Competing fiat moneys and nominal rigidities

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Abstract

Monetary economics traditionally does not consider a market-based benchmark: when we study trade, we start with a benchmark of free trade; when we study monetary economics, however, we start with a benchmark of central banking. This paper aims to fill that gap. We study competition among unbacked, costless ("fiat") moneys. First, under flexible prices and perfect competition, there is a first welfare theorem for money: When producers of such moneys have commitment technology – such as blockchain technology – then competition implements the optimum quantity of money. Second, under nominal rigidities where the competing moneys also serve as competing units of account, then competition *can* also implement the equivalent of "optimal monetary policy" to avoid macroeconomic fluctuations, if the competing moneys pay interest. We show how these results are suitably modified when competition is imperfect, and we also extend the model to consider the cases of backed or costly-to-produce moneys.

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1 Introduction

Economic analysis typically begins with a market-based benchmark. When studying and teaching the economics of trade, it is standard to begin with a benchmark of free trade before considering the economics of tariffs, export controls, or other government interventions. When studying and teaching labor economics, it is standard to begin with the familiar supply and demand curves from a free market for labor before considering the economics of a state intervention imposing a minimum wage. When studying public finance, it is standard to begin with a benchmark of private provision of a service like health insurance, before discussing whether public provision of the service would be superior. However, when studying monetary economics, the standard benchmark is instead central banking: a state monopoly on the production of fiat money and state control of the unit of account.

The contribution of this paper is to provide the missing market-based benchmark to central banking. We study competition among moneys issued by profit-maximizing agents, to understand whether the "invisible hand" of competition applies to money. We focus most of our analysis on moneys that are unbacked and costless to produce: "fiat" money. This type of money includes the prevailing government-issued fiat currencies but also includes cryptocurrencies; we discuss the economic differences between the two and the implications of these differences for efficiency. We also consider moneys that are backed and costly to produce, as under the gold standard.

We study monetary competition in the standard Walrasian framework, as used in mainline business cycle models like the New Keynesian model. This facilitates a direct comparison between central banking and monetary competition in terms of *macroeconomic performance*: would monetary competition improve or aggravate economic fluctuations? Because the model is built on the standard business cycle framework, it is tractable and can easily be ported to alternative settings to understand how monetary competition would perform differently from central banking in that setting.

Unlike prior work, we analyze not just the case when moneys compete as different media of exchange, but also the case when moneys serve as competing *units of account* and nominal rigidities are present. Concretely, this would be as if Wal-Mart stores in the United States actively decided whether to post their prices in units of dollars or in bitcoin or in renminbi; and that furthermore such posted prices were sticky in the units of the chosen currency, as in the New Keynesian literature. This stickiness is crucial for understanding whether monetary competition would ameliorate or worsen recessions. In other words, this allows us to study if monetary competition can implement the equivalent of "optimal monetary policy" – indeed, whether competition can *improve* on optimal central

banking.

A first welfare theorem under price flexibility. Our first result is to show that – initially setting aside nominal rigidities and as long as agents have commitment power – the first welfare theorem extends to the market for money: competition among private moneys is efficient. This is true regardless of whether the money is fiat, i.e. costless to produce and unbacked, or if it is backed by a commodity like gold. Indeed, social welfare is higher under fiat competition than with commodity-backed moneys, because commodity moneys require costly backing (Friedman 1951) and additionally are costly to produce.

This result runs counter to a common intuition that competing producers of fiat money will simply wish to "print an infinite amount of money" because it is costless to do so, and therefore the price of fiat moneys under competition must be driven to zero. For example, Friedman (1960) writes:

> So long as the fiduciary [fiat] currency has a market value greater than its cost of production... any individual issuer has an incentive to issue additional amounts. A fiduciary currency would thus probably tend through increased issue to degenerate into a commodity currency – into a literal paper standard – there being no stable equilibrium price level short of that at which the money value of currency is no greater than that of the paper it contains.

The key intuition for understanding the efficiency result that – as long as producers can commit – instead of driving the *nominal price of money* to zero, competition necessarily drives the *rental rate* of money to zero. Any asset has both a purchase price and a rental price. The purchase price is the amount paid to obtain ownership of an asset forever, whereas the rental price is the price one pays to derive services from the asset for a fixed period of time. In the case of money, that rental price is the opportunity cost of holding money: the difference in real return between holding the money and investing in a risk-free nominal asset.

It is this opportunity cost of holding money which must be driven to zero by competition – not the purchase price. That is, competition among fiat moneys implements the Friedman rule for the optimal quantity of money: the rate of return from holding money equals the rate of return on risk-free savings. Assuming the risk-free rate is positive, the positive return on money can be either implemented through steady deflation in the value of the money, or via an explicit interest rate payment to money holders (analogous to "interest on reserves" paid by central banks).

We provide another piece of intuition for the efficiency result by showing that competition in the market for money implements the canonical Hotelling (1931) rule for the

optimal rate of extraction of a non-renewable resource. In the case of fiat money without interest rate payments, the Hotelling rule and the Friedman rule coincide: under the Friedman rule the price of the money rises at the risk-free rate, just as under the Hotelling rule the price of the non-renewable resource rises at the risk-free rate. Indeed, the mathematical structure of the firm's profit maximization problem when producing fiat money is the same as that of the canonical Hotelling resource extraction problem, with a sign flipped.

The role of commitment & blockchain technology. An important necessary condition for the efficiency of monetary competition is that money producers be able to *commit* to a production plan. That is, money producers must be able to precommit to a future path of their money supply.

