

Money and its institutional substitutes: the role of exchange institutions in human cooperation

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Abstract. This paper offers an increasing returns model of the evolution of exchange institutions building on Smith’s dictum that ‘the division of labor is limited by the extent of the market’. Exchange institutions are characterized by a tradeoff between fixed and marginal costs: the effort necessary to execute an exchange may be economized by up-front ‘investment’ in strategies to facilitate the publication and accounting of trading histories. Increases in the size of the exchange network select for higher-fixed-cost exchange institutions, beginning with autarky, through various intermediate stages, and finally to mass monetary exchange. By identifying the relevant fixed costs of money and its institutional substitutes across time, the paper both accounts for the persistence of pre-monetary exchange institutions, despite the ‘inevitability’ of monetary exchange that seems to be a feature of traditional models of the origin of money, and illuminates the forces driving the transition from one to another.

1. Introduction

Monetary theory has been concerned at least since Menger (1892) with the question, just what feature of the world makes money necessary? The answer depends crucially on what we take to be the relevant analytical alternative to monetary exchange.

Hicks (1935) suggested a frictionless general equilibrium (GE) economy as the relevant alternative, in which direct barter is sufficient to achieve a Pareto-optimal allocation of resources. The key difference of the real world is the presence of frictions, or (in Coasean language) transaction costs, which makes direct barter infeasible. A great part of the subsequent literature is occupied with identifying the set of necessary and sufficient frictions that result in monetary exchange. We will call this the Hicksian approach.

The central question of the Hicksian approach, however – what specific frictions distinguish the world from an ideal frictionless model? – is not the same as the question: how did money in fact arise? This latter question we will identify with a historical approach. Rather than beginning with a frictionless

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model and introducing frictions to bump it out of a barter equilibrium, we may get a better sense of the function of and the relevant alternatives to monetary exchange by taking our starting point from its actual historical precursors.

Unfortunately the two approaches have not to this point been clearly distinguished and separated from other relevant questions. Without the benefit of a detailed history, Menger's conjectural history of the evolution of monetary exchange out of barter has been taken both by friends and foes as an actual history.¹ Similarly, without the benefit of a detailed theory, proponents of a historical approach are often derailed into mere history, and are prone to elevate historical accidents as necessary conditions (cf. Salter and Luther 2014). For this reason the historical approach is often conflated with a 'state money' paradigm (Goodhart 1998; Wray 2004), in which money gains currency and value from the diktat of some central authority.

This paper offers an alternative approach that is both evolutionary and historical, unlike the evolutionary-but-ahistorical Mengerian approach and the historical-but-constructivist state money approach. It offers an increasing returns model of the development of exchange institutions in which increases in the scale of the exchange network select for increasingly higher fixed-cost exchange institutions, which in turn lower the marginal costs of exchange. The fixed costs of these exchange institutions account for the persistence of in-kind exchange in more primitive societies (i.e. those with a small exchange network), in contrast to the inevitability of monetary exchange that seems to be a feature of Menger's story in 'On the origins of money'. The marginal costs of exchange then determine the scope for the division of labour in a society. Monetary exchange is unique among exchange institutions primarily in having the lowest marginal costs, and (therefore) allowing an extremely wide scope for the division of labour.

The following section argues that the initial conditions of Hicksian models of monetary exchange have little validity in a world where the division of labour is limited by the extent of the market. The next two sections set up the theory, and the remaining sections identify the relevant fixed costs of money and its institutional substitutes throughout history.

2. The necessity of a historical approach

Hicksian models are typically motivated not by the historical emergence of monetary exchange, but by current monetary policy concerns. Two different frictions that both result in the emergence of indirect exchange in a GE economy may have very different implications for its reaction to a monetary shock, for example. The financialized market economy to which they are intended to apply is characterized by strong and distinct equilibrating forces, which justifies a solution with a unique symmetric equilibrium (cf. Koppl 2002: 94). The initial

1 Though more careful writers have interpreted it as pure theory (e.g. Mises 1966: 408ff).

conditions of these models do not correspond in any meaningful way to the conditions out of which monetary exchange in fact emerged, nor are they meant to. For this reason they should be interpreted as fundamentally *synchronic* rather than *diachronic*, despite their featuring ‘emergence’ of money as an equilibrium result.

The equilibrating forces characteristic of a monetary economy cannot be taken for granted in a model of the *development* of monetary exchange. The increasing returns model in this paper has no such neat result as the emergence of a single medium of exchange out of the interaction of optimal trading strategies. Instead, it advances a broad framework through which the selective forces propelling the development of exchange institutions can be understood and organized.² These institutions are the crucial missing piece that renders Hicksian models inapplicable to the actual historical emergence of monetary exchange.

An exchange institution is a set of conventional practices that facilitates the incentive-compatible exchange of goods and services. Monetary exchange in particular is an institution where exchanges are facilitated by the common acceptance of one or several media of exchange – money – in terms of which the prices of other goods are quoted and rendered comparable with one another.

The necessity of exchange institutions is often overlooked, both in economics broadly and monetary economics more specifically. John Stuart Mill (1848, bk. 3, ch. 7, §3), anticipating Hicks, argued that ‘there cannot, in short, be intrinsically a more insignificant thing, in the economy of society, than money . . . It is a machine for doing quickly and commodiously, what would be done, though less quickly and commodiously, without it.’ Abstraction from the particulars of exchange institutions has been standard practice in economics ever since. Indeed, because exchange benefits both parties, it may seem not to require any particular explanation. Adam Smith (1776, bk. 1, ch. 2, §1) referred to the ‘propensity to truck, barter, and exchange’ as a basic feature of human nature, and most economists have taken this assumption as axiomatic.

Nevertheless, the *ability* to truck, barter and exchange runs into a number of impediments that are typically assumed away in Hicksian models of monetary exchange, where the institutional background is more or less invisible. In particular, non-trivial institutions must be present in order to assume either (1) pre-existing specialization, or (2) straightforward property arrangements.

