Financial Frictions, Liquidity and the Business Cycle

Final exam, August 2019. Solution guide

1) This is a DD model with two modifications. First there are two types of consumption goods. Second, the economy must borrow since initially it has no endowment.

a) The planner's problem at date 0, given some level of borrowing, d (to be repaid at zero net interest rate in period 2), is to choose investment in the long term project, x, investment in storage, y, investment to produce non-tradables, z, and the fraction of z withdrawn in period 1, α, to maximize expected utility

$$p[u(c_{1T}) + v(c_{1N})] + (1-p)[u(c_{2T}) + v(c_{2N})]$$

subject to the following constraints

$$\begin{aligned} &x + y + z = d, \\ &pc_{1T} = y, \\ &(1-p)c_{2T} = Rx - d, \\ &pc_{1N} = \alpha Az, \\ &(1-p)c_{2N} = (1-\alpha)A^2 z. \end{aligned}$$

Writing the planner's objective function replacing c_{tl} by the expressions above we get

$$\max_{x,z,\alpha} p\left[u\left(\frac{d-x-z}{p}\right) + v\left(\frac{\alpha Az}{p}\right)\right] + (1-p)\left[u\left(\frac{Rx-d}{1-p}\right) + v\left(\frac{(1-\alpha)A^2 z}{1-p}\right)\right]$$

b) The first order condition with respect to α, assuming a interior solution, is

$$v'(c_{1T})Az - v'(c_{2T})A^2 z = 0.$$

Since $z > 0$ (otherwise there is no consumption of non-tradables) we get $v'(c_{1N}) = Av'(c_{2N})$. The interpretation, which is standard, is that it is efficient to equate the marginal rate of substitution between consumption of non-tradables in periods 1 and 2 to the marginal rate of transformation, which is A.

c) The remaining first order conditions for an interior solution are

$$\begin{aligned} -u'(c_{1T}) + u'(c_{2T})R &= 0, \\ -u'(c_{1T}) + v'(c_{1T})\alpha A + v'(c_{2T})(1-\alpha)A^2 &= 0. \end{aligned}$$

The first one again tells us that efficiency calls for equality of the marginal rate of substitution between consumption and the marginal rate of transformation, in this case for tradables (for whom the marginal rate of transformation is R). Note that since both marginal rates of transformation are larger than one ($R > 1$ here, $A > 1$ in b) above), efficiency implies $c_{1T} < c_{2T}$ and $c_{1N} < c_{2N}$.

The other first order condition, when we replace from b) above, gives

$$u'(c_{1T}) = Av'(c_{1N}).$$

In this case since the marginal rate of transformation between tradables and non-tradables at date 1 is A (since tradables come from the storage technology that has a unitary return, while non-tradables are produced with return $A > 1$), then it is efficient to allocate consumption between these goods in period 1 such that their marginal rate of substitution is equal to the marginal rate of transformation.

Finally a note on d. If we take borrowing to be a choice of the planner, then the first order condition for d would be

$$u'(c_{1T}) - u'(c_{2T}) \geq 0.$$

Since we found that $c_{1T} < c_{2T}$, then this must be strictly positive implying that if there is an upper bound on borrowing the planner would be constrained (and in the absence of constraints we would have $d \to \infty$).

d) For the optimal consumption allocation to be implementable as a bank deposit contract we need to verify that it is incentive compatible, i.e. that no type of consumer gets a higher utility by pretending to be the other type. It is trivial to see that the impatients would never pretend to be patients. For the patients, by assumption they cannot consume more than c_{1T} and c_{1N} since the tradable can be stored, the non-tradable cannot be reinvested and at most it could be stored (the question is not clear on this point but definitely it must be the case that c_{1N} is an upper bound on consumption of non-tradables for patient consumers that withdraw in period 1). Since $c_{1T} < c_{2T}$ and $c_{1N} < c_{2N}$, the contract is incentive compatible and therefore implementable by a bank offering deposit contracts.

e) For a bank run to be a Nash equilibrium it must be the case that a patient consumer that expects all other patient consumers to be withdrawing their funds from the bank at date 1 has a higher utility from withdrawing her deposit at date 1 than at date 2. This can only happen if the bank is bankrupt by the run, i.e. if a bank that liquidates all its investments is unable to fully service c_{1T} and c_{1N} to a mass one of depositors.

Now bankruptcy can happen in one of two ways. First, as in the traditional DD model, a bank is bankrupt if the liquidation of the long run technology is insufficient to pay c_{1T} to all depositors, i.e. if

$$c_{1T} = \frac{d - x - z}{p} > d - x - z + rx - d = (r-1)x - z.$$

Since the right hand side is always negative (since $r < 1$), a run will always be a possible Nash equilibrium in this model. (Thus we do not need to consider the second possibility which was that $c_{1N} < Az$ which requires that the optimal $\alpha > p$.) Borrowing from the rest of the world makes the financial system more fragile if sovereign debt is senior and must be repaid before depositors.

