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The monetary dimension of arbitrage. A brief note.

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Abstract. Financial frictions give rise to the value of money. According to DeAngelo and Stulz (2015), such a principle lies at the foundations of banking. It is the aim of this short note to deepen the reach of such a principle with respect to the role of arbitrageurs of interacting with financial frictions. The methodological relevance of such a perspective for the current macroeconomic debate is thoroughly discussed, building on the stylization of “friction setting”. Recent advances in the analysis of market-making and limits of arbitrage provide concrete empirical backing for our approach, which is meant to shed light on the analogy between the macro-role of money and the nature of arbitrage. Potential implications for the theoretical analysis of shadow banking are briefly sketched.

Keywords. Macro-Finance; Financial Frictions; Liquidity Transformation; Arbitrage.

JEL Classification. E32; E44; G23.

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1 Introduction

The great financial crisis and its reverberation on the advanced economies have projected not only monetary policy and regulation at the center of the economic debate, but the macroeconomic representation of the financial sector as well, in particular the role of credit and liquidity (see for instance Stiglitz, 2018; Wright, 2018). A reconsideration is taking place of the appropriate microfoundation and level of stylization of macroeconomic models. In fact, a rethinking of the nature of money and of the role of collateral has been advocated by a number of Authors (e. g. Andolfatto and Williamson, 2015; Singh, 2017). It is the aim of the present short note to shed light on a monetary angle to arbitrage activity that seems to fix a sound perspective on such relevant questions.

The “efficient market hypothesis” posits frictionless markets in which ‘perfect’ arbitrage supports ‘perfect’ liquidity, funds flow to the most profitable projects – so that the economy can be studied in terms of a representative agent (Brunnermeier et al., 2013) – and banks are redundant institutions (Freixas and Rochet, 2008). In such an ideal world, money is an irrelevant “veil” underneath which the truly relevant economic forces of profit seeking and innovation unleash their power; the veil of money embodies the monetary (irrelevance) dimension of ideal arbitrage. The monetary (relevance) dimension of arbitrage emerges in a world with financial frictions, whose macroeconomic impact has been pointed out well before the crisis (see Stiglitz and Greenwald, 2003) and is being increasingly appreciated; “financial frictions are a key driver of business cycle fluctuations” (Brunnermeier et al., 2013, opening remark).

The monetary dimension of arbitrage unfolds with the function of arbitrageurs of supporting market liquidity by raising (wholesale secured) funding liquidity – beyond risk (unsecured) capital. Noticeably, the *procyclical* interaction between market liquidity and funding liquidity (Brunnermeier and Pedersen, 2009; Krishnamurthy, 2010a) has been diagnosed at the heart of the crisis as a truly relevant macro-monetary problem (Banque de France, 2008) emerging from the micro-frictions that shape both the incentives and the constraints facing money dealers and security dealers. In a frictionless world, in which risk is perfectly priced, no interaction occurs between market and funding liquidity. In the real world such interaction does occur, and endogenizes the emergence of frictions as (typically procyclical) financial constraints, in particular wealth and collateral constraints. Such phenomena have been addressed in previous decades (see de Jong and Rindi, 2009); the crisis and its aftermath have unveiled the evolution of such problems in connection with the crucial market-making role of dealers (see Krishnamurthy, 2010b; Adrian et al., 2017; Di Maggio, 2017). In such respects, money and arbitrage seem to revolve around analogous problems.

The extent to which the functioning of a real market resembles the ideal functioning of a frictionless market depends on the well functioning of the various forms of money, collateral and arbitrage therein. The macroeconomic representation of such problems entails both conceptual and methodological challenges.

The current phase of macroeconomic thinking is to a large extent concerned with a synthesis of the manifold insights that the literature has been developing over the last decades, in particular after the crisis. A point of view is receiving increasing consideration according to which macroeconomic models should be “small” and “modular”, i.e. tractable building blocks – accounting for definite problems – that one can connect with one another (see Vines and Wills, 2018, and references therein). We shall denote such a logic by “L1”. Definitely, the ideas we shall be discussing are meant to fit L1, in the hope of contributing sharp conceptual elements for explicit model building and policy analysis. Interestingly, in connection with a rethinking of modeling strategies, the current debate stages a reconsideration of the first principles¹ that macro models are supposed to embody. It seems therefore natural to fix our insights into a “principle” that one can communicate (and criticize) efficiently.