Pre-existing specialization

The assumption of pre-existing specialization can be seen plainly in search-theoretic models. Menger’s (1892) illustration is of a man who has produced some wares and seeks to bring them to market in exchange for other items he desires, which suggests a barter society that has already achieved some degree of

² In this sense, while the paper takes a historical approach to monetary theory, it is not a history of money.

specialization in production. The formalization in Kiyotaki and Wright (1993) features an exogenous parameter $x \in [0,1]$ that ‘captures the [inverse of the] extent to which real commodities and tastes are differentiated’. This parameter also represents the probability of one agent desiring the good offered by another random agent. But because trade requires both agents to desire the good the other is offering, any agent’s probability of a successful trade with a randomly matched partner will be x^2 . This is the double coincidence of wants problem. By contrast, if each agent carries and accepts money balances, the probability of a profitable exchange rises to x .

The problem with using the double coincidence of wants to explain the emergence of money, however, is that – as Adam Smith (1776, bk. 1, ch. 3) famously stated – ‘the division of labour is limited by the extent of the market’. In other words, though monetization is indeed endogenous to specialization, *specialization is endogenous to the size of the exchange network*. And because (as sections 3 and 4 argue) the size of the exchange network is limited by the prevailing exchange institution, we have a ‘bootstrap’ problem. A sufficiently specialized society that somehow found itself without a medium of exchange would surely converge upon one. But without the requisite exchange institution, the assumption of pre-existing specialization begs the question. Because x is a decreasing function of the number of regularly traded goods, to the extent that arranging trades is costly, members of such a society will rarely find it worthwhile to specialize in the first place. An unspecialized society, in turn, faces no incentive to monetize: $x = 1$ is a stable non-monetary equilibrium.

Unlike search-theoretic models, then, a diachronic model of the emergence of monetary exchange must (1) endogenize Kiyotaki and Wright’s x parameter, (2) assign it an initial value of 1 – i.e. uniformity in tastes and production³ – and (3) identify a shock with sufficient force to break it out of that equilibrium. Advances in specialization cannot get off the ground without increases in the size of the exchange network, and increases in the size of the exchange network are out of the question without institutions to manage cooperative exchange. A model like Kiyotaki and Wright’s that assumes both pre-existing specialization and ‘a large number of . . . agents’ therefore has little bearing on the coevolution of specialization and wide-scale exchange, whatever its usefulness for other questions.

Property by assumption

The assumption of well-defined and well-enforced private property rules is also inapplicable to the conditions out of which monetary exchange developed. The centrality of this assumption to the Hicksian project can be seen even more clearly in the Walrasian class of models (Alchian 1977; Banerjee and

³ See Gangotena (2016) for a formalization of the first two conditions.

Maskin 1996), which – in addition to pre-existing specialization – also assume pre-existing *organized markets*.

In the first place, if Smith's dictum about the division of labour is valid, this is an even more heroic and question-begging assumption than that of pre-existing specialization. In the presence of such frictions as characterize the real world, a commonly accepted medium of exchange is a prerequisite for organized markets, not the other way around.

More importantly, however, the 'market' of this model depends on the limited behavioural repertoire of its agents. Specifically, the agents are only permitted to buy and sell. There is no possibility of theft, voting on political arrangements, or any number of other market-inhibiting behavioural possibilities. Though agents can be duped into making unfavourable exchanges, and no authority exists to enforce credit contracts, they are in general perfectly secure in their endowments. One may wonder, then, why the same implicit institution that supposedly causes Walrasian agents to respect property does not also cause them to respect contracts.

For the operation of actual markets, the range of 'defecting' behaviour is much larger than contract non-fulfilment. If the behavioural profile is expanded to include the possibility of theft, expropriation and the contestation of ownership – if we drop the assumption of a basic respect for property – an organized market cannot emerge. Indeed, the higher the potential gains from exchange, the greater an impediment to cooperative exchange open-ended behaviour poses (Stewart *et al.* 2016).

Though some notion of private property broadly speaking has characterized human social relations since at least the Neolithic revolution, the specific rules are partly constitutive of the difference between different exchange institutions. Relevant differences include what sorts of goods are recognized as ownable and for whom, the recourse available against theft and its reliability, and the internal consistency among various parts of property law or custom. Hicksian models *assume* the property norms characteristic of a monetary exchange economy. The historical question, however, is the *emergence* of those norms.

Atomistic barter

Taken together, we may call the initial conditions of Hicksian models 'atomistic barter'. Atomistic barter is characterized by simultaneous exchange of differentiated goods between basically anonymous agents, whether through random matching or in an organized market.

There is, of course, no evidence of any pre-monetary society using anything like atomistic barter as a primary exchange institution (Humphrey 1985).⁴ From the perspective of a modern market economy, a Walrasian situation without

4 However, Humphrey does document something like atomistic barter in *post-monetary* societies that have suffered a sufficiently catastrophic collapse in the volume of trade.

contracts or third-party enforcement (which rules out exchange on credit) might seem appropriately primeval to serve as the initial condition. However, the historical record suggests that incentive-compatible credit exchange was in fact the *first* problem to be solved in the chain of exchange institutions that led to monetary exchange, with expansive property rights, permanent specialization, and anonymous exchange coming much later. We turn now to this first step.

3. A prehistory of the division of labour and the extent of the market

In light of these restrictions on our initial conditions, we begin with autarky – the size of the exchange network being zero, and therefore without specialization. This will give us a sense of the basic impediments to the regularization of exchange that *any* exchange institution must solve.

Consider the prospects of two identical and autarkic foragers, Crusoe and Friday, arranging an exchange. We must suppose the first exchanges to happen under conditions of zero endowment: the existence of individualized endowments presumes a pre-existing property norm (i.e. uncontested control of goods), and the exchange of *differentiated* endowments further presumes pre-existing specialization. For this reason, our prototype must be the reciprocal exchange of undifferentiated *services*. More specifically, services performed on the body of the other party – for example grooming, which must be performed sequentially – are a more plausible prototype for the first exchanges than other services that might be performed simultaneously, because the former are easier to monitor.

Crusoe and Friday are, by hypothesis, both better off exchanging grooming. But both would also rather receive a grooming and then go swimming without returning the favour. By the same token, conditional on not receiving a grooming, each party would rather avoid the hassle and stay at the ocean. Despite the potential gains from trade, the equilibrium outcome is no exchange. The basic problem with getting trade started in the first place is that the time-separated quality of service exchange poses a prisoner's dilemma and opens the door for defection.⁵ Without this first step, there is no opportunity for the development of specialization and the exchange of goods.