Possible institutional arrangements to eliminate the bank run equilibrium are, a) suspension of convertibility, which by putting a stop at withdrawals in period 1 might give

incentives to patient consumers to wait until period 2 (from an ex ante perspective this always prevents a run, but might not be ex post optimal, see Ennis and Keister (2008)). b) deposit insurance, since if patient consumer know that they would be paid even if the bank is bankrupt have no incentive to withdraw early, thus there is no run. c) narrow banking, which implies regulations that guarantee that a bank will be able to meet a mass one of depositors withdrawals in period 1 (there are different versions on narrow banking depending on what the bank is allowed to do to pay depositors, e.g. liquidate long run investment or not, securitize assets or not, etc.).

2) This is an open question that should show the grasp that students have on the course material and how to use it to analyze a real world problem. The students where told in particular to read the starred parts of the following bibliography for this essay (but of course an answer that correctly uses other material of the bibliography or other relevant papers is fine). Rambling leads to less points in grading.

Bibliography: (JT) Tirole J., "The Theory of Corporate Finance", 2006, Princeton University Press

1. The great recession

Barth, J., R. Brumbaugh, and J. Wilcox, 2000, 'Policy Watch: The Repeal of Glass-Steagal and the Advent of Broad Banking", The Journal of Economic Perspectives, 14(2), 191-204.

Adrian, T. and H. Shin, 2010, "Liquidity and leverage", Journal of Financial Intermediation, 19, 418-437.

Mian, A. and A. Sufi, 2010, "The great recession: Lessons from microeconomic data", American Economic Review: Papers and Proceedings, 100, 1-10.

2. Finance under asymmetric information. Moral hazard and adverse selection. Credit rationing

*JT chapter 3.1, 3.2, 3.4, 6.1, 6.2.1, 6.3

Stiglitz J. and A. Weiss, 1981, "Credit Rationing in Markets with Imperfect Information", American Economic Review, 71, 393-410

3. Heterogeneity, net worth, and the financial accelerator

*JT chapter 13 , 13.1, 13.2, 13.3

Bernanke, B. and M. Gertler, 1989, "Agency costs, net worth, and business fluctuations", American Economic Review, 79, p.14-31.

*Bernanke B. and M. Gertler, 1990, "Financial Fragility and Economic Performance", Quarterly Journal of Economics, 105, 87-114.

4. Liquidity. Leverage, fire sales and the asset market feedback

*JT chapter 5, 5.1-3

JT chapter 14, 14.1, 14.2, 14.3

Shleifer A. and R. Vishny, 1992, "Liquidation values and debt capacity: A market equilibrium approach", Journal of Finance, 47, 1343-1366.

*Kiyotaki N. and J. Moore, 1997, "Credit Cycles", Journal of Political Economy, 105, 211-248. Fanelli S., M. Gonzalez-Eiras and D. Heymann, 2016, ?Resolution of Collateral Crises", working paper.

5. Fire sale externalities

Fanelli, S. and M. Gonzalez-Eiras, 2019, "Resolution of Financial Crises", working paper.

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Hart O. and L. Zingales, 2015, 'Liquidity and Inefficient Investment", Journal of the European Economic Association, 13(5), 737-769.

6. Asymmetric information and asset market feedback

*Kurlat P., 2013, "Lemons Market and the Transmission of Aggregate Shocks", American Economic Review, 103(4), 1463-89.

Kurlat P., 2018, "How I learned to stop worrying and love fire sales", working paper.

Gorton G. and G. Ordonez, 2014, "Collateral Crises", American Economic Review, 104(2), 343-78.

Asriyan V., 2015, "Balance Sheet Recessions with Informational and Trading Frictions", CREI working paper.

7. Endogenous leverage and the leverage cycle. The lending channel and its effects

Geanakoplos J., 2009, "The leverage cycle", in Acemmoglu D., K. Rogoff and M. Woodford, eds., NBER Macroeconomics Annual.

Gorton G. and A. Metrick, 2011, "Securitized banking and the run on repo", Journal of Financial Economics, 104(3), 425-451.

Kashyap, Anil K and Jeremy C. Stein, 2000, "What Do a Million Observations on Banks Say About the Transmission of Monetary Policy?", American Economic Review, Volume 90(3), 407-428.

*Chodorow-Reich G., 2014, "The Employment Effect of Credit Market Disruptions: Firm-level Evidence from the 2008-09 Financial Crisis", Quarterly Journal of Economics, 129(1), 1-59.

8. Managing aggregate liquidity

*JT chapter 12 and 15

*Allen F., and D. Gale, 2000, "Financial contagion, Journal of Political Economy, 108, 1-33.

Holmstrom B., and J. Tirole, 1998, "Private and Public Supply of Liquidity", Journal of Political Economy, 106, 1-40.

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Krishnamurthy A. and A. Vissing-Jorgensen, 2012, "The Aggregate Demand for Treasury Debt", Journal of Political Economy, 120(2), 233-267

9. House prices, mortgage market, and household debt

*Mian A. and A. Sufi, 2011, "House Prices, Home Equity-Based Borrowing, and the US Household Leverage Crisis", American Economic Review, Volume 101(5), 2132-56.