To begin with, recall, money and frictions are intimate companions. The liquidity of money is a means to circumvent the frictions that impinge on exchange and trade. In the words of Brunnermeier and Sannikov (2017), financial frictions give rise to the value of money. According to DeAngelo and Stulz (2015), such a principle lies at the foundations of banking. Definitely, the present contribution is meant to deepen the reach of such a principle in terms of the role of arbitrageurs of *interacting* with financial frictions (Principle 1 below). To “overcome” financial frictions is one of the fundamental functions of financial institutions (Brunnermeier et al., 2013). The specific role of arbitrageurs in such a plot is not easily singled out;² still, no doubt, the role of supplying liquidity to incomplete markets by managing the frictions therein is a major aspect of arbitrage activity.

It is often the case that market participants take financial frictions as given. Among other things, the ‘weight’ of the market participant is at stake. Still, recent advances in the analytical representation of trade have been sharpening the effects of trade of altering the frictions in place. For instance, Kurlat (2018) represents the effects of trade patterns on the informativeness of signals about the quality of securities. In such respect it matters to notice that a standard feature of macroeconomic modeling is to take frictions as *exogenous* (see Wright, 2018, p. 114; Stiglitz, 2018, p. 84). In the author’s view, it may be relevant for macroeconomic modeling to focus with comparable interest the fact that trade may affect financial frictions not only as an externality. Arbitrageurs, at times, *purposely* try and exploit financial frictions by altering their nature. A paradigmatic example is the dealer function of making (contributing to the completion of) a market. The macroeconomic relevance of price taking, price making and price setting has been extensively discussed over the last decades; analogously, beyond “friction taking”, macroeconomic modeling seems to focus with increasing sharpness the relevance of market-making and “friction setting” as the *endogenous* interacting patterns between intermediaries

¹ To quote but a pair of examples, a rethinking of the applicability of the Modigliani-Miller irrelevance results to banking is advocated, among others, by DeAngelo and Stulz (2015), and the relevance of wealth distributions in a world with frictions is pointed out for instance by Brunnermeier et al. (2013).

² Hedge funds and trading desks of global banks are typically considered to embody the theoretical functions ascribed to arbitrageurs (Gromb and Vayanos, 2018). It has been pointed out that in practical cases it may be difficult to draw the distinction between arbitrage and market-making (e.g. Du et al., 2018). Recall, the saying goes in the hedge fund industry, *you cannot define us, we all do such different things*.

and financial frictions. Intermediary asset pricing (He and Krishnamurthy, 2013; He et al., 2017) represents one such analytical approach.

A dealer can be considered to “set” (part of) the frictions in a market along the lines discussed by Treynor (1987). The dealer *assumes* and *prices* (perhaps, imperfectly) some of the risks in the (incomplete) market, and in so doing reshapes the frictions that impinge on trade (in particular in OTC markets). The arbitrageur, roughly speaking, explores the boundaries of such activity. Financial markets do evolve – think of the evolution of central banking, money markets and shadow banking – and such processes alter *qualitatively* the nature of the frictions in place, and (therefore) of the instabilities of macroeconomic variables like monetary aggregates. In such respect, recent strands of macroeconomic literature have been emphasizing the role of collateral constraints and scarcity of net worth (see for instance Meeks et al., 2017; Moreira and Savov, 2017; references therein). This note is meant to shed light on the “friction setting” angle to such problems.

As pointed out by Kiyotaki and Moore (2001), the economic drive to create liquidity is a perpetual evolutionary force. The Authors tailor a truly engaging model of the emerging liquidity of ex-ante illiquid private IOUs once incentives to supply credit are supported by the pledgeability of trustworthy collateral, and argue that such premises may justify a displacement of Monetary Economics by “Liquidity Economics”. One need not agree with such a bold statement to acknowledge the fundamental role of collateral in the lubrication of the financial system (Singh, 2017) as connected with its potential for destabilization. It is our aim to argue about a macro-methodological perspective on such matters in terms of a generalization of the normative analysis of banking set forth by DeAngelo and Stulz (2015, “DS” henceforth).

