Globalization, Market Efficiency, and the Organization of Firms*

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Abstract

We develop a matching model in which bilateral bargaining between agents is inefficient due to the presence of private information about the gains from trade. Globalization, by reducing market frictions, increases the probability that bilateral trade breaks down but also reduces the costs of such breakdowns. Overall, a fall in market frictions reduces welfare if the initial level of market frictions is high and it increases welfare otherwise. Firms respond to the increased probability of trade breakdowns caused by globalization by adopting more flexible vertical structures that make it less costly for them to transact with third parties, for instance by switching from vertical integration to outsourcing, thereby further increasing the probability of trade breakdowns.

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1 Introduction

The last few decades have witnessed a substantial fall in trade barriers, unprecedented advances in information technologies, and the collapse of centrally planned and inward looking political systems. This 'globalization' of the world economy has made it easier for firms to locate consumers, workers, and suppliers in national and international markets. In spite of the apparent gains made possible by these developments, not all are happy to live in a more globalized economy, as demonstrated resolutely by activists in Seattle, Genoa, and other cities. In particular, some of the skeptics point to the fact that globalization can lead to instability in existing relationships and thereby cause potentially severe disruptions to the working of the economic system.

Besides occupying a prominent place in the media,[1] this claim has been the object of a limited number of recent contributions in the economics literature. In particular, Scheve and Slaughter (2002) use U.K. survey data to show that perceived job insecurity has increased substantially in recent years, especially for workers in sectors with a large presence of multinational enterprises. A special issue of the Journal of Labor Economics (1999) provides some evidence that, when considering actual rather than survey data, the instability of labor relationships has indeed increased for some worker groups over the last few decades. Rodrik (1997) argues that globalization, by limiting the scope for product prices adjustments in small economies, increases the elasticity of labor demand and thus job insecurity in these economies.

In addition to this alleged increase in the instability of established relationships, substantial, and possibly better documented, changes have taken place in the vertical structure of firms. There is in fact a growing body of evidence – see Grossman and Helpman (2001, 2002) for a discussion – indicating that over the last few decades the organization of production in many industries has been characterized by a marked increase in the number of production stages that are outsourced. Some authors – e.g. Thesmar and Thoenig (2002) – have argued in turn that this increase in outsourcing might have further contributed to the increase in the instability of economic relationships.

In this paper we analyze a matching model in which agents have private information about their gains from trade and show that these developments are indeed consistent with the reduction in market frictions caused by globalization. Our analysis focuses on the well-known inefficiency that arises when two agents bargain with each other

[1]See McLaren and Newman (2002) for a discussion of some journalistic accounts of the effects of globalization on the stability of existing economic relationships.

over the sharing of potential gains from trade in the presence of private information – see, in particular, Myerson and Satterthwaite (1983). Our aim is to analyze how this inefficiency, and the institutional arrangements that agents design to minimize it, depend on the level of market frictions. We first show that a fall in market frictions reduces the probability that agents agree on efficient trades and, as a result, can lead to welfare losses. We then show that firms respond to the increase in instability caused by a fall in market frictions by adopting more flexible vertical structures, for instance by abandoning vertically integrated structures and outsourcing production stages involving the use of supplier specific assets. This organizational response by firms, in turn, further increases the observed instability of existing vertical relationships.

To understand the intuition of our results, consider two agents who bargain with each other over potential gains from trade in the presence of private information and suppose that, because of market frictions, it takes time for these agents to find alternative trading partners should the decide not to trade with each other. A fall in market frictions then has two opposing welfare effects. One the one hand, it is welfare enhancing since, in the case of disagreement, it makes it easier for agents to find new trading partners. On the other hand, however, precisely because it makes disagreement less costly, it has the negative welfare effect of increasing the incentives for opportunistic behavior by agents with private information, making trade in existing relationships less likely to occur in the first place. We show that the latter effect dominates if the initial level of market frictions is high and the former effect dominates if the initial level of market frictions is low. In other words, the relationship between welfare and the level of market frictions is typically U-shaped. This suggests that the transition from a rather slow and/or mainly local market to a slightly faster and/or more global market can entail substantial welfare costs, as it introduces instability in trading relationships without providing agents with sufficient alternative trading opportunities to offset this negative effect. Only if the improvement in the market mechanism is substantial enough is it actually welfare improving.

