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THE MONETARY DIMENSION OF ARBITRAGE. A BRIEF NOTE

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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 in connection with 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-premium pairs". Such an approach seems to shed new 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.*

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JEL Classification. E32; E44; G23.

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1 Introduction

The great financial crisis and its reverberation on the advanced economies have brought 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 under way of the relevance of the proper microfoundation and level of stylization of macroeconomic models. 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. In what follows we shall be concerned with the monetary (relevance) dimension of arbitrage 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 sensitivity of arbitrage activity to the *procyclical* interaction of market liquidity and funding liquidity (Brunnermeier and Pedersen, 2009; Krishnamurthy, 2010a), which represents a truly relevant macro-monetary problem (Banque de France, 2008), has been receiving increasing attention in connection with the anatomy of the crisis. At the roots of the interaction between market and funding liquidity are the frictions that shape both the incentives and the constraint faced by money dealers and security dealers. In a frictionless world in which risk is perfectly priced no such interaction occurs. In the real world such interaction does occur, and endogenizes the emergence of frictions as (typically procyclical) financial constraints, in particular collateral constraints and margin requirements.

Building on the monetary framework envisioned by Mehrling (2012a) for the role of dealers, we shall try and sharpen the macroeconomic relevance of the way financial frictions interact with trade. With respect to such dynamics, 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 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 principles[1] 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), but the specific role of arbitrageurs in such a plot is not easily singled out (perhaps to exploit the riskier or subtler opportunities); for sure the role of supplying liquidity to incomplete markets by managing the frictions therein is a major aspect of arbitrage activity.[2]

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 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 "friction setting"

[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*.

as the *endogenous* interacting patterns between intermediaries and financial frictions (one can think of recent financial regulation as an *exogenous* mechanism of friction setting).

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 emergence of shadow banking – and such evolution alters qualitatively the nature of the frictions in place, and (therefore) of the instabilities of macroeconomic variables like monetary aggregates. In such respect, different strands of macroeconomic literature have been emphasizing the role of collateral constraints and scarcity of net worth (see Moreira and Savov, 2017, and 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. Mehrling's (2012a) monetary framework provides a comprehensive architecture for reproducing such a mechanism at the various layers of the hierarchy of money, thereby stylizing its 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). Our approach is meant to fit such a point of 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, and compare it with the 'stable' system depicted by Mehrling (2012b). 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]

The world we live in is 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 microstructure and balance sheet constraints that limit the ability of arbitrageurs to perform their stabilizing activity (see Gromb and Vayanos, 2018). These days the limits of arbitrage represent a truly engaging line of progress of financial economics, whose potential spillover to macroeconomic modeling is the subject of this note.

The comprehensive monetary framework devised by Mehrling (2012a) provides a transparent big picture for appreciating the inherent connection between money markets and capital markets in the current financial scenario. Generalizing the dealer function discussed by Treynor (1987), one envisions a hierarchy of dealers that, by issuing "money", transform funding liquidity into market liquidity (and viceversa) and transport liquidity from one market to another. Such a picture fixes a sound perspective (at least, in the author's view) on the secular process of evolution of liquidity management – that in recent decades has combined with the eruption of "financial engineering" and ICT revolutions – towards the pre-crisis system built around market liquidity (Banque the France, 2008; Mehrling et al., 2013). The emergence of the shadow banking system represents to a large extent a regulatory arbitrage meant to circumvent regulatory frictions that stand in the way of liquidity transformation and marketing. The risk transformation recipes embodied by securitization practices enhance the potential for transforming illiquid assets into liquid (riskless) ones, thereby facilitating the short-term financing of positions in those instruments. The sustainability of such practices, unfortunately, is not guaranteed. 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. According to a well established principle, frictions give rise to the value of money. DS sharpen the relevance (for the bank capital structure) of such a principle

[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.

by arguing that the primitive role of banks is to produce liquidity on demand, the demand for liquidity being generated by the frictions faced by part of the agents in the economy. 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 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.

In the light of Mehrling's monetary hierarchy of market-makers (money-and-security dealers), it is somewhat natural to envision the generality of such a perspective. 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. The *methodological* relevance of P1 is the point of the present contribution, in particular concerning the connection between risk management and "friction setting", which is crucial for "how markets actually work" (Stiglitz, 2018).

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, such requirements call for a suitable backstop. With respect to the intricacies connected with the analytical representation of such problems, DS provide a benchmark model in which risk admits a perfect management. In the real world, unfortunately, risk transforms and builds up, and new frictions typically emerge in 'response' to liquidity transformation – witness the crisis. In such respect, P1 is not meant to uncover previously unappreciated financial phenomena, and rather to sketch a potential 'channel' through which current theoretical and empirical advances in the analysis of arbitrage may permeate the macroeconomic debate.

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. The DS bank creates liquidity in a market by suitable hedges in another market. What is really remarkable, in the light of P1, is that a similar logic underlies the representation of shadow banking as "money market funding of capital market lending" (Mehrling et al., 2013). The stylized shadow bank 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 market liquidity in order to exploit a liquidity premium by issuing some form of "money". The intermediaries (arbitrageurs) pictured by Moreira and Savov (2017) issue different forms of money in order to optimize their ability to exploit the premia generated by emerging trading opportunities (see section 3 below).