The Authors envision a benchmark representation of banking in terms of a fundamental friction to which part of the agents are subject – they are not in a position to access a perfect frictionless financial market. Such a *representative* friction commands a “premium” that triggers the profitability of banking. One may argue that such basic mechanisms may extend – to some extent – at the various layers of liquidity dynamics, and, possibly, embody stylized macroeconomic implications via the feedback loop between arbitrage and frictions. Macroeconomic models, unavoidably, embody highly stylized market properties; in essence, our aim is to envision one such line of stylization that seems to convey sharp insights on the evolving macro-role of liquidity. According to Stiglitz (2018), good theory is based on “how markets actually work” (ivi, p. 73). The ongoing advances in the representation of the limits of arbitrage (that, in fact, represent advances in the very theory of financial markets) seem to align with such a view.

The plan of the rest of the paper is as follows. In section 2 we motivate our “principle”. In section 3 we envision the macroeconomic model set forth by Moreira and Savov (2017) as a representation of our vision. A final section sketches potential implications of our approach.

2 Arbitrage and frictions

In a world of perfect and complete markets, prices are efficient and market liquidity is ‘perfect’. Such an ideal setting is predicated, among other things, on the existence of almighty arbitrageurs that have unlimited capacity of absorbing imbalances in order flows, and profit from even tiny mispricing. Money is irrelevant in such a frictionless world, in which agents can issue claims (on their activities) whose risk is perfectly priced, and whose liquidity is guaranteed.³ Financial frictions give rise to the value of money. Write P0 for such a principle.

The world we live in is indeed characterized by frictions that have monetary relevance (Stiglitz and Greenwald, 2003; Brunnermeier et al., 2013) and entail limits of arbitrage (Shleifer and Vishny, 1997; Gromb and Vayanos, 2010; references therein). True, the far reaching consequences of such limits on financial stability seem not to have attracted widespread interest until the emergence of the great financial crisis. In the wake of the turmoil, arbitrage crashes have indeed attracted increasing attention (e.g. Mitchell and Pulvino, 2012), and a growing literature is currently engaged in the explicit analytical representation of the market microstructures and balance sheet constraints that limit the ability of arbitrageurs to perform their stabilizing activity (e.g. Gromb and Vayanos, 2018; Kondor and Vayanos, 2018), which transforms funding liquidity into market liquidity (and viceversa) and transports liquidity from one market to another. Such research advances shed further light on the secular process of evolution of liquidity management, that in recent decades has combined with the rise of large centrally managed cash pools (and the increasing demand for deposit-like instruments like those supplied by MMMFs), the eruption of “financial engineering” and the ICT revolution.

More recently, the ‘originate to distribute’ paradigm has driven the evolution of securitization and market-making that resulted in the pre-crisis system built around market liquidity (Banque the France, 2008) and “shadow banking” (Mehrling et al., 2013). The risk transformation recipes embodied by *tranching* securitization practices enhance the potential for transforming illiquid loans into liquid assets, and the story is well known of off balance sheet vehicles, “regulatory arbitrage” and short-term financing. The emergence of cryptocurrencies as well can be interpreted as a regulatory arbitrage meant to circumvent some of the ‘rigidities’ associated with standard payment systems. The previous considerations seem to witness the relevance of the following analogy between the role of money and the nature of arbitrage activity.

DS sharpen the relevance (for the bank capital structure) of P0 by arguing that the primitive role of banks is to produce safe liquid claims, whose demand is generated by a fundamental friction, namely, the fact that part of the agents in the economy have no access to a perfect financial market. The bank exploits the privilege of having access to a perfect market. Thus, in the DS stylized world the role of banks is to transport liquidity from a perfect market to an imperfect one. In essence, the ideal bank is

³ As Andolfatto puts it, “In a frictionless world, there is no reason why I shouldn’t be able to buy my Starbucks latte by peeling off a slice of my house or my future earnings.” MacroMania, May 2, 2016.

an *arbitrageur*, and the value of bank money can be explicitly represented in terms of the “liquidity premium” generated by the frictions that such money (arbitrage) is meant to circumvent.