The primary impediment to exchange at this point is not search costs, since at this stage any individual is more or less as good as any other at performing an available service, but a *commitment problem*. The pertinence of the dilemma can be seen even more readily in the animal kingdom, where the fitness costs of being suckered preclude most forms of cooperation and exchange.⁶ Even in this

⁵ The prisoner's dilemma quality of exchange is what characterizes *social* behaviour, as opposed to *herding* behaviour where no incentive incompatibility need exist.

⁶ On the various specific forms this fitness cost can take, and the concomitant margins along which social behaviour can vary, see Wilson (1975, ch. 3).

setting completely lacking in specialization, if Friday cannot commit to return the grooming, there is no exchange.

Dilemmas such as that faced by Crusoe and Friday are pervasive impediments to exchange and social organization (cf. Miller 1992). The distinctiveness of human social behaviour is *not*, therefore, as is usually assumed, merely that man is able to appreciate gains from trade whereas animals are too dull to do so. Rather, humans are distinctive in their ability to commit on a non-rational basis to act contrary to their own narrow interests, though these departures from narrow-sense rationality are themselves ‘rational’ in a broader sense (Frank 1987). It is not because humans are more rational than animals, but indeed because they are *less* narrowly rational that they can be trusted, on the whole, to reciprocate cooperative behaviour even at some cost to themselves.

4. A taxonomy of exchange institutions

With autarky as the backdrop, the problem facing any exchange institution will be: how to overcome the prisoner’s dilemma of reciprocal altruism and make exchanges self-enforcing? There are factors that both help and hinder as we move toward a consideration of more familiar large-scale human interaction. Repeated play allows Crusoe to punish Friday if he defects or free-rides. However, this equilibrium becomes more and more difficult to enforce as Friday’s brothers, Wednesday and Thursday, arrive on the island. As Bowles and Gintis (2008) show, repeated play on its own is generally insufficient to sustain cooperation in groups larger than about four.

Cooperative exchange in a larger group therefore requires an *exchange institution*, which consists of norms and strategies that facilitate:

1. The accounting and publication of exchange histories to *identify* defectors at low cost, and
2. Convergence upon a coordinated strategy to *punish* defectors.

The folk theorem implies that the space of potential exchange institutions is extremely vast. Nevertheless, because the costliness of complex strategies will tend to select against them if they fail to provide a corresponding benefit, we can imagine a rough correlation between institutional complexity and the size of the exchange network. This will allow us to categorize exchange institutions along a single dimension of strategic complexity.⁷

⁷ Much of the literature on early human development has focused on the punishment aspect, especially as used to suppress overt violence, and its historical trajectory toward more centralized administration (see Johnson and Koyama (2016) for a survey). Comparatively little has focused on either the use of punishment in the context of exchange institutions (which may or may not overlap with the mechanisms and strategies used to punish overt violence), or the accounting and publication necessary to orient such

The basic problem with increasing the size of the exchange network is that the accounting necessary to prevent defection from becoming a dominant strategy as group size increases requires increasing strategic complexity, which in turn requires increasing cognitive capacity (Dunbar 1992, 1995). Humans do have an advantage here among animals: from their very emergence as a separate species, anatomically modern humans have been characterized by efficient facial recognition (Haxby *et al.* 2002) and a relatively large memory for keeping track of personal obligations. Still, impressive as it is compared to other primates, humans' natural capacity for accounting obligations allows them to maintain group sizes averaging a few dozen, and maxing out around a few hundred.

However, humans do have another advantage: the ability to *extend* their cognition by imbuing elements in their environment with symbolic significance (Clark and Chalmers 1998). Writing is the prototypical example: we can extend our effective memory by replacing huge quantities of information with a reference, i.e. with the knowledge of where to find it. Similarly, investment in the capacity to offload the accounting of exchange balances into the environment has the potential to vastly increase the information taken into account when making an exchange, and therefore also the scale and complexity of social organization.

We can use this idea of extended cognition to operationalize our taxonomy in terms of fixed and marginal costs. The fixed costs of an exchange institution are the opportunity costs for a society of converging onto and socializing its members into certain norms, symbols and meanings necessary for extending cognition, taking biological and evolutionary costs as given.⁸ To put it another way, any pattern of behaviour can in principle be identified as having a joint basis in biology and culture. The cultural pattern may build upon, interact with, or even override biological patterns (cf. Hayek 1960: 93). The learning and habituation necessary to maintain an institution – i.e. its fixed cost – will be higher the greater (1) its cultural as opposed to biological basis, (2) the extent to which it conflicts with or overrides biological predilections, and (3) the information set upon which it conditions action (i.e. its complexity).

The marginal cost, on the other hand, is the cost of executing a particular exchange, including the risk of defection by the other party. Because costly but 'functionless' practices will tend to be selected against in the long run, marginal costs will be a diminishing function of an institution's fixed costs. On the accounting side, the more extensive the convergence on accounting strategies and symbols, the less cognitively costly exchange will tend to be on the margin. And on the punishment side, the more effective the punishment strategy, the

punishment. Widespread free-riding is at least as deleterious to social cooperation as overt violence, but is generally punished in a different manner. We therefore focus the following taxonomy on these aspects.

⁸ In principle, language acquisition will be costly in the same way; however, those costs are biologically obligatory and largely pre-conscious for humans (Hauser *et al.* 2002). For this reason we reckon them as sunk costs rather than fixed costs, not subject to change on the timescale of institutional evolution.

lower the risk of defection. In both cases, lower marginal costs increase the potential scale of human organization.

The investment in symbolic convergence that constitutes an exchange institution enables an increase in strategic complexity without a corresponding increase in on-board cognitive capacity. To anticipate the following sections somewhat, the organization of exchange using only the natural cognitive faculties (what we will call ‘tribal credit’) involves a high marginal cost for each relationship – i.e. some relatively high portion of the brain’s social memory. Despite its low fixed cost, the high marginal costs of maintaining ongoing relationships mean that tribal credit exhausts cognitive limits at a very low scale. Monetary exchange, by contrast, involves high fixed costs but minimal marginal costs. Any given transaction requires relatively little thought to accomplish, and once completed, can be safely forgotten in a way that would destroy the self-enforcing quality of tribal credit exchange.