Mian A, A. Sufi, and F. Trebbi, 2015, "Foreclosures, House Prices and the Real Economy, The Journal of Finance, 70(6), 2587-2633.

Eggertson G. and P. Krugman, 2012, "Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo Approach", Quarterly Journal of Economics, Volume 127, 1469-1513.

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10. Lender of last resort

*Freixas X. and J. Rochet, 2008, "Microeconomics of Banking", MIT Press chapter 7.7

*Fahri E. and J. Tirole, 2017, ?Shadow Banking and the Four Pillars of Traditional Financial Intermediation?, working paper.

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Rochet J. and X. Vives, 2004, "Coordination Failures and the Lender of Last Resort: Was Bagehot Right after all?", Journal of the European Economic Association, 2(6), 1116-1147.

Examples of what I expect to see in the answers are

a) There are several channels through which a decline in property prices could produce a recession (or a decline in economic activity). For example, the home equity channel studied by Mian and Sufi (2011) affects homeowners. This channel requires that previously property prices increase such that consumers borrow against their increased home equity. As prices go down, levered consumers must meet mortgage payments and reduce consumption. Another possibility is that banks are exposed to real estate. Then the bursting of the property bubble creates a shock to their balance sheet that impairs lending and this had effects on economic activities for the reasons suggested by Holmstrom and Tirole (1997) and estimated in Chodorow-Reich (2014). Jensen and Johannesen (2015) (mentioned in class, not in reading list), finds evidence that Danish banks in poorer health during the Great Recession reduced lending the most and that this had a negative effect on aggregate consumption.

b) Restrictions on the contracts that banks can offer for mortgages will reduce the demand for real estate in Copenhagen. This will reduce prices of real estate there below what would have been observed in the absence of regulation. This regulation might improve welfare if the Danish central bank believes that the likelihood of a decrease in property prices is high enough to worry about the negative pecuniary externalities of a fire sale (as in Lorenzoni, 2008). Indirect effects could be a downward pressure on interest rates as banks now have excess liquidity relative to the absence of regulation, or the diversion of funds to other activities (hopefully to fund investment of domestic private firms).

c) If investors perceive the regulation as "scary news", as in Geanakoplos (2010), they might consider that Danish mortgage bonds are riskier assets that before the regulation. The reduction in bond demand lowers their price and thus the net worth of institutions that hold them. This might further reduce the demand of the bonds and create a fire sale, accelerated by increased margins from intermediaries. This might cause the regulation, which presumably seeks a smooth adjustment in real estate investment in Copenhagen, to backfire, as the adjustment in property prices accelerates. Furthermore, if the institutions

that hold Danish mortgage bonds are Danish banks, they will suffer a "liquidity shock" if these bonds lose liquidity. Banks will first try to meet their liquidity needs through the interbank market but there are limitation for this when, as this case, the shock is an aggregate one (as seen in Allen and Gale (2000) and Holmstrom and Tirole (1998), covered in JT 15). Furthermore, the Danish Central Bank might face limitations to act as a lender of last resort to provide liquidity given the constraints from the peg of the Danish Krone to the euro (as shown in a related context in Gonzalez-Eiras (2003), not a starred reading).

d) Reducing interest rates in Australia will soften the negative impact of falling real estate prices on economic activity, even though it will probably be insufficient to restore property prices to their pre-crisis levels. This is achieved by reducing intermediaries access to funding and increasing investment demand from the private sector. Given what we have seen in class (Mian, Sufi and Trebbi, 2015; Agarwal et al, 2017) this might be insufficient in preventing underwater homeowners from defaulting on their mortgages. Thus, a more powerful regulation, if one is interested in reducing the financial accelerator effects, would be to improve homeowner's net worth, by reducing their debt obligations (Geanakoplos, 2020; Fanelli and Gonzalez-Eiras, 2019).

e) Liquidity requirements are a way to make the banking system more resilient to systemic risk (we covered this in Freixas and Rochet 7.7, then seeing that a lender of last resort would be a more efficient way for this). Another reason for liquidity requirements might be when banks face a moral hazard problem. Then for reasons seen at length in JT (in particular JT 5, and JT 15), banks would be unable to raise funds if they have a large liquidity shock leading to inefficient liquidation of outstanding lending (in the original model these are firms, but we saw in the course that banks can be seen as a particular type of firms whose investment is lending). A possible solution is for banks to hoard liquidity but this must be subject to a liquidity requirement, since moral hazard would otherwise lead banks to excessive lending. That bank lending is impared when there is a liquidity shock was seen in Kashyap and Stein (2000) (and other papers mentioned in class, none a starred reading, but some mentioned in Chodorow-Reich). Finally, Lorenzoni (2008) finds that there can be excessive lending in a market equilibrium with incomplete markets and pecuniary externalities, and prescribes capital regulations to reduces this. Liquidity requirements is an alternative regulation that leads to the same result.