It is somewhat natural to generalize of such a perspective to the hierarchy of money-and-security dealers (Mehrling et al., 2013). The liquidity of the instruments supplied by “money dealers” (central banks, commercial banks, dealers, etc.) enables agents to circumvent (alleviate the effects of) the frictions that impinge on trade and therefore command a “liquidity premium”. Correspondingly, the market-maker arbitrageur profits from opening channels of liquidity supply – in a generalized sense – for which market participants are willing to pay a “premium”. Thus, financial frictions give rise to the value of the monetary function of arbitrage. In order to fix a proper macroeconomic stance for such insights, we need to envision a definite level of stylization.

The fundamental friction envisioned by DS provides an effective stylization (aggregation) of the kaleidoscope of micro-frictions that single agents are supposed to face (costly state verification, transaction costs, asymmetric information, agency costs, search costs, etc.). True, on analytic grounds, what really matters is the *premium* that the representative friction commands, and which justifies the market-making activity of arbitrageurs. Following such a line of thought, we can advocate a macroeconomic level of stylization (aggregation) of “friction-premium pairs” that enables one to rationalize their emergence and, most notably, *evolution*.

Principle 1. *The financial frictions that hinder the liquidity of assets may provide incentives to liquidity and/or market transformation. In order to exploit such opportunities, arbitrageurs assume onto their balance sheet the interaction between market liquidity and funding liquidity, and in particular interact with frictions. In so doing, arbitrageurs alter the nature of the frictions in place by contributing to market completion, price discovery, information processing and disclosure. The new frictions in place may expose the arbitrageur to new channels of market instability.*

A financial economist may feel somewhat unimpressed by the content of Principle 1 (P1). A macroeconomist, on the other hand, may consider such matters as beyond the aim of macroeconomic modeling. P1 may then be dismissed by the former and rejected by the latter. It is in fact the gap between standard macroeconomic modeling and financial economics that P1 is meant to target. Our point is the *methodological* relevance of P1, in particular concerning the connection between risk management and “friction setting”, which is crucial for how markets actually work.

The DS stylized bank “sets” the only friction in place, and in fact *eliminates* it via a “perfect hedging” technique. The perfect liquidity of its assets enables the ideal bank to produce perfectly riskless liquid claims. In the real world, we all know, a perfect hedge is out of reach, and banks – and dealers in general – are not in a position to issue perfectly riskless liquid claims. Bank money *should* be information insensitive, and maintain a fixed price (“par”) at which to trade with currency; in times of stress, we all know, such requirements call for suitable backstop. With respect to the intricacies of the

analytical representation of such problems, DS provide a benchmark model in which risk admits a perfect management; the consequences of imperfect risk management can then be compared with such a benchmark. It may be the case that the new frictions in place undermine the sustainability of a newly established “frictions setting” recipe – witness the crisis. In such respects, P1 is not meant to uncover previously unappreciated financial phenomena, and rather to sketch a potential ‘channel’ through which current advances in the analysis of financial frictions may permeate the macroeconomic debate. Stiglitz (2018) notices that different financial frictions in general differ in their policy consequences, and argues that constraints should be endogenously derived; such a conceptual stance, admittedly, underlies our approach.

The economic drive to liquidity creation (Kiyotaki and Moore, 2001) is a major evolutionary force that the DS model extends to the foundations of banking activity. What is really remarkable, in the light of P1, is the analogy with the representation of shadow banking as “money market funding of capital market lending” (Mehrling et al., 2013). In such a picture the stylized shadow bank assumes positions in structured securities that transform illiquid loans into marketable securities, and hedges ‘perfectly’ its assets, so as to make them – in principle – ‘perfectly’ liquid. Short-term financing can then be raised against such positions. Thus, at a definite level of stylization, the “spread business” of the traditional bank compares significantly to that of the shadow bank: they are both arbitrageurs managing the market liquidity of their assets in order to exploit a liquidity premium by issuing some form of “money”. It is somewhat evident that banks are more than that (see for instance Diamond and Rajan, 2006, and references therein); still, at the highly stylized level of macroeconomic models, such a simple picture seems to yield convincing patterns (see section 3).