To see the implications of our model for the vertical structure adopted by firms in market equilibrium, suppose now that, before bargaining over the price of a specific input, the buyer and the seller can take actions to make themselves more or less dependent on each other. In particular, they can make themselves more dependent on each other by agreeing on 'inflexible' vertical structures that reduce the profits they can realize if they disagree in the future. This can be achieved, for instance, by vertical integration of production stages involving the use of supplier specific assets. Analogously, they can make themselves less dependent on each other by agreeing on 'flexible' vertical structures that increase the profits they can realize if they disagree in the future. This can be achieved, for instance, by outsourcing production stages involving the use of supplier specific assets. The choice between these vertical structures involves a clear trade-off: flexible vertical structures, by increasing the disagreement payoffs, make the parties better off when they do not trade, but they also reduce the probability of trade, whereas inflexible vertical structures have exactly the opposite effects. The way in which the agents resolve this trade-off, and thus the vertical structure that we observe in market equilibrium, depends crucially on the level of market frictions. We show that if market frictions are severe, agents adopt the most inflexible vertical structure. They do so since this maximizes the probability that they will trade with each other, which, given the high cost of finding an alternative trading partner, is very important for them. If, instead, the level of market frictions is low, agents adopt the most flexible vertical structure so as to maximize their disagreement payoffs. This is optimal for them since they know that, given the low cost of disagreement, opportunistic behavior is going to make disagreement in the future very likely, independently of the vertical structure that they adopt.

Our analysis therefore predicts that, as a consequence of the fall in market frictions caused by globalization, firms change from inflexible to flexible vertical structures by, for instance, outsourcing production stages involving the use of supplier specific assets that were previously carried out in-house. As already mentioned, this organizational response by firms further increases the observed instability of vertical relationships since it makes disagreement even less costly and thus even more frequent. Finally, note that our analysis of the welfare implications of a fall in market frictions is not essentially altered by this change in the vertical structure of firms, as it is still the case that a moderate fall in market frictions can cause welfare losses when the initial level of frictions is high.

Our paper is related to recent contributions by McLaren and Newman (2002) and Ramey and Watson (2001).[2] In both these papers a reduction in market frictions increases the instability of existing relationships, but the mechanisms through which this happens is different from the one that operates in our model. McLaren and Newman (2002) focus on a situation in which the incomes of risk averse workers and firms are subject to random idiosyncratic shocks. Since income realizations are not

[2]Note that McLaren and Newman (2002), Ramey and Watson (2001), and our model are, to the best of our knowledge, the only ones in the the vast literature on matching and search theory - see Mortensen and Pissarrides (1999) for a complete survey – in which an increase in the matching rate can have possible negative welfare effects.

verifiable by third parties, explicit insurance contracts between the parties are not enforceable, and workers and firms resort to implicit mutual insurance contracts that can be privately enforced in a long-term relationship by the use of trigger strategies. An increase in the matching rate makes it less costly for either party to renege on the implicit commitment to insure the other party, leading to less mutual insurance and greater economic instability. Ramey and Watson (2001) focus instead on a situation in which firms have to give workers incentives to exert high effort, and they can do so by investing in technologies that increase the relative gains from exerting high effort over exerting low effort. Since, all else equal, an increase in the matching rate makes it easier for workers to shirk, firms have to compensate by increasing their initial investment, and this over-investment is the source of welfare losses.

Our paper is also related to the literature on the rate at which the inefficiency caused by private information is reduced when the number of buyers and sellers in a market increases – see, for example, Satterthwaite and Williams (1989a, 1989b) and Rustichini, Satterthwaite, and Williams (1994). However, whereas these contributions consider a centralized market that is cleared by a fictional auctioneer, we study a decentralized market in which trade takes place in bilateral meetings.

In our analysis of the organization of firms, we adopt the general conceptual framework of the property rights theory of the firm, as developed by Grossman and Hart (1986) and Hart and Moore (1990). In particular, we follow this literature in assuming that contracts are incomplete, defining ownership as a residual control right, and taking asset ownership to be the defining characteristic of firms. There are, however, two main differences between our approach and that taken in most of that literature. First, instead of considering two agents in isolation, we study how their choices depend on their continuation utility in the general equilibrium of a matching market. A second, and more fundamental, difference concerns the nature of the inefficiency on which we focus. Most of the property rights literature assumes that bargaining between agents is efficient and studies the role of asset ownership in determining ex-ante investment inefficiencies. In contrast, we abstract entirely from ex-ante investment inefficiencies and focus instead on the role of asset ownership in determining ex-post bargaining inefficiencies. There are only very few papers in the property rights literature that analyze the role of asset ownership in determining ex-post bargaining inefficiencies and Matouschek (2002) is the closest to ours.[3] In the present paper we build on the partial

[3]Another contribution to the property rights literature that considers ex-post inefficiencies is Hart and Moore (1998), who study the design of a firm's constitution when ex-post asymmetric information prevents recontracting.

equilibrium property rights theory of the firm introduced in that paper to develop a dynamic general equilibrium model within which to study the effects of a fall in market frictions on welfare and the vertical structure of firms. Grossman and Helpman (2001, 2002) and McLaren (2000) also develop property rights models of vertical structure in a general equilibrium setting, but, in the Grossman-Hart-Moore tradition and in contrast to our paper, they focus on ex-ante investment inefficiencies.