In fact, if money producers are not able to commit and must operate under discretion, then monetary competition drives the value of money to zero. This captures the intuition discussed above that competitive producers of fiat money are continually tempted to print infinite quantities of money, which then must have zero value to ensure zero profits. This time consistency problem is analogous to the incentive for "time-0 default" in public finance, or to the time consistency problem for optimal capital taxation.

While there are many possible ways that a money producer can credibly commit to a plan for the path of its money supply, the recent development of blockchain technology provides one particularly notable commitment technology (Nakamoto 2008; Buterin et al. 2014). Blockchains are a cryptographic technology which can be succinctly summarized as "computers that can make commitments". The explosion of competing cryptocurrencies using blockchain technology indicates that efficient monetary competition may be more feasible today than it had been historically.[1]

The efficiency and time consistency results developed here have antecedents in the important models of Taub (1985) and Marimon, Nicolini, and Teles (2012), and find inspiration in the pamphlet of Hayek (1976). The former two prove similar results in specific environments with additional assumptions about the demand for money.[2] Our results

[1] We review blockchain technology and empirically document the success of such technology in enforcing money supply rules for cryptocurrencies, such as Bitcoin's precommitted asymptotic growth towards a 21 million supply cap.

[2] The pamphlet of Hayek (1976) argued informally for the efficiency of fiat monetary competition; Klein (1974) offered one formalization in a non-rational expectations model. Selgin (2015) and White (2015) noted the role of blockchains in allowing for credible commitment. Selgin and White (1994) survey the literature on (among other things) competition among money, with a large focus on commodity money. To our knowledge, the extant monetary competition literature (fiat or commodity-based) has not recognized the crucial importance of the Hotelling rule for equilibrium. We discuss the relation of our results to the commodity money literature in more detail in section 3.

generalize and considerably simplify these earlier results. In particular, we do not require any assumptions about the shape of the demand for money, which allows for the connection to the first welfare theorem to be very direct and transparent.

Competing units of account. The discussion thus far has assumed an absence of nominal rigidities, which has meant that whether or not price-setters denominate prices in units of a given competing money has had zero consequence. One way of framing this is in terms of the canonical "three functions" of money: a medium of exchange, a store of value, and a unit of account. Without some form of nominal rigidities, the unit in which prices are set does not matter, meaning that the discussion thus far has analyzed money solely as a medium of exchange or as a store of value – not as a unit of account.

In section 4, we study competing moneys which serve as competing *units of account*, rather than serving merely as competing media of exchange and stores of value. We suppose that price-setters choose to denominate their prices in units of competing moneys – USD or RMB or BTC or otherwise – in order to best maximize their individual profits, like any other firm decision.

In the presence of nominal rigidities, studying competing units of accounts amounts to asking: can monetary competition improve on central banks in terms of *macroeconomic performance*? In the discussion thus far without nominal rigidities, the question of efficiency has been whether competition merely minimizes Harberger triangles. With nominal rigidities, the question of efficiency is much larger: whether monetary competition can avoid recessions and minimize economic fluctuations.

We show as a benchmark that under a notion of a "complete set of units of account", then monetary competition *fully* undoes the distortions created by nominal rigidities and avoids inefficient recessions and inflation altogether. Monetary competition, with a complete set of units of account, outperforms central banking in terms of macroeconomic stabilization by giving firms an incentive to *endogenously* offset nominal rigidities, eliminating their distortive effects.

The intuition for this result is the following. For any given rigidity a price-setter may face when choosing its optimal price, there is always *some* path for the value of a possible unit of account which ensures that the *real* price – the nominal price adjusted by the value of the unit account – equals that which would occur under flexible prices. Moreover, under monetary competition, it is always feasible to create a money whose value follows exactly this path. This is because monetary competition only requires that the *total* return of every money follow the Friedman rule, and the total return is the sum of the change in the value of the money plus the explicit interest paid on the money. Any price path

for the money is possible, because the interest on the money can be set to offset the gap from the Friedman rule. Thus, under a complete set of units of account with monetary competition, all possible price paths are possible. A price-setter will then endogenously select the unit of account which offsets the rigidities that she will face.

While we take completeness as a useful appropriate benchmark – just as the canonical Arrow-Debreu model takes complete markets as the appropriate benchmark – we argue that in reality competition among units of account is likely to be incomplete. Given the lack of competition among units of account in reality thus far, our modeling of this topic is necessarily more speculative.

Our analysis of competing units of accounts is related to the (largely informal) "new monetary economics" literature of the 1980s, surveyed by Cowen and Kroszner (1994). We discuss that literature in light of our results in section 4.

The importance of perfect competition. In our concluding section, we discuss in detail potential limitations and the extensive opportunities for future research on monetary competition. Here, we briefly highlight what we see as the main limitation: the assumption of perfect competition. The model that we analyze assumes that money producers operate in a perfectly competitive environment and earn zero profits. In reality, network effects likely break perfect competition: if an entrepreneur were to clone the open source Bitcoin protocol today to create NewCoin, it would *not* be perfectly substitutable with Bitcoin due to the network effects that Bitcoin has accumulated by virtue of its size.

Layout. The rest of the paper proceeds as follows. In section 2, we lay out some motivating facts on the rise of monetary competition from cryptocurrencies. Section 3 analyzes monetary competition in the absence of nominal rigidities. Section 4 incorporates nominal rigidities. Section 5 concludes.

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