The formulation of exchange institutions in terms of fixed and marginal costs suggests an analogy to capital theory. Lachmann (1956: 80) asks the same question of physical capital that we have asked of institutions:

It will not pay to install an indivisible [i.e. high-fixed-cost] capital good unless there are enough complementary capital goods to justify it. Until the quantity of goods in transit has reached a certain size it does not pay to build a railway. A poor society therefore often uses costlier (at the margin) means of transport than a wealthy one . . . [N]ew indivisibilities account for the increasing returns [to capital investment].

Similarly, even for a society on the brink of subsistence, investment in high-fixed-cost institutions is not an equilibrium outcome until a sufficient volume of exchange has built up to amortize the costs. Tribal foraging societies, limited as they are in scale, simply cannot sustain enough exchange to make the fixed cost of monetary exchange – namely, a system of writing and mathematics, along with appropriately credible institutions – worthwhile to develop and sustain.

This process of mutual feedback brings us back to the bootstrap problem (cf. Kaldor 1972): if specialization and the volume of exchange are mutually limiting, and if zero-fixed-cost institutions are a stable equilibrium, how does the process of investment in higher-fixed-cost exchange institutions ever get off the ground?

Because an instrumental approach to the development of an institution would tend to destroy its commitment power, we must suppose the process to be driven without anyone deliberately aiming at the result. A process of variation and selection fits the bill. If we assume some degree of random variation in exchange institutions, population pressure will select for higher-fixed-cost institutions, simply because a mismatch where the size of the society significantly outpaces the exchange institution will imperil that society’s continued survival. A society with numerous groups in close proximity must find a way to live peaceably with most of them most of the time, or face perpetual conflict and possibly extinction.

In this sense, whatever other aspects it may have, any integrative institution that results in expanding the feasible scale of social organization must necessarily be an exchange institution – i.e. it must involve strategies for accounting and/or punishment.

One implication is that any ‘big push’ effort to monetize a society is likely to fail, for the same reason that Lachmann’s theory predicts the failure of ‘big push’ investment as a development strategy. Both elements of the mutual feedback must proceed roughly *pari passu*. If social scale outpaces the supporting exchange institutions, it must not be to such an extent that the discovery of and acclimation to new institutions is out of reach, in which case a defection cascade and social collapse will ensue.⁹ By the same token, higher-fixed-cost exchange institutions *enable* increases in social scale but do not *drive* it. If institutional investment outpaces social scale, the result is likely to be wasted effort, and eventual atrophy of a functionless institution.

As evidence for this account, a striking feature of contemporary tribal credit societies is that they persist in areas with little to no *space constraint*.¹⁰ Environmental pressure, then – whether high birth rates or more intense competition for land – is a likely candidate at least for the initial shock that would push a society out of the zero-fixed-cost equilibrium, and into either extinction or a higher-fixed-cost exchange institution.

5. The tribal credit economy

This zero-fixed-cost case, relying entirely on the brain’s innate capacities for accounting and publication, will correspond to the earliest known form of social organization in cognitively modern humans, as well as the form characterizing the most primitive hunter–gatherer and subsistence agricultural societies today. We will call this the ‘tribal credit’ economy.

Tribal credit is the terminus of a more or less straightforward progression from autarky through dyadic and small-group cooperation as cognitive capacity increases. Most importantly, *the time-separated quality of exchange is preserved* through the whole chain, even as the exchange of fishing for gathering becomes reified into an exchange of fish for berries – hence the ‘credit’ aspect of early exchange (Wray 2004), ruled out by hypothesis in Hicksian models. As Wiessner (1977) notes, the term ‘gift economy’ obscures this exchange aspect: despite the nominally gratuitous transfer of goods, participants keep mental accounts of who owes how much to whom, and ‘woe to him who does not

⁹ This would be one way to interpret Polanyi’s (1944, ch. 9) claim that rapid industrialization, which was largely coextensive with mass monetization, led to pauperization of the lower classes in 17th- and 18th-century England.

¹⁰ See note 11 for suggestive ethnographies.

[eventually] make a corresponding present in exchange' (Simmel [1907] 1978: 95).¹¹

Tribal credit is named after its key institution, the *tribe*, within which both accounting and punishment are performed in a relatively decentralized manner. Regular interaction with a more or less definite group of people facilitates the regular dissemination of reputational information. Punishment, likewise – both of violence and of free-riding – consists of diffuse social pressure that can escalate into ostracism or death. Each member has familiar knowledge of all or most other members,¹² and the 'trading history' of each member – unlike under atomistic barter – is common knowledge.

With the regular publication of reputations and the collective exercise of social pressure on defectors, the tribe is able to harness the time-separated quality of early exchange to create mutual rents among tribe members sufficient to enable them to commit to cooperate with one another for the foreseeable future. In contrast, simultaneous exchange – by giving up the leverage of repeated play within a local structure – would make it relatively infeasible to punish defection.

Unfortunately, the marginal cost of exchange under tribal credit is extremely high, which places a hard limit on both group size and the division of labour. Because cooperation in a reputational game depends on knowledge of the identity and history of each potential trading partner, it breaks down when enough players are anonymous. The scale of tribal credit organization is therefore limited by humans' cognitive capacity for keeping track of relationships and obligations, thought to average around 150 relationships (Dunbar 1992, 1995). Indeed, in the absence of investment in higher-fixed-cost integrative institutions, tribal credit societies cannot get far past 150 members before free-riding and conflict become endemic. Such societies invariably have processes for fissioning the tribe or village after reaching a few hundred people (Bandy 2004; Chagnon [1968] 2009). As a community approaches the size where any two individuals are as likely to know each other as not, free-riding becomes the dominant strategy, conflict rends it in two, and one faction is forced to establish itself elsewhere.

With the extent of the exchange network thus limited, the division of labour under tribal credit remains mostly ad hoc (cf. Hooper *et al.* 2015), with little capacity for permanent specialization beyond gender roles. There are simply not

11 For ethnographies of tribal credit societies that highlight the specific norms and routines enforcing the incentive-compatibility of time-separated exchange, see e.g. Chagnon ([1968] 2009) on the Venezuelan Yanomamö and Wiessner (1977) on the Botswanan !Kung San.