In a sense, P1 provides a *definition* of arbitrage. Recall, the classical definition envisions arbitrage as the simultaneous purchase and sale of the same, or essentially similar, security in different markets for advantageously different prices (Sharpe and Alexander, “Investments”). It has been argued that such a definition is much too narrow to account for the variety of strategies typically ascribed to arbitrageurs. For instance, Mitchell and Pulvino (2012) notice that many arbitrage strategies commonly employed by hedge funds, like convertible debenture arbitrage or merger arbitrage, are not “truly” arbitrage strategies (ivi, p. 470). In such respect, P1 is meant to focus the market-making function of arbitrageurs, for which the ongoing inquiry on the failure of covered interest parity (CIP) conditions provides interesting insights.

2.1 CIP

Repeated violations of CIP have been detected over the last decade. It has been repeatedly cheaper to borrow USD directly rather than synthetically via swaps with major currencies like Euro or JPY. The relevance of the phenomenon is connected in first instance with the fact that CIP is a *standard* no-arbitrage condition; according to Borio et al. (2016), CIP is “the closest thing to a physical law in international finance.” As such, it is interesting not only on empirical grounds – a standard arbitrage

opportunity is easily identified and, seemingly, more easily exploited than 'less standard' ones – but on theoretical grounds as well, in that it represents a transparent playfield for analytical considerations. Du et al. (2018) notice that CIP violations occur in one of the largest and more liquid markets in the world, thereby suggesting that other arbitrage opportunities may be found elsewhere. For a number of reasons, deviations from CIP have attracted increasing interest over the last years.

Different Authors have pointed out different effects that shed light on such phenomenon. Recent unconventional monetary policies have been conjectured to be part of the plot for the imbalances in cross currency investments that have been driving forward-spot exchange rate differentials; see Sushko et al. (2016). The Authors address in particular deviations from CIP at long maturities, and the empirical connection with fluctuations in net FX hedging demand for USD, which is driven, among other things, by US corporations issuing bonds denominated in foreign currencies and hedging currency risk. Arbitraging CIP in such a setting entails taking the other side in forward USD hedges.

Hedge funds, banks, official reserve managers, etc. engaging in such an arbitrage assume onto their balance sheet the interaction between, on the one hand, the funding liquidity collateralized by the instruments denominated in different currencies, and, on the other hand, the illiquidity of (commitment to) the positions in forward hedges. In fact, not only for banks, balance sheet space has become more 'precious' in recent years, and a problem of opportunity costs clearly emerges in engaging in CIP arbitrage for long term. Sushko et al. (2016) notice that, since markets have to clear, the balance sheet exposure of arbitrageurs must equal net hedging demand, and that fluctuations in such demand result in "market clearing exchange rates that remain out of line with CIP when FX hedging demand is large and imbalanced across currencies." In the author's view, the methodological stance represented in P1 may help channel such relevant insights to the highly stylized grounds that macroeconomic models are meant to tread.

3 A macroeconomic model

In the words of Caruana and Kodres (Banque de France, 2008), liquidity is created and maintained by market participants themselves. P1 is meant to sharpen such an observation in connection with abundant evidence that the evolution of financial markets is typically driven by incentives to financial innovation (in particular, liquidity transformation), and it is often the case that constraints undermining the sustainability of such evolutions manifest themselves only *ex-post*.⁴ The meltdown of the shadow banking system built around top tranches of residential mortgage-backed securities is an egregious example. Thus, the point of P1 is the *interaction* between arbitrageurs and frictions: the arbitrageur may be in a position to exploit the liquidity premia generated by financial frictions; frictions, in turn, may strike back once the sustainability of the arbitrageurs' positions is undermined

⁴ Recall, MMMFs have been considered a *stabilizing* element for the financial system until the credit crunch of 2007.

by the procyclical interaction of market liquidity and funding liquidity, that alters the nature of the frictions in place.

