

Social and economic behaviour in organizations

Restricting the means of exchange within organizations

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Abstract

This paper considers why firms often ban monetary exchange between their employees, while encouraging these trades through other means, such as through the reciprocation of favours or barter. Despite classical inefficiencies associated with non-monetary exchange, we illustrate two themes as to why non-monetary trade may be preferred to allowing money. First, the use of non-monetary trade may affect the allocation of rents in surplus-enhancing ways, as agents respond strategically to the existence of these rents. Second, non-monetary trade improves the ability of agents to impose sanctions on those who act dishonestly. © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

Firms typically restrict the ability of their employees to use money for certain trades. A striking characteristic of work life is that one cannot reward individuals in cash for some things, but can compensate them in other ways. For

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instance, divisions often barter projects and employees between themselves with minimal haggling over terms; typically, the division which does not gain this time is offered the ‘next one’ in return. Thus, reciprocated favours become an acceptable and encouraged means of exchange, while explicit negotiations of cash for services is either banned or frowned upon. We believe that such exchanges of favours are the norm rather than the exception in organizational life. The purpose of this paper is to begin to understand why firms restrict the use of money for some trades, while still allowing trades to be conducted through other means of exchange.

It is a universal theme in economics that the existence of pure money facilitates exchange. Since it has less deadweight loss in its transfer than other assets, it best overcomes the famous absence of ‘double coincidence of wants’ between consumers and producers that plagues non-monetary exchange. If this is the case, why not use it for all trades, to avoid such ‘classical inefficiencies’ of barter? In this brief paper, we illustrate a number of reasons why firms may prefer to ban the use of money while allowing non-monetary exchange.¹

We begin Section 2 by setting up a simple model of exchange with two productive goods, outlining the classical inefficiencies entailed by barter, which are then weighed against certain strategic benefits enumerated by our two themes. Section 3 illustrates two examples of our first theme: that the *means of exchange affects rent-seeking in ways that are sometimes beneficial*. First, Section 3.1 considers the incentives to invest in monetized and barter settings and illustrates the possibility of better investment in barter settings. Second, Section 3.2 addresses how the exercise of monopoly power varies in monetized and barter settings, and shows how barter trade can constrain the use of monopoly power. In both cases, banning money can increase welfare. Finally, Section 4 illustrates our second theme, that *non-monetary exchange affects the willingness of individuals to cooperate in repeated interactions*.

2. Classical inefficiencies caused by the absence of money

We begin by illustrating the classical inefficiencies of barter exchange with a simple bilateral model of production and exchange that is used throughout the

¹ This paper only considers cases where a firm may *ban* the use of money by their employees for some transactions. There are, of course, other reasons why individuals eschew the use of money sometimes. For instance, there are many instances where people *choose* not to use it in exchange. For instance, in social relationships, individuals often eschew the use of money, as offering money to friends is seen as impersonal or offensive. See Prendergast and Stole (1997a,b). This paper restricts attention to economic reasons why firms do not allow their employees to exchange money with each other.

paper. At this stage, there are three assets, goods 1 and 2, and ‘money’. We then consider the allocations which arise under barter (B-allocations) – where trade only occurs over the two goods – and compare this allocation to those in which money is also exchangeable (M-allocations). Initially consider a simple barter model with two agents, $i = 1, 2$, each producing a quantity of good q_i for the other agent’s consumption at cost $c(q_i) = \frac{1}{2}q_i^2$. Importantly, these goods may be differently valued by the two agents, where the marginal value from consuming q_i by individual $j \neq i$ is v_j .

Throughout the paper, utilities are denominated in monetary units, even when the firm bans the agents from transferring money between each other.² The utility to individual i from trading q_i in exchange for q_j is $u_i = v_j q_j - \frac{1}{2}q_i^2$. The third asset is ‘money’. We characterize money as any asset which efficiently transfers utility between the agents, and to characterize a pure liquidity role for this asset, we assume that utility is linear in money with a marginal utility of unity. Hence, utility is always transferable without any *direct* efficiency consequences when money is present. We also assume that the firm can credibly ban monetary exchange if it wishes to do so.