12 Smith *et al.* (2016) show that cooperation and reciprocity fall dramatically as tribal membership becomes more fluid. Bowles and Gintis (2008) also argue that the regular and honest publication of private information ('gossip') is not incentive-compatible except on the assumption of some degree of prosocial, other-regarding preferences ('true' altruism), including the willingness to inflict costly punishments on defectors. Tomasello (2009) demonstrates that humans do indeed possess such preferences innately (i.e. from birth), and to a unique extent compared to other primates. Bowles and Gintis (2004) construct a plausible model of their evolution.

enough potential exchange partners for it to be worth it for any of them to relinquish food production and to specialize in, say, pottery manufacture.

Such societies must form the starting point for a theory of monetary exchange. Unlike Hicksian models of atomistic barter, where commitment is impossible and unlimited cognitive power allows for costless optimization, early human society is characterized by robust institutions for long-term commitment and extremely limited accounting capacity. Though there are no markets per se in a tribal credit society, even a basic organization of in-kind multilateral exchange offers sufficient incentive for defection that mechanisms for accounting and punishment are necessary to make it work. Tribal institutions, by making exchange *ongoing* and *personal*, enable sufficient commitment to sustain cooperation at a scale of a few dozen to a few hundred individuals. As compared with Menger's story, and without permanent specialization, these credit relationships render in-kind and time-separated barter sufficiently tolerable to forestall the spontaneous development of indirect exchange.

6. Trading networks

Exchange at a supra-tribal scale will require institutions to facilitate exchange without the extensive personal information that the tribe provides. The first step, historically, was the formation of inter-tribal trade networks, which allowed trade to take place on the basis of group affiliation rather than personal knowledge.¹³

There are two basic preconditions for the formation of trade networks. First, agents must be organized into groups within which some combination of internal and external forces suppresses defection. Leaving external enforcement to the side until the following section, our question will be: how can a community organize itself internally in order to commit credibly to forswear opportunism *vis-à-vis* other communities, and what forces lead it to do so? This is precisely the function of tribal institutions from the perspective of an outsider: by suppressing internal defection, they allow the group to act as a 'superorganism' (Wilson and Gowdy 2015) and ensure its trustworthiness *vis-à-vis* outside groups.

Second, agents must be able to use information about the reliability of the defection-suppressing mechanisms of another class or tribe as a substitute for knowledge of its individual members. This allows agents to respond to *trustworthiness* with *trust*, and in turn makes trustworthiness a worthwhile investment. Marwick (2003) argues,

13 For historically important examples of pre-monetary trading networks, see Malinowski (1922) on tribal credit, and Mederos and Lamberg-Karlovsky (2004) on customary exchange.

The ability to express symbolic categorizations of social systems allows individuals to identify and interact with unrelated individuals in terms of symbolic categories rather than as unique individuals. This allows for relationships based on mutual rights and obligations rather than the histories of interpersonal relations that require renegotiation at each encounter.

To the extent that group affiliation can substitute for personal knowledge in the evaluation of trustworthiness, higher-fixed-cost institutions can regularize ad hoc trading into permanent inter-group specialization, with the trading relationships between groups analogous to the relationships between individuals in the previous section.

Inter-group trade is the prototype of simultaneous exchange. Indeed, demanding repayment at the time of exchange is seen in tribal credit societies as a peculiar form of trade reserved for ‘outsiders’, and protects to some degree against defection in a situation where the two groups are not in regular enough contact to make something like tribal credit relationships feasible on an inter-group scale.¹⁴ A small number of outside trading partners makes simultaneous inter-group exchange far more manageable than it would be in the intra-group network of dozens or hundreds of people.

Consider a society consisting of an inland and a coastal village. Because their ecologies are so distinct, the gains from trade are readily apparent: it pays to organize an ongoing division of labour between the coastal village, which provides fish, and the inland village, which provides vegetables. But even with simultaneous exchange, the two villages still face the prospect of defection. Specifically, permanent specialization implies reliance on the other party, which allows it to ‘exploit’ the first for better terms of trade (cf. Klein *et al.* 1978). In order to make specialization worth the cost, the village must be assured of a steady (or at least a predictable) demand for its product. Even if the gains from trade are substantial, a society just embarking on the division of labour will have limited means of smoothing consumption. For a risk-averse agent, an increase in the variance of their consumption is only worth it for a substantially higher mean (see the discussion in Wiessner 1977).

For this reason, inter-tribal trade tends to be richly laden with ceremonial significance. Ceremony and religion are examples *par excellence* of fixed costs of exchange institutions, in the sense of imbuing certain objects or actions with additional symbolic significance for the purposes of coordination. The

¹⁴ Polanyi (1944, ch. 5) makes a similar point on inter-group trade. However, per Marwick, it is *not* the case that ‘economic man’, with his tendency to truck and barter for private advantage, is a late development in the history of mankind. Nor, on the other hand, is it the case that primitive societies can be adequately interpreted as the atomized *homines oeconomici* of modern financial markets. Rather, we find that cognitively modern man, even in his most primitive state, possesses *both* the deliberative capacity to truck and barter outside the tribe *and* the social altruism necessary to commit credibly to cooperative exchange within the tribe (Bear and Rand 2016).

ceremonial organization of exchange facilitates coordination and goodwill by sanctifying certain arrangements and removing them from the set of negotiable terms (Leeson and Suarez 2015). In other words, restricting the scope of deliberation can convert a prisoner's dilemma – i.e. the negotiation of terms afresh with every interaction – into a coordination game – i.e. convergence upon the significance of the relevant ceremonial symbols (Bear *et al.* 2017). Indeed, the more permanent and integral a particular trading relationship, the more elaborate the ceremony is likely to be (see e.g. Malinowski 1926, ch. 3).

7. Managing specialization

In a fairly small or sparsely populated society, the probability of failing to find trading partners willing to buy one's wares in sufficient quantities to safeguard against starvation is high enough that investment in most specialized human capital is not worth the risk. As the size of the trading network increases with the development of inter-group trade, groups are able to settle into permanent patterns of specialization and individuals are able to find productive ways to specialize in intra-group roles. Increased demand for particular products arises with specialization in *production*.

This section, then, describes investment in two different directions to manage incipient specialization – namely, indirect exchange, which can develop in a quasi-tribal structure, and customary accounting, which is largely a political innovation upon which economic structures can build. The later convergence of the two, with indirect exchange augmented by precise accounting, we will call *monetary* exchange.