A number of recent contributions have been emphasizing the macroeconomic relevance of endogenous financial constraints. For instance, He and Krishnamurthy (2013) envision a representative endogenous wealth constraint that gauges the ability of intermediaries to raise equity capital. A “risk premium” is associated with such a friction, which implies a kernel for asset pricing that differs from standard ones. One thereby envisions an endogenous “friction-premium pair” to which, though, P1 applies only ‘tangentially’, since it is the connection between liquidity transformation and market completion that our approach is primarily meant to address. With that said, the fundamental insight that intermediaries are in a position to trade in almost all securities (He et al., 2017) witnesses the relevance of arbitrage activity in the effects that “intermediary asset pricing” is meant to pin down.

The model of shadow banking set forth by Meeks et al. (2017) is somewhat in line with our approach to liquidity transformation. The Authors depict the interaction of commercial banks and shadow banks in the emergence of recent securitization practices, and provide a convincing representation of the consequences for the macro cycle. Still, the monetary dimension we are interested in is discussed in greater detail by Moreira and Savov (2017, “MS” henceforth). The Authors tailor a macroeconomic representation of shadow banking activity in which the liquidity cycle drives the macro cycle, and which enables us to pin down the analytical grounds that P1 is meant to target. The following sketchy summary does no justice of the analytical sophistication of the MS model, and disregards a number of features of the model (like the mechanism of Bayesian learning or the dynamics of capital prices) that stand orthogonal to our line of reasoning. We refer the reader to the original paper for an appropriate account of the conceptual and analytical approach therein.

MS posit the exogenous emergence of trading opportunities (“liquidity events”) that intermediaries exploit by buying assets and tranching them into securities with different “crash exposure”. Intermediaries issue optimally three types of claims: *money*, which is always liquid (no crash exposure), *shadow money*, which economizes on collateral but is “fragile liquid” (partial crash exposure), and equity, which is illiquid (complete crash exposure). The model features a “liquidity premium” (ivi, p. 2395) which gauges the value of having a liquid dollar instead of illiquid equity. From the point of view of P1, it seems reasonable to interpret the issuers of shadow money as arbitrageurs; shadow money enables intermediaries to exploit the full potential of trade opportunities. The issuance of shadow money is a way to *complete the market*, i.e. of enlarging the supply of liquid instruments that support trade and boost asset prices and economic growth. In a sense, this functions generalizes the primitive function of the DS ideal bank.

The model features time-dependent constraints for portfolio and consumption choices, and a time-dependent collateral constraint that sets the potential for intermediaries to finance their positions in

terms of money m or shadow money s . This constraint establishes the interaction between market liquidity and secured funding liquidity, and, in normalized form, reads (ivi, formula 22)

$$m_t + s_t(1 - \bar{\kappa}) \leq 1 - \kappa_{A,t} \quad (1)$$

being the parameter $\bar{\kappa} \in (0,1)$ the crash exposure of shadow money and $1 - \kappa_{A,t}$ “the value of assets in the case of a crash per dollar of current market value, that is, their collateral value” (ivi, p. 2396). Such a constraint embodies the “macro-representative” friction that gives rise to the value of shadow money in connection with the “collateral multiplier” $1/(1 - \bar{\kappa})$. In fact, a “collateral premium” can be defined as the Lagrange multiplier of such constraint in the minimization problem for the cost of funding liquidity, and given the analytical task of transmitting changes in collateral scarcity to discount rates and asset prices. This is the “friction-premium pair” that motivates our interest in the MS model.

In fact, the cornerstone of the model is the explicit representation of the line of coexistence of money and shadow money (the “liquidity provision frontier”). Investors indifference (between m and s) curves are contingent on the level of uncertainty, and therefore the liquidity of shadow money. An explicit mechanism is thereby represented for the way “shadow money crowds out money when uncertainty is low”, and then a “rise in uncertainty brings the shadow banking boom to an end” (ivi, p. 2402). A shift in investors demand leads intermediaries to contract shadow money and expand money; however, intermediaries cannot fully offset the contraction of shadow money with money, so that the liquidity premium raises. In turn, asset prices and investment fall. In this sense, MS picture a liquidity cycle that drives the macro cycle, and fits the logic of P1. The analytic representation of the way *i*) shadow money opens a new channel for liquidity supply to support trade, and *ii*) the endogenous collateral constraint exposes the money supply to new instability channels, provides an explicit chart of the macroeconomic grounds that P1 is meant to tread. Frictions are not given exogenously in the model, they interact with trade, and uncertainty undermines the sustainability of “friction setting”.