First consider the allocation where markets are complete, so that all assets, including money, can be exchanged for one another. We call this the M-allocation. In a monetary world in which the two agents can write enforceable spot contracts for exchange, Pareto efficiency requires that $q_i^* = v_i$, for $i = 1, 2$, with joint surplus of $S^m = \frac{1}{2}(v_1^2 + v_2^2)$. We will refer to such an efficient allocation as M-efficient. Suppose instead that money cannot be exchanged for the two goods, and hence the two agents barter over $\{q_1, q_2\}$ combinations (the B-allocation). Here, the Pareto frontier associated with the monetary economy (the M-Pareto frontier) is everywhere above the barter frontier (the B-Pareto frontier), except at a single point of tangency, which occurs at the point where the slope is -1 . As such, anything which prevents the barter allocation from achieving this point will cause the B- and M-allocations to differ. Two differences are considered in the paper which generate such a barter inefficiency: differences in valuations and asymmetric bargaining power.

For simplicity, we confine our attention to the Nash bargaining solution, where each party has equal bargaining power. Straightforward calculations reveal the NBS allocation to be $q_i^{NB} = v_i^{1/3}v_j^{2/3}$, which replicates the M-allocation only if $v_1 = v_2$, i.e., where there is a double coincidence of wants. Otherwise, the allocation is B-efficient but not M-efficient. Second, even if $v_1 = v_2$, the presence

² A simple interpretation of this is that the individual utilities of the agents reflect profits to the firm, but where the agents themselves seek to maximize their own individual profits, μ_i , subject to set of goods that they can trade.

of asymmetric bargaining power will generate differences between the two allocations, since the implication of bargaining power in this case is that the allocation will not be on the 45 degree locus.³

The familiar classical inefficiency of barter is that there is underproduction of goods, as trades cannot be consummated without a double coincidence of wants (for example, consider the case where $v_1 = 0$ and $v_2 > 0$, in which case it is M-efficient for trader 1 to consume v_2 units of trader 2's output, but the B-allocation involves no trade). A less recognized but equally immediate observation is that when the barter allocation is not M-efficient, necessarily one of the two goods is marginally *overproduced* relative to the M-efficient outcome, with the other underproduced. In our setting with $v_2 > v_1 > 0$, we have $q_1^{NB} > v_1 = q_1^*$ and $q_2^{NB} < v_2 = q_2^*$.⁴

3. Theme 1: Means of exchange affect bargaining rents

The novelty of the paper arises from outlining why such classical inefficiencies may sometimes be outweighed by benefits of restricting the means of exchange.⁵ In this section, we consider how the means of exchange affects bargaining rents in ways that make banning money beneficial. First, following Cai and Milgrom (1998), we allow non-contractible investment by one party⁶ and show how banning money can induce more efficient investment by changing bargaining power. Second, we extend the apparatus in Section 2 by allowing agents to price in an inefficient monopolistic fashion. We show that such inefficient pricing may be muted in a barter economy (relative to its monetary counterpart), and hence, banning money may be efficient.

³ As a trivial example, consider the case where $v_1 = v_2 = 1$ and agent 1 has all the bargaining power, where he makes a take-it-or-leave-it offer to the other. The M-allocation is $q_1 = q_2 = 1$. By contrast, the B-allocation is given by $q_1 = 2^{-1/3} < 1$ and $q_2 = 2^{1/3} > 1$ (remember that agent 1 consumes good 2).

⁴ Economically, one can think of the overproduced good, q_1 , as serving two roles – a classical production–consumption role (with a marginal return of $v_1 - q_1$) and a liquidity role (with a marginal return of $(v_1/q_2)(v_2 - q_2)$). In the latter role, the good has marginal value in facilitating the trade of the undertraded good, q_2 .

⁵ In each of these cases, there is a similar conceptual framework. In each of the settings below (and unlike the last section), the B-allocation is characterized by more than one incomplete market, where allowing a market for money still implies a single remaining source of market incompleteness. Therefore, each of our examples is in the same spirit of the theory of the second best (Lipsey and Lancaster, 1956), where completing a single market need not improve welfare.

⁶ See Cai and Milgrom (1998) for the multilateral investment case in the context of committee decision making.