Indirect exchange

Indirect exchange in its basic form arises out of tribal institutions as trading networks become sufficiently regularized and village populations expand beyond the cognitive limits of tribal credit. At this point we can recognize a properly Mengerian process: each agent's desire to hold some stock of the most saleable good leads the group to converge spontaneously on a single medium (or a common set of media) of exchange. But note how far along the process is already by this point: specialization is very far from an analytical primitive!

The specific set of media – cowrie shells are a well-known example (Quiggin 1949, ch. 4) – tends to originate from the same ceremonial context that previously coordinated inter-tribal trade.¹⁵ Armstrong (1924), for example, documents that ceremonial offerings at life events such as marriages and property transfer on

¹⁵ Decorative origins of these media are also attested (Szabo 2002), though in many cases adornments themselves have ceremonial origins.

Rossel Island had become regularized into routine economic transactions. The demand for these various offerings, then, gave rise to a set of 22 separate media of exchange arranged into a value hierarchy, with the use of higher-valued media still attended by a good deal of pomp and ceremony.

Though tribal credit, with its punishment strategy of personal pressure, remains important within an agent's close circle, regular contact with 'outsiders' necessitates less informationally demanding exchange practices. The convergence onto a medium (or media) of exchange enables people to offload accounting into a reified commodity, which serves as a store of value – i.e. an indication of a positive account in the balance of reciprocal altruism (cf. Kocherlakota 1996). Punishment of free-riding then consists in the simple rule: no exchange without an acceptable monetary consideration. With the advances in accounting and punishment made possible by indirect exchange, the investment of individuals in permanent specialization now creates sufficient rents to bind them to their community and prevent defection as long-term tribal obligations decline in importance.

Customary exchange

Indirect exchange does not necessarily entail numerical accounting or calculation. The history of these is bound up in a somewhat different exchange institution: customary exchange.

Customary exchange is defined by the organization of the division of labour along the lines of social station within a geographic area and under some degree of central administration. Hereditary apportionment of occupation is a frequent hallmark, such as in palace economies, slavery, feudalism or guild systems. Where indirect exchange arose out of the routine expansion of tribal institutions, customary exchange institutions became necessary with the advent of hierarchy and social stratification.

A customary exchange economy is characterized by three important aspects of symbolic convergence. First, it features advances in punishment technology, including formal law and a specialized administrative class. This class that formerly suppressed defection within one group now grows into the permanent bureaucracy characteristic of a proper legal system and suppresses defection in many groups. The groups themselves commingle, but rely on this external bureaucracy to punish the defection of other groups in order to maintain trustful relations with them. Religion also becomes more systematic and punishment-oriented as compared to tribal ceremony. A credible signal of belief in vengeful gods commits the community of believers to forswear opportunistic behaviour with exchange partners (Shariff and Norenzayan 2011; Purzycki *et al.* 2016).

Second, administrative and merchant classes make use of writing and para-writing schemes for their own internal accounting (Schmandt-Besserat 1992). This entails the development of an open-ended numerical system. By contrast,

many tribal credit societies get by with no precise numbers beyond one, two, three, many;¹⁶ and in at least one case no exact numbers at all (Everett 2005).

Third, identity rules defining social stations are important points of orientation for the larger population's exchange strategy.¹⁷ For this reason they cannot be modified except at great cost; certainly not on the initiative of any single individual who might like to change occupations. As Leijonhufvud (1977) noted,

In largely non-monetary economies, important economic rights and obligations will be inseparable from particularized relationships of social status and political allegiance and will be in the same measure permanent, inalienable, and irrevocable.

Customary exchange, with its more centralized administration of punishment, entails lower marginal costs than tribal credit. For this reason it scales up better as a method of social organization – well enough, at least, to manage a modest empire. Rather than exchanging with a particular person in the context of an ongoing relationship, agents gain the ability to trade with members of a permanent class of people who specialize in some production, without worrying about the personal history of their particular trading partners. Because the delineation of its particular elements lies outside any single mind, the division of labour can reach far greater complexity than what was possible under tribal credit organization.

Monetary exchange

Early customary exchange economies were characterized by more or less centralized administration of the distribution of goods and the division of labour. Like the accounting abilities of the individual brain in a tribal credit context, the calculative abilities of a central bureau run into inherent scale limits, for reasons later articulated in the context of modern attempts at such an institution (see Lavoie [1985] for a summary). We observe, therefore, a strong decentralizing tendency over time as early 'centrally planned' customary exchange economies run up against the cognitive limits of a single administrative hierarchy, and as private entities begin to adopt accounting technologies (Hudson 2003a).¹⁸ Paradoxically, the decline in the intricacy of administrative technique between

16 See Epps *et al.* (2012) for a survey. Greenberg (1978) links generative numerical systems (i.e. those without an upper bound) to the division of labour. Golla (2011: 219) links them to external trade using a medium of exchange.

17 Political organization along the lines of identity rules, as opposed to impersonal rules, is the key distinctive of what North, Wallis and Weingast (2009) call the 'natural state'. The administrative structures necessary to manage customary exchange are thus complementary to those necessary to manage a natural state, and for the most part the two tend to co-occur.

18 It is curious in this connection that Hudson concludes by criticizing 'modern [economic] ideology' for 'hold[ing] public planning to be inherently inefficient'. The question, of course, is efficiency *at what scale?* That something akin to palatial central planning brought ancient Mesopotamia from tribal credit to customary exchange around 2000 BC has scant relevance to industrializing or industrialized societies

ancient Sumer and ancient Greece probably reflects an increase in the intricacy of the division of labour, as important exchange and production roles devolved to private parties.

The appearance of indirect exchange within a customary exchange society, whether from emergence or adoption, takes on a different character than in a tribal context due to the existence of a system of mathematics and numerical accounting. Rather than fixed prices in value equivalency tables, the decentralization of accounting makes it possible and necessary to compare the values of an increasing variety of goods via a single unit of account and store of value – usually, in these early stages, a cow, a quantity of barley or their metallic value equivalent (Ridgeway 1892). Punishment of violence remains relatively centralized, but punishment of free-riding benefits from the simple rule of indirect exchange: no trade without money.