Compare the MS model with the benchmark DS model. The DS arbitrageur (the stylized bank) exploits the ‘value’ of the friction in place, which does not strike back since it is eliminated by a perfect hedging technique. Friction setting is ‘perfect’ in the benchmark DS model. On the other hand, friction setting is ‘imperfect’ in the more realistic MS model, in which the issuance of shadow money alters the nature of the collateral constraint and opens new channels of financial instability. In particular, the MS model features a “collateral decelerator” mechanism for the delayed recovery of asset prices. It is not the aim of this short note, evidently, to argue about the positive soundness of such analytic mechanism; still, on pure methodological grounds, it matters to notice that – quite unsurprisingly – a richer phenomenology emerges from the analytical interaction between frictions and trade.

In the light of L1, the MS model can be considered a “modular” model connecting a “core” model with a “small” model of shadow banking. One may argue about different “small” models of shadow banking as market-based credit system. Mehrling (2012) provides one such model which refines the financial degrees of freedom at play. Four entities are considered: I) a “capital funding bank” that raises wholesale funding liquidity in order to assume long positions in suitably hedged structured securities, II) an asset manager that bears the risk embedded in such securities, III) a money dealer that supplies funding liquidity to the capital funding bank, and IV) a derivative dealer in charge of the risk transfer in the system. The model is meant to picture sort of ‘physiology’ of what a future market-based credit system may embody, in order to provide a clear setting for thinking about principles for regulation.

In the light of P1, it matters to notice that the model depicted by Mehrling (2012) embodies the potential of *absorbing* the destabilizing effects associated with the emergence of collateral constraints, such as the liquidity spirals extensively discusses in recent years (e.g. Brunnermeier and Pedersen, 2009; Krishnamurthy, 2010a): the “credit network” is designed so that suitable collateral flows *may* enable the system to contract smoothly, without igniting amplification mechanisms. In this sense, the (essentially normative) model conceived by Mehrling (2012) is *stable* in the region of the ‘state space’ in which collateral flows support such stability.

The comparison between the two models is evidently of great interest from the macro-modeling viewpoint. “Understanding the structures that are most conducive to stability [...] represents one of the areas of important advances since the crisis” (Stiglitz, 2018, p. 79). The methodological stance represented in P1 provides a clear point of view on the relative – positive and normative – merits of the models. On the one hand, the MS “friction-premium pair” at the roots of shadow banking activity determines an unstable “friction setting”. On the other hand, no friction-premium pair displays in Mehrling (2012), and the intelligent design of the (normative) system gauges the sustainability of the “friction setting” therein.

4 Conclusions

The previous sections have been sketching a methodological approach to the macroeconomic relevance of financial frictions. To rephrase a well known principle, frictions-premium pairs give rise to the value of the monetary dimension of arbitrage. In the author’s view, the “friction setting” problem we have been envisioning fixes a sound perspective on the current rethinking of the nature of liquidity, collateral and banking (e.g. DeAngelo and Stulz, 2015; Andolfatto and Williamson, 2015; King, 2016). At a recent conversation (Council on Foreign Relations, 2015, June 25), Dan Tarullo⁵ has been asked about the feasibility of sharpening the assessment of the effects of the actual frictions at play in contemporary markets, in order to enhance the effectiveness of policies and regulations. The difficulty

⁵ Former Governor, Federal Reserve Board.

in answering such question witnesses the positive relevance of the point of the present contribution. The methodological relevance of our approach should build on the applicability of P1 to the effects of the financial frictions at play in contemporary markets, for instance, *network effects*.

Recent policies and regulations have been reducing the incentives and tightening the constraints faced by banks in making markets for bonds. Opportunities for non-bank dealers emerge in such a context; still, the network effects at play in OTC markets may impinge critically on the fluidity of ‘substitution’ of dealers. Di Maggio (2017) notices that a network of consolidated inter-dealer relations is likely to generate problems of *path dependence* in the adjustment to the exit of bank dealers. Such restructuring (market evolution) problems seem to enlighten the reach of our principle.