3.1. Non-contractible investments

We begin with our initial model with $u_i = v_j q_j - \frac{1}{2} q_i^2$, $i = 1, 2$, $i \neq j$. Suppose now that agent 1 has an opportunity to invest in increasing v_2 , his marginal utility of consumption. Investments are costly and are made prior to any enforceable contract regarding trade.

Consider the M-allocation for any fixed level of investment. The joint trading surplus (gross of investment costs) with monetary exchange is $S^M = \frac{1}{2}(v_1^2 + v_2^2)$ and the Nash bargaining solution provides player 1 with (gross) pay-offs of one-half of social surplus: $u_1^M = \frac{1}{4}(v_1^2 + v_2^2)$. Hence, the social marginal return to investment is v_2 , while the private return is only $\frac{1}{2}v_2$. The familiar underinvestment result from the incomplete contracts literature emerges. One feature of the Nash bargaining solution with money is that the share of surplus earned is $\frac{1}{2}$, independent of contributions.

Now consider B-allocations. First, joint (gross) surplus is $S^B = \frac{1}{2}(v_1^{4/3} v_2^{2/3} + v_1^{2/3} v_2^{4/3})$ which is lower than that under monetary exchange for any fixed v_1 and v_2 (unless $v_1 = v_2$). Thus the familiar classical inefficiency remains. The private (gross) payoff to trader 1 is $u_1^B = \frac{1}{2} v_1^{2/3} v_2^{4/3}$, where, importantly, the share of surplus attained by agent 1 is $v_2^2 / (v_1^2 + v_2^2)$, which now depends on investments.

This effect in itself leads to greater returns to investment than when money is allowed, as the agent now invests as a way of extracting a greater share of rents. To see the isolated impact of this effect, consider the case where $v_1 \approx v_2$, i.e., where there is a double coincidence of wants and $S^M \approx S^B$. The marginal return in consumption-enhancing investment is $\frac{2}{3} v_1^{2/3} v_2^{1/3}$, which in the neighborhood of $v_1 \approx v_2$ is $\frac{2}{3} v_2$ – an improvement in incentives over the monetary environment, $\frac{1}{2} v_2$. Thus the desire to extract rents in this neighborhood implies strictly higher incentives to invest in a barter setting than with money.⁷ In short, the absence of money generates an incentive for the investing party to invest in technologies which make utility transfers from the other party to the investing individual more efficient. When such investment is also socially efficient, barter takes on a beneficial effect.

In general, it is not possible to show that the incentives to invest are higher under barter than with money, as the classical inefficiencies of barter also affect the incentive to invest. Consequently, whether the investment level under barter exceeds or falls short of the level under monetary allocations depends on

⁷ Note that in this case, those investments which increase rents also increase surplus. It should be stressed that this may not generally be the case. In particular, suppose that instead of investing in v_j , agent i has the opportunity for cost-cutting investment. In that case, by investing in reducing costs, the agent passes bargaining power in the B-allocation to the other party as he renders utility transfers easier to that party. As a result, non-monetary exchange would have harmful strategic effects in addition to the classical inefficiencies.

parameter values. However, it is straightforward to generate examples where return investing in a barter environment is enough to encourage the investment but where it would not be undertaken with money, and where the joint surplus generated by the investment exceeds the classical barter losses.⁸

3.2. Monopoly pricing

In this section, we illustrate how the willingness of agents to exploit their bargaining power depends on the medium of exchange (Ellingsen and Stole, 1996; Prendergast and Stole, 1998a,b). We extend the basic model by (i) allowing private information over valuations and (ii) assigning asymmetric bargaining power. First, suppose our two agents have privately known independent valuations for each other's goods. These valuations are high, $v = \bar{v}$, with probability ϕ or low, $v = \underline{v}$, with probability $1 - \phi$. Traders can consume up to one unit of production, $q \in [0, 1]$. For simplicity, we also assume that there are constant marginal costs of cq .⁹ As before, we consider two trading environments: money and barter. To model bargaining power, we design an extensive form bargaining game in which the only change under barter is that the strategy spaces for offers is appropriately restricted to only goods. In particular, we assume that with equal probability, one of the two traders is selected to make a take-it-or-leave-it-offer (possibly an elaborate trading mechanism) to the other; the respondent either accepts the offer and the resulting pay-offs induced by the terms, or rejects the offer thereby ending the game with zero pay-offs for both traders.