Calculation in terms of a unit of account embodied in a medium of indirect exchange, therefore, is an important hallmark of *monetary* exchange. Not only are there *more* profitable opportunities for specialization due to the larger pool of people to whom one can sell, but the diffusion of accounting and calculative technologies makes it possible to *more precisely identify* profitable opportunities for specialization, opportunities that could be seen only impressionistically in pre-monetary economies. And as specialization necessitates that more and more transactions be made on an outsider basis, without the benefit of ceremony, this diffusion also makes it possible to ensure against exploitation by numerically precise comparisons of income and expenditure.

8. Market prices and the mass money economy

Monetary exchange is not a sufficient condition for the economic development we enjoy in the modern world. Customary exchange shades into monetary exchange over the course of vast expanses of time; indeed, several millennia elapse between the development of cuneiform writing in ancient Sumer and the first coinage in 7th-century BC Lydia. And from the beginning of coinage, more than two millennia elapse before Europe's 'great divergence'.¹⁹ Something of the character of monetary exchange changed over the course of the 18th and 19th centuries, beginning in England and radiating out to Western Europe.

in AD 1917 or 2017, whose division of labour is orders of magnitude more complex than that of ancient Uruk. As Lavoie (1985: 61) argues:

the use of the unconscious ordering mechanism of the price system and money calculations has led to such an advance in the complexity of the social production process as a whole that it is no longer possible for the human mind [or, we might add, a palace bureau] to directly subsume this process under conscious control.

¹⁹ With periodic and sometimes extended interruptions when the volume of exchange collapsed, most notably in Europe following the fall of the Roman Empire. See the following section.

The bootstrap problem points toward an explanation. The problem is not merely to get the mutual feedback process going, but to *keep* it going, rather than settling into a mutually reinforcing equilibrium at a particular level of investment. While selection due to population pressure imparts some motion to the system, the major shift characterizing the era of economic growth – what we will call the *mass money economy* – appears to be that, at a threshold level of specialization, technology begins to propel the feedback loop: increases in specialization make it possible to develop and profitably invest in market-expanding technologies that further increase the scope for specialization, and select for higher-investment exchange institutions much more quickly than had been possible to that point.

The preconditions of mass monetization

The mass money economy is defined by the near-total displacement of customary exchange by monetary exchange, for the great majority of people and for the great majority of transactions. In order for this displacement to happen, the marginal cost of monetary exchange must be extremely low, which entails a great deal of prior investment in exchange institutions.

For the money itself, there are a number of developments in minting technology that require a relatively advanced division of labour. Coinage itself was one such development, which (if reliable) allowed the counting rather than the weighing of metallic units.²⁰ More recently the screw press, adopted in the 17th century in English and French mints, dramatically lowered the cost of coinage and increased the quality and standardization of coins. The reeded edge gave assurance that the coin had not been clipped or shaved, allowing exchanges to be conducted without high-marginal-cost haggling or verification. A coin whose quality must be haggled over is not a solid foundation for the explosion of ad hoc exchange.²¹ Advances in the reliability of the external tokens solidify the reliability of the mental operations based on them, and on the margin, more mental accounting can be offloaded onto them.

The lack of small change was another frequent impediment to the money economy's extension to smaller transactions. Especially under a bimetallic standard, the silver coins in use for small change – already too valuable for many small transactions – would periodically vacate the country due to Gresham's law, leaving only much more valuable gold coins. The issue of token coins, which solved the small change problem with some finality, required institutions

20 However, Hudson (2003b) argues coinage was sufficiently unreliable until the late medieval period that, compared to the weighing of ingots, its adoption must be thought of as a politically driven regress rather than a spontaneous cost-saving advance. On this point see also Kohn (1999).

21 Alchian (1977) argues that low informational costs (i.e. of assessing the quality) of some good are an essential quality for the emergence of money. In light of the account here, the fact that loosely standardized coinage persisted for so many centuries suggests, first of all, that the costs of evaluating non-cash goods under barter are *even higher*; and second, that the fixed costs of economic integration and standardized coinage are also extraordinarily high.

sufficiently credible to forswear over-issue (Redish 1990). The development of institutions for credibly restraining the administrative class from predation also enabled the development of liquid banking and finance institutions (North and Weingast 1989), which contributed to the stability of the value of the monetary unit (Harwick 2016) and (therefore) to the widespread use of reliable paper money.

Finally, we should not take for granted the costs of learning, not to mention teaching an entire society, to count indefinitely high and to compare two arbitrarily large numbers (Deheane 1997). In conjunction with the availability of small change, the rise of mass education following the Protestant Reformation, by raising literacy and basic numeracy (Dittmar and Meisenzahl 2016), enabled large swaths of previously excluded people to participate in the money economy. This had the effect of dramatically expanding the size of the market, and thus the potential division of labour.

Market-expanding technology

These incremental improvements, however, do not in themselves account for the epochal take-off of economic growth in the 1800s. The key difference from previous advances is that the technological investments made possible by advances in the division of labour made the mutual feedback self-propelling over that range. Transportation and communication infrastructure, for example – roads, canals and telegraphs – encouraged market integration, and therefore expansion of the size of the market once specialization became sufficiently advanced to make those investments profitable (Nye 1991). In turn, this expansion created scope for further advances in the division of labour, which made possible further market-expanding innovations and investments.

Lachmann's discussion of capital indivisibility becomes relevant in a more literal sense here, rather than simply by analogy. These are costly investments that depend on some level of permanent specialization, but they are not cognitive costs, and therefore not constitutive of an exchange institution. Nevertheless, they do redound on the marginal costs of exchange, and thus impart motion to the feedback loop. Expanded markets select for investment in higher-fixed-cost institutions – i.e. the spread and deepening of monetization – much more quickly than had been the case with population pressure. After several centuries of development along these lines, the developed world apparently has yet to exhaust the technological drivers of the feedback between specialization and the volume of exchange.

Once markets are sufficiently integrated to reach some threshold size, money gains additional cognitive significance: in addition to its inherent embodiment of accounts, money prices now reify global data on conditions of supply and demand. Whereas market prices may be observationally equivalent to customary prices in an isolated village, the rapid convergence of prices over long distances facilitates phenomenal strategic complexity with respect to resource use. As has

long been recognized in economics,²² competitive prices make available vast quantities of information in summary form, and enable agents to coordinate their plans without being consciously aware of the circumstances to which they must adjust.