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 complexity of the activities 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 provides a monetary characterization of arbitrage that builds on genuine empirical grounds.

2.1 CIP

Despite its methodological stance, our principle is motivated by concrete empirical effects. Consider for instance the ongoing efforts to understand the reasons for the repeated violations of covered interest parity (CIP) over the last decade. It has been repeatedly cheaper to borrow USD directly rather

than synthetically via FX swaps with major currencies like Euro or JPY. Is this a relevant phenomenon? Why should one care?

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. The same Authors point out that persistent and significant departures from the CIP condition introduce wedges between the interest rates in cash and swap markets that may influence the external transmission of monetary policy. The relevance of deviations from CIP is quite uncontroversial.[4]

Different Authors have pointed out different mechanisms that shed light on such a phenomenon. Most Authors agree that recent unconventional monetary policies are part of the plot for the imbalances in cross-currency investments that have been driving forward-spot exchange rate differentials; see for instance Sushko et al. (2016). The same Authors argue about the costs of the balance sheet commitment of taking the other side of the net FX positions needed to trade against CIP violations. The "friction setting" positions set in place by arbitrageurs seem to find it hard to exploit the basis premium since, among other things, frictions strike back in terms of the riskiness of positions. "The currency basis responds to demand shocks to hedge currency risk forward" (ivi, p. 2). These challenging effects, in the author's view, provide genuine empirical motivation for the content of our principle.

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 processes manifest themselves only ex-post. 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 by the procyclical interaction of market liquidity and funding liquidity, that alters the nature of the

[4] A symposium dedicated to the phenomenon has taken place at the Bank for International Settlements in 2017.

frictions in place. The macroeconomic model set forth by Moreira and Savov (2017, "MS" henceforth) seems to fit such a logic. The Authors tailor an explicit representation of shadow banking activity in which the liquidity cycle drives the macro cycle. The following sketchy summary does no justice of the analytical sophistication of the 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 "liquidity transformers 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, in the sense of enlarging the supply of liquid instruments that support trade and boost asset prices and economic growth.

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

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

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 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 model.

In fact, the cornerstone of the MS model is the explicit representation of the line of coexistence of money and shadow money (the "liquidity provision frontier"), that resembles a standard budget constraint. 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.

The MS model seems to provide a significant playfield for 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”. In addition, the model provides 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.

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 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 (2012b) 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 be, 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 (2012b) 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). A fall in asset prices for sure tightens the collateral constraint faced by the capital funding bank, but 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 (2012b) is *stable* in the region of the ‘state space’ in which collateral flows support such stability. On the contrary, the MS model (whose positive

relevance is emphasized by the Authors) represents the nature and effects of the instabilities generated by a stylized shadow banking system.

The comparison between the two models is evidently of great interest from the macro-modeling viewpoint. "Understanding the structures that are most conductive 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" depicts the instability of the "friction setting" built on the collateral constraint. On the other hand, no friction-premium pair displays in Mehrling (2012b), and the intelligent design of the (normative) system gauges the sustainability of the "friction setting" therein.

4 Conclusions

The previous sections have been addressing a new (to the author's knowledge) perspective on the macroeconomic inquiry on financial frictions. To rephrase a well known principle, financial frictions give rise to the value of the monetary dimension of arbitrage. In a recent conversation at the Council on Foreign Relations (2015, June 25), Daniel Tarullo[5] 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 in answering such question seems to witness the positive relevance of the point of the present contribution. Needless to say, a more profound and systematic consideration of our approach is supposed to establish its methodological relevance. An inspiring line of reasoning may pertain to issues of *path dependence*.

Kurlat (2018) provides an analytical representation of the way learning in markets can display path dependence, which impacts significantly on the 'history' of market liquidity. 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

[5] Former Governor, Federal Reserve Board.
[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.

possibly inappropriate – disordered – backstop network. Krishnamurthy (2010b) argues at length about the relevance of the plumbing of debt markets.

One may then argue about irreversibility issues – a collapse of (a ban on) shadow banking does *not* bring us back to the initial position – and the feasibility of introducing some notion of the "entropy" of the system in terms of which to fix some "law of irreversibility". These are really fascinating issues that may represent exciting lines of progress of monetary economics; however, it is on more concrete grounds that one should envision the relevance of our approach.

Consider the manifold challenges currently facing monetary policy and regulation. Nowadays there seems to be little disagreement about the fact that financial stability should be the prime aim of monetary policy. Opinions seem to be more differentiated about the desirability of 'new normals'. Should central banks reconsider the Taylor rule along the lines discussed by Mehrling (2016)? 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 microstructure of markets 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; see MS and references therein – 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 (2012b) 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. 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 money market mutual funds. 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, the truly relevant role of money (collateral and arbitrage) of preventing and dissipating the tensions that ignite margin spirals and fire sales currently represents a genuine macro-modeling challenge, for which the ongoing advances in the analysis of the limits of arbitrage may contribute conceptual and analytical building blocks.

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