Suppose that $\phi(\bar{v} - c) > \underline{v} - c > 0$, so the optimal action by a monopoly seller in a monetized setting is to price at \bar{v} . In the monetary version of this trading game, the agent with bargaining power will offer the following two-part contract, where either item can be accepted: (i) supply one unit at price of $p = c$ and (ii) sell one unit at price $p = \bar{v}$. The first part of the contract is always accepted, while the agent accepts the second component only if he has the high valuation. The expected distortion from this mechanism is the expected distortion from monopoly pricing on one good, i.e., $(1 - \phi)(\underline{v} - c)$.

Now consider the barter environment. Again, an optimal offer consists of a single pair of quantities which will be swapped. The agent can guarantee acceptance from both type of consumers in the barter setting if he offers c/\underline{v} of his

⁸ As an example, consider the case where $v_1 = v_2 = 1$ before and $v'_1 = \frac{3}{2}$ after a discrete investment with cost I . Under the monetary allocation the utility of agent 1 is increased by investing from 0.50 to 0.81, the Nash Bargaining Solution with money. This increase is not sufficient to induce investment if $I > 0.31$. However, under barter his share increases to 0.86; if $I < 0.36$, this increase in utility is enough to induce investment, so that the optional institution bans money for $0.36 > I > 0.31$.

⁹ This assumption allows us to ignore the complications of non-linear pricing which is never optimal in a two-type monetary or barter world with constant returns to scale.

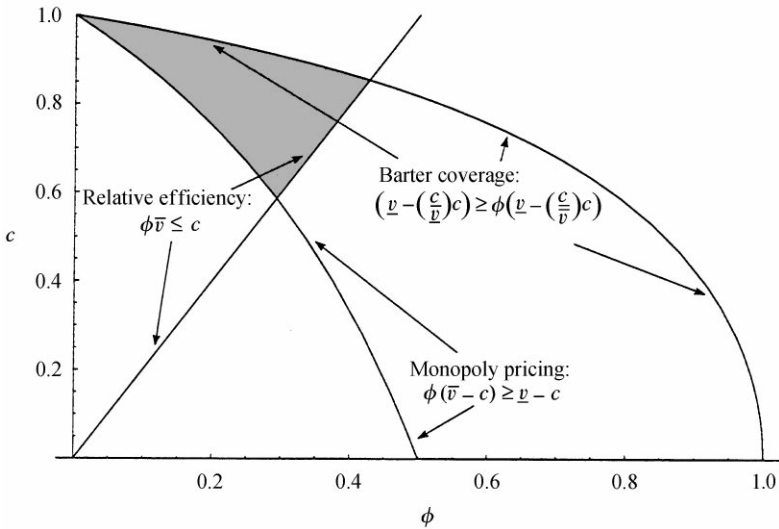


Fig. 1.

good in return for a full unit of his good, or he can offer c/\bar{v} , where the offer is acceptable only to those with type \bar{v} . Providing that $(\underline{v} - (c/\bar{v})c) \geq \phi(\underline{v} - (c/\bar{v})c)$, the offering agent will always¹⁰ cover the entire market (rather than offer c/\bar{v}).¹¹ If $\underline{v} > c$, this condition is nested with respect to the monopoly constraint with money; this implies that there is always a non-empty set of $\{v, \bar{v}, c, \phi\}$ for which all types consume some output under barter, but do not do so in a monetized allocation, because barter exchange generates less aggressive rent seeking behavior. However, since the agent with the bargaining power need only offer the other a fraction c/\underline{v} of his good, there is a classical barter inefficiency of $(1 - c/\underline{v})(E[v] - c)$. Since the expected inefficiency in a monetary setting is $(1 - \phi)(\underline{v} - c)$, barter is then strictly preferred to monetary exchange if and only if $c > \phi\bar{v}$.

The various regions are illustrated in Fig. 1 for $\underline{v} = 1, \bar{v} = 2$, where the shaded region illustrates the cases where barter exchange dominates the monetized allocation.