In fact, on general grounds, the complexity of global financial phenomena makes it somewhat natural to acknowledge the potential relevance of path dependence issues. According to P1, arbitrageurs purposely alter the frictions in place, and the evolution of the system depends on the feedback loops between arbitrage and frictions along a given evolutionary path.⁶ Interestingly, one such pattern seems to have been recognized in recent market history. It has been conjectured that the real problem with shadow banking is the ‘disordered’ way with which it has grown. The point of the conjecture is not the well known fact that markets rarely evolve according to an intelligent design; the point is that it may not be the functions of shadow banking (for instance, the five economic functions of “narrow” shadow banking according to FSB, 2018) that become “toxic” in certain circumstances, but rather their possibly inappropriate (disordered) backstop network.

One should not envision the drivers of the emergence of shadow banking as inherently associated with the potentialities of financial engineering. Consider for instance the analysis of the process of joining the Federal Reserve System set forth by Anderson et al. (2018). The Authors demonstrate that the moral hazard problem of shadow banking was already in place in the early era of the Federal Reserve. “Many state-chartered banks managed to get indirect access to the Federal Reserve’s discount window while avoiding the higher reserve requirements of the Federal Reserve” (ivi, p. 196). It is somewhat natural for historical processes to display instances of “regulatory arbitrage”; true, the point of P1 is to shed light on the role of friction-premium pairs of both driving such processes and gauging their sustainability and *reversibility*. Notice that a collapse of (or a ban on) a shadow banking sector may *not* bring us back to the initial position – in the Moreira-Savov model, after a market downturn, output is permanently below trend if shadow banking were in place. One then may argue about the feasibility of introducing some notion of the “entropy” of the dealer network, in terms of which to state some “law of irreversibility”. These are really fascinating issues that may represent exciting lines of progress of monetary economics, and for which our principle may contribute a simple conceptual perspective. However, it is on more concrete grounds that one should envision the relevance of our approach.

⁶ According to the influential biologist S. J. Gould, should we run again the tape of evolution we would probably end up with a different story.

Consider the manifold challenges currently facing monetary policy and regulation. Should central banks reconsider the Taylor rule along the lines discussed by Andolfatto and Williamson (2015)? Should they embrace emergency lending rules in the spirit of King (2016)? Should they display concerns about the allocation of credit in connection with the questionable efficiency and sustainability with which markets at times perform such an allocation (Turner, 2015)? Such questions tread common grounds as far as the market-making role of dealers is at stake. Think of the subtleties involved in the characterization of the ‘substitutability’ of risky and riskless assets – it has been argued that “Operation Twist” contracted rather than expand the supply of liquidity – or the complexity of a “map” of shadow banking (Pozsar, 2014; FSB, 2018).

According to Lord Adair Turner, shadow banking is like cholesterol, there is good and there is bad. Mehrling (2012) seems to represent the good. How to discriminate between good and bad is an interesting question; to turn it into a “good question” we need an explicit model (like the one discussed by Meeks et al., 2017). In the author’s view, one such model should embody, among other things, the methodological stance represented in P1. The crucial point, we all know, is the fragility of the system and its potential role for contagion. Such issues are explicitly stated for instance in the recent EU regulation of MMMFs. The “same business – same rules” principle is often advocated as a sound guide for such undertakings; our principle may help focus the extent to which the functions of shadow banking can be considered “different” from more traditional banking activities with respect to the exogenous frictions they are meant to circumvent and to the endogenous frictions that may emerge in response.

To conclude, the chain of reasoning we have been through seems to suggest that *the relevance of money is connected with its aspiration to irrelevance*. It is the relevant (and delicate) well functioning of the various forms of money – their liquidity in tranquil times – that makes markets work smoothly *as if* money were irrelevant. It may be difficult to fix such an insight into a “principle”. Still, it is by now quite undisputed that money, collateral and arbitrage play a truly relevant role in preventing and dissipating the tensions that ignite margin spirals and fire sales. To rephrase Caruana and Kodres, liquidity is created and maintained by market-making dealers, and market-making is, to some extent, endogenous – central banks have been part of the game over the last decade. Arguably, macroeconomic models should address the delicacy of such stabilization mechanisms on both positive and normative grounds.

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