-induced recessions. Yet the effectiveness of this type of policy is mostly an empirical question. In this respect, I see this article as a first step in understanding the impact of liquidity constraints on asset prices and quantities. More needs to be done to quantify how important this cause of recession is. Del Negro et al. (2017)

[2]Adding heterogenity in previous-period wealth of labour income would however make the model much more complicated. I can understand why the authors kept it so streamlined.

and co-authors have done such work, it would be interesting to see more emprical confirmation of Kiyotaki and Moore's framework.

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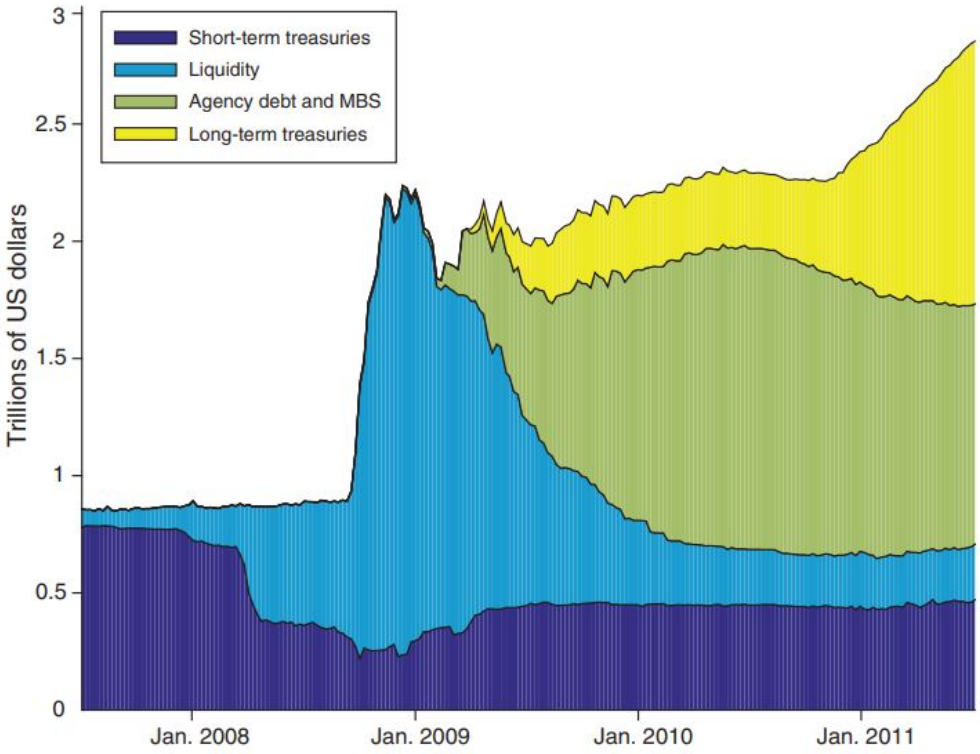

Figure 1. federal Reserve's assets between July 2007 and July 2011.
Figure 1. from Del Negro et al. (2017)