¹⁰ We show the incentive compatibility constraint for type \underline{v} . If this type covers the market, so also will type \bar{v} .

¹¹ In other regions with partial barter coverage, monetary exchange dominates barter.

4. Theme 2: The means of exchange affects cooperation

So far, we have assumed that agents can credibly commit to the delivery of promised goods. However, a central theme of the economic literature over the last two decades has been the possibility that future promises are not credible, and that some mechanism of enforcement may be necessary. Accordingly, in this section we consider a version of our initial model where favours are offered over time, but where agents cannot credibly promise to deliver goods unless it is in their interest to do so at that point of time. We show that the agents may wish to ban money as money can reduce the incentives of agents to cooperate intertemporally.¹²

We make a number of changes to the basic setting in Section 2. First, we assume that the agents trade favours over time in a setting where in the absence of money, there is never a double coincidence of wants. However, we also assume that intertemporal contracts for promises of delivery of goods in the future are not feasible; instead, agents must find it incentive compatible to provide goods at the point at which they are asked to do so. Second, we assume that the quality of some goods is unknown to the demander when he receives them.¹³ In particular, the quality of these goods can only be determined by consumption, which occurs immediately after their receipt. We call such goods *non-contractible*.

More specifically, we now allow two types of goods: k goods are contractible, or more precisely, their characteristics are perfectly observable to the buyer at the time of trade; and n goods which are non-contractible (their characteristics are unobservable to the buyer at the time of trade, but become observable upon consumption).¹⁴ To be clear, contractible goods can be verified, but a static double-coincidence-of-wants is still required to guarantee efficiency within spot markets. We consider a continuous time model in which in any given interval of time, dt , there is some probability $\lambda_i dt$ that one agent will have a demand for the other's production of good i . Let q_k and q_n represent the levels of trade in the two goods following the relevant demand realizations and let surplus in each state be

¹² The effect of money on punishments builds on related ideas in Prendergast and Stole (1998b), Kranton (1996), Baker et al. (1994), Di Tella (1998), Bernheim and Whinston (1998) and Schmidt and Schnitzer (1995). Additionally, the idea that monetary payments can pool incentive compatibility constraints is considered in MacLeod and Malcolmson (1989).

¹³ Suppose that the non-contractibility of trade is the only source of market incompleteness. The most efficient barter allocation is characterized by the standard repeated game where the degree of patience determines the extent of trade. Then the introduction of money can only improve allocations, for the reason that money completes all markets where agents simply pay for the goods they require with money. Thus, non-contractibility alone cannot offer a role for efficient non-monetary exchange, so we also assume non-contractibility of the quality of some goods.

¹⁴ Formally, an agent can offer the other a low quality non-contractible good which is observationally identical before consumption, but which has cost and value 0.

given by $s_i(q_i) = v_i q_i - \frac{1}{2} q_i^2$, $i = k, n$. Thus, λ_k and λ_n denote the respective probabilities of demand arising for each type of good. Note that because the probabilities of demand follow a Poisson process, with probability 1 there is a lack of a static double-coincidence-of-wants in the absence of money. Finally, let r denote the common discount rate for the traders. To simplify, we assume that the preference and arrival rates of demand are symmetric between the traders and that the marginal valuation of consumption of contractible and non-contractible goods is identical: $s_n(q) = s_k(q) = s(q)$.¹⁵

4.1. Cooperative barter equilibria

Initially consider the allocation without money. Since agents have no contemporaneous incentive to deliver goods, a suitable punishment must be designed for those who fail to satisfy their obligations in the implicit contract. We consider the maximal credible punishment here, which consists of excluding the agent from all future trade. Then the incentive compatibility constraints for each trader who is called upon to deliver either q_k or q_n (depending upon which good is demanded) are

$$\frac{1}{r} [\lambda_k s(q_k) + \lambda_n s(q_n)] \geq \max \{c(q_n), c(q_k)\}. \quad (1)$$

In short, each trader must receive more in present value expected returns from cooperation than from refusing to deliver the appropriate good, q_i .