Market prices are crucial in the emergence of what North, Wallis and Weingast (2009) call the ‘open access order’:²³

Limited access [i.e. customary exchange] prevents market prices from allocating resources between competing uses . . . Rather than capturing rents by charging a high price, the possessor of a privilege may exploit it by charging a low price and allocating the resource to political allies . . . When elites charge less than market clearing prices to secure political ends, the result is that prices cannot be used for impersonal coordination of the behavior of individuals. [Customary exchange] thus cripple[s] the price mechanism as a means to convey information about marginal benefits, marginal costs, and scarcity . . . Competitive use of resources has existed since the dawn of human existence, but, with a few notable exceptions (such as ancient Greece), competitive markets with prices that convey information capable of coordinating human action are a recent development.

The spread of monetization as an exchange strategy consists in the progressive substitution of ad hoc spot-exchange relationships for customary relationships. This substitution is equivalent with increasing social mobility. As Mitchell (1944) argues, echoing Simmel ([1907] 1978, ch. 4), the wide freedom in both consumption and occupation that we enjoy in the modern developed world is unthinkable without low-marginal-cost monetary exchange:

When money is introduced into the dealings of men, it enlarges their freedom . . . As a society learns to use money confidently, it gradually abandons restrictions upon the places people shall live, the occupations they shall follow, the circles they shall serve, the prices they shall charge, and the goods they can buy.

9. Institutional disinvestment

In order to avoid the impression of a Whig theory of the history of exchange, the possibility of *disinvestment* in exchange institutions must be acknowledged as well. There are numerous historical examples of such disinvestment following a collapse in the size of the exchange network. Humphrey (1985), for example, documents ‘post-monetary’ societies whose use of indirect exchange atrophies after the severing of an important trade route.

22 Hayek (1945) is the canonical statement. Mises ([1920] 1935), anticipating the subsumption of market prices under the notion of extended cognition, also refers to market prices as ‘aids to the mind’. Horwitz (1992) expands on the cognitive aspect of prices in economic coordination.

23 We may, therefore, add to their ‘take-off conditions’ a low-marginal-cost monetary system.

The most significant Western example is the increasing unreliability of the monetary unit at the fall of the Roman Empire, and later the Carolingian empire. The collapse in both international and domestic trade triggered a dramatic ruralization and spontaneous dioecism throughout Europe, and Rome's money economy to fall into disuse (Kohn 1999). Bloch's description of the rise of feudalism (1966: 250f) can be understood in these terms:

Estate management requires careful account keeping, which became more and more difficult for average administrators, in the ignorance and disorder which the great distress of the opening Middle Ages brought with it. The repeated, and almost puerile, instructions which abound in the estate ordinances of the ninth century . . . show us how hard it was for the great men to make their subordinates apply the most elementary rules of book-keeping. To adopt tenancy as a solution was the line of least resistance . . . [T]he new tone of social life and the new habits of mind were all against any effort to maintain the old, and far too complicated [i.e. high-fixed-cost], methods.

In other words, at some threshold market size between that of Roman cities and rural estates, and without a reliable monetary unit, specialization became a less attractive prospect. Enough people returned to subsistence agriculture that the whole process began to unravel, and Europe fell back for a time to an early customary exchange equilibrium. Without specialization, there was little need for a medium of indirect exchange, without which there was little need for numeracy and accounting skills. As these began to atrophy, the monetary economy became more and more defunct until feudal organization was settled into as 'the line of least resistance' – simple enough in its basic form to be conducted largely without the aid of arithmetic or money. It was not until the 12th century, when long-distance trade again began to increase the size of the market, that Europe was able to remonetize, and even then only in fits until the 17th century (Spufford 1988).

One must hope that nothing so cataclysmic awaits the developed world today. Nevertheless, the slowdown in global trade since 2010 (Hoekman 2015) and the ballooning of unfunded obligations throughout the developed world over the past half-century have the potential to trigger the 'liquidation' of prior investment in exchange institutions, and especially in those more recent institutional developments that credibly restrain political actors from manipulating their currencies too extensively in their own favour through debt monetization. Such a breakdown might necessitate, if not a return to customary exchange, at least a return to full-bodied currencies as a prophylactic against overly extensive manipulation.

10. Conclusion

Anthropologists studying tribal credit societies are often impressed by the extent of the division of labour. From a zoological perspective, the division

of labour that can be managed at essentially zero fixed institutional cost is one of humanity's great distinguishing characteristics. It impresses us, however, because the whole complex can (and indeed must) be grasped in its entirety. The division of labour characterizing modern society, although orders of magnitude more intricate than that characterizing hunter-gatherer society, fails to impress us precisely because such intricacy *does not have to be* (and indeed cannot be) grasped in its entirety by a single mind. The accounting is dispersed throughout the environment by convergence on the meaning of money. When Hayek (1945: 519) argues that 'the "data" from which the economic calculus starts are never for the whole society "given" to a single mind which could work out the implications', we might add that this is true only of those societies that have advanced beyond tribal credit. Of course, for any society which today enjoys an appreciable level of development, tribal credit lies quite a way back.

Situated at the dawn of the era of mass monetary exchange, Adam Smith (1776, bk. 1, ch. 2, §1) observed mankind's 'propensity to truck and barter', and suggested it as 'one of those original principles in human nature'. Evidence from numerous fields supports his observation. Nevertheless, the fact that humans have some disposition to solve the problems posed by regular exchange should not cause us to neglect the existence of those problems, nor the variety of institutions that exist to solve them. Humans' ability to extend their cognition into symbols in the environment opens the door to a vast array of strategies to manage the accounting and punishment necessary to coordinate exchange and the division of labour.

It is no surprise, then, that this cognitive extension is the primary driver of the advancement of human behaviour and cognition in a span much faster than could be provided in evolutionary time. This paper has offered a unifying account of this development through time in the context of an increasing returns model of exchange institutions, and shown its fruitfulness in accounting for important milestones in the history of exchange. In this sense it represents a bridge between monetary theory and the state capacity literature, approaching the former in the context of developments in the latter. Indeed, compared to the deep and detailed study of political and administrative institutions, there has been surprisingly little comparative work on exchange institutions and economic growth. It is my hope, then, that the thread of increasing returns and the division of labour being limited by the extent of the market, running from Adam Smith to Kaldor, Lachmann and North, should move to centre-stage in the explanation both of economic development and monetary exchange.

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