We restrict our attention to trading allocations which maximize social welfare using equal welfare weights for each individual, subject to the above incentive compatibility condition. It is straightforward to demonstrate that in our barter environment, there is a critical discount factor $\hat{\delta} = 1/(1 + \hat{r})$ such that for all $\delta < \hat{\delta}$, the optimal traded quantities are $q_k = q_n < q^* = v$, less than the M-efficient level and strictly increasing in δ , while for all $\delta \geq \hat{\delta}$, the first-best allocation is obtainable: $q_k = q_n = q^*$.

4.2. Cooperative money equilibria

The introduction of money has a number of effects in the model. Most immediate, the introduction of money allows a static double-coincidence of wants if quality is observable to the buyer at the time of trade. Hence, M-efficient trades of the contractible goods will always emerge with money. However, there are two additional effects. The first is that money reduces the punishment path

¹⁵Note that subscripts now refer to the type of good being traded; because we will focus on symmetric equilibria in trading games in which there is symmetry in preferences between agents, we can ignore the agent subscript used above.

between the traders following a breach of the implicit agreement. With the presence of money, M-efficient trades of the contractible goods will always emerge both on and off the equilibrium path of the game: agents cannot credibly be excluded from trade in the contractible good, even if they fail to satisfy their obligations on the non-contractible good.¹⁶ Instead, the expected present value of surplus at risk from breach is simply $(\lambda_n/r)s(q_n)$, the value of trade on the non-contractible.

The second additional effect from introducing money is more subtle: because money provides a static double-coincidence of wants, the traders may be able to relax their incentives to cooperate on the non-contractible good by offering voluntary transfers of money following the supplier's provision of an appropriate quality good. More formally, the agents can pool their incentive compatibility constraints on the provision of non-contractibles using monetary payments. To see this, note that the existence of money allows the consumer to be called upon to make an immediate money transfer, t , to the producer after determining if the good was high quality. In that case, there are two relevant incentive compatibility constraints for a given trade: (i) $(\lambda_n/r)s(q_n) \geq c(q_n) - t$, for the supplier of the good, and (ii) $(\lambda_n/r)s(q_n) \geq t$, for the consumer, who must voluntarily make the transfer of t after identifying its quality. Maximizing the expected present value of the traders' joint surplus requires that t is chosen such that both constraints bind jointly, if at all. This implies that trade is (weakly) maximized at $t = c(q_n)/2$ and the relevant incentive compatibility constraint is simply

$$\frac{\lambda_n}{r} s(q_n) \geq \frac{c(q_n)}{2}. \quad (2)$$

Hence, the equilibrium to the trading game with money can be characterized by a critical value of $\tilde{\delta}$ such that if $\delta < \tilde{\delta}$, $q_n < q_n^* = v$, and otherwise q_n is at its M-efficient level; $q_k = q_k^* = v$ for all δ .

4.3. *The effect of money in an environment of reciprocal exchange*

To understand the implications of these effects, we need to determine whether (2) is a tighter constraint than (1) for the non-contractible good, which is determined by whether λ_n exceeds λ_k or not. As shown in Prendergast and Stole (1998b), the net effect of these implications is as follows. First, if $\lambda_n > \lambda_k$, then money is always valuable and should never be banned. More interestingly, if

¹⁶ If one party can make any trading suggestion following a breach of any implicit contract, then q_k will be traded efficiently for cash following breach. What this implies is that if the shared surplus following breach is symmetric, the surplus generated from trading q_k is not relevant for the trader's incentive compatibility condition.

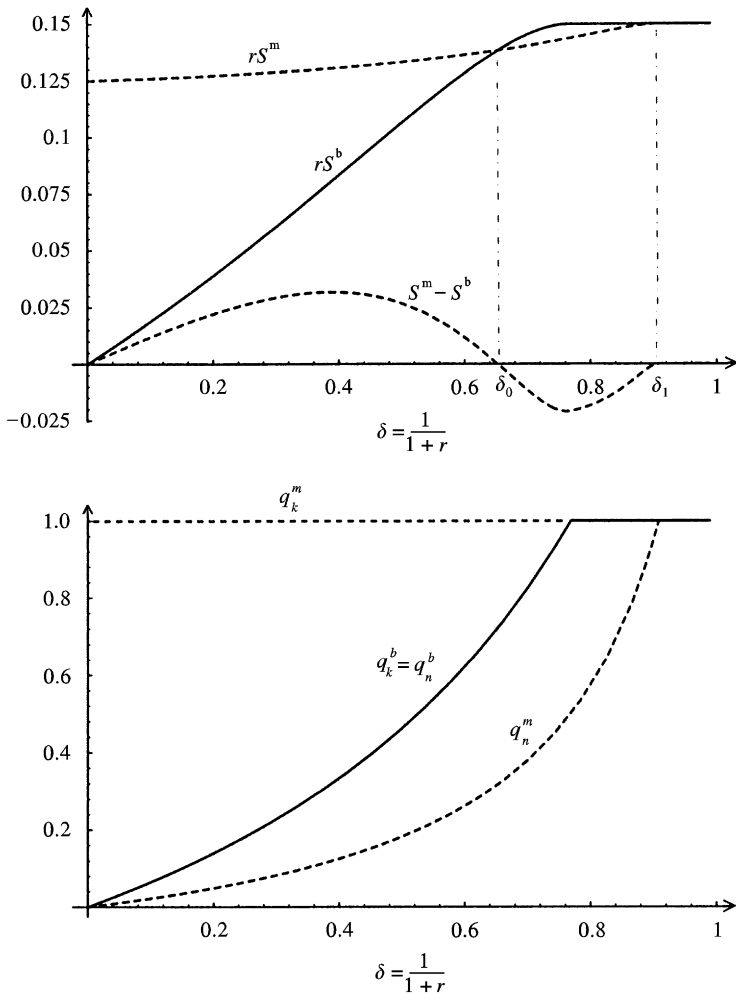


Fig. 2.

$\lambda_n < \lambda_k$, then there exist three regions of discount factors – $[0, \delta_0)$, $[\delta_0, \delta_1)$ and $[\delta_1, 1]$ with distinct outcomes. For low discount factors, $\delta \leq \delta_0$, monetized trade is superior to bartered trade because cooperation is largely unsupported in the barter setting, and the advantages of producing a double coincidence of wants on contractible goods dominate. For sufficiently high discount factors, $\delta \geq \delta_1$, the introduction of money has no effect as either regime will generate first-best trades; there is no need for a static double coincidence of wants. However, for moderate discount factors, between δ_0 and δ_1 , the introduction of

money always reduces trading surpluses as the reduction in cooperation from monetizing q_k trade more than offsets the elimination of the classical inefficiencies, so that banning money is efficient.¹⁷

These outcomes are illustrated in Fig. 2, where we consider the case where $v_i = 1$, $\lambda_n = 0.05$ and $\lambda_k = 0.25$, so that we are considering the range of parameters ($\lambda_n < \lambda_k$) where monetizing trade can be harmful. The surplus from the relationship is plotted on the upper figure while in a barter environment the lower figure maps traded quantities. Note that the effect of money on total surplus $S^m - S^b$ depends on the discount factor as described above.¹⁸

5. Closing remarks

Economist tend to extol the virtues of monetary exchange. However, they typically ignore the fact that many trades in monetized societies do not involve the use of money, either by choice (as in social relations) or by fiat (as in many of the cases within firms). The purpose of this paper has simply been to highlight some effects of the means of exchange within firms which go beyond documenting the standard classical inefficiencies of barter.

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¹⁷ This analysis leaves many unanswered questions, which space considerations do not allow us to address. Foremost among these in this section is the ability of firms to commit to the means of exchange for their employees. This is a particularly acute problem in instances where the agents want to commit not to use money. We implicitly assume that the firm can make such a commitment, both on and off the equilibrium path. However, conditional on the implicit contract breaking down, the firm would like to renegotiate to allow money transfers, thus causing our results to break down. We feel that there are a number of (conjectured) reasons why such commitment may be possible, including the achievement of social norms and the fact that the firm may be unable to observe a breakdown of trading relations (at least temporarily) in such a way as to make such a commitment, which will be considered in future work.

¹⁸ See Kranton (1997), Prendergast and Stole (1998b), Baker et al. (1994) and Bernheim and Whinston (1997) for other applications.

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