The rest of the paper is structured as follows. In the next section we develop a basic pure exchange model with asymmetric information. In section 3 we extend this basic model by allowing for asset ownership and analyze the optimal vertical structure of firms. The purpose of the first two sections is to present the most parsimonious framework in which the trade-offs that we discussed in the introduction arise. To this purpose we sacrifice generality in exchange for simplicity by assuming one-sided asymmetric information, a simple and exogenously given bargaining game, and uniform distributions of the individual gains from trade. In section 4 we relax these simplifying assumptions and show that the results of the basic model continue to hold in much more general environments. Section 5 concludes.

2 A Simple Pure Exchange Model

In this section we develop and analyze a model of pure exchange in a matching market in which bilateral trade takes place in the presence of private information. Our main objective is to characterize how the welfare of a representative agent depends on the level of market frictions.

2.1 Structure of the Model

We consider a dynamic market in which time is discrete and runs indefinitely. All agents are risk-neutral, liquidity unconstrained, and discount the future by a factor $\delta \in [0, 1]$ per period. At the beginning of each period t, a unit mass of new agents enters the market, where they join those agents who entered the market in previous periods and have not left yet. Half of the newly born agents are sellers and half are buyers. Upon being born all agents are randomly matched with a trading partner. However, should they fail to trade during their first period in the market, at the beginning of all subsequent periods t each agent is randomly matched with a new counterpart with probability $m \in [0, 1]$. Low values of m characterize a market in which frictions are severe. Each seller can produce only one unit and each buyer needs only one unit of the good. It is common knowledge that the sellers can produce at zero cost and that the buyers' valuations π are uniformly distributed on $[\alpha, 1+\alpha]$, where $\alpha \in [0,1]$. The higher the parameter α, the higher the potential gains from trade between a seller and a representative buyer. [4]

After having been matched with a seller, each buyer learns the realization of his valuation π_t. The uninformed seller then makes the buyer a take-it-or-leave-it price offer p_t. If the buyer accepts, trade takes place and both agents leave the market permanently. If the buyer rejects the offer, trade does not take place, the match is dissolved, and the seller and the buyer remain in the market until period $t+1$. At the beginning of period $t+1$ each agent is randomly matched with a new trading partner with probability m, the buyer observes a new realization π_{t+1} of his valuation, and the sequence of events that we have just described repeats itself.[5]

We denote the expected utility of a seller and a buyer who are unmatched at the beginning of time t by $U_{s,t}$ and $U_{b,t}$, respectively, and we define $U_t \equiv U_{s,t} + U_{b,t}$. We instead use $V_{s,t}$ to denote the expected utility of a seller who is matched at the beginning of period t but does not yet know if the price he asks for will be accepted or not. Analogously, $V_{b,t}$ denotes the expected utility of a buyer who is matched at the beginning of period t but does not yet know his type. We also define $V_t \equiv V_{s,t} + V_{b,t}$.

2.2 Disagreement Payoffs and the Expected Value of a Match

Consider a representative buyer-seller match at time t. Denote by $D_{s,t} \geq 0$ and $D_{b,t} \geq 0$ the payoffs that the seller and the buyer, respectively, realize if they do not trade at time t, and define $D_t \equiv D_{s,t} + D_{b,t}$, $D_t \in [0, \overline{D}]$. These disagreement payoffs are endogenous in this model, as they are given by the expected value of going on the market at time $t+1$ in search for another partner, which in turn depends on m and on the equilibrium strategies being played by other agents. However, we start to solve

[4] The results that we discuss below continue to hold for $\alpha > 1$. We rule out these parameter values since, when the gains from trade are sufficiently large (i.e. when $\alpha > 1$) there exist (low) values of the disagreement payoffs for which all types of agents agree to trade with probability one. Although this would not constitute a problem for our analysis, our aim is to use the simplest possible set-up in which bargaining can be inefficient due to private information.

[5] Assuming that buyers draw new realizations of their valuations at the beginning of every period greatly simplifies our analysis, as it implies that all buyers have the same expected continuation utilities and that the distribution of types in the market is exogenously given. A possible, and rather realistic, interpretation of this assumpton is that the valuation of all buyers is affected by the same random aggregate shock at the beginning of each period, but the realization of this aggregate shock is not perfectly known to the sellers on the other side of the market.

the model by taking the disagreement payoffs $D_{s,t}$ and $D_{b,t}$ as given. This allows us to study in a simple way the effects of a change in disagreement payoffs on the strategies and welfare of a pair of matched agents. After having characterized how the value of a given match depends on any exogenously given $D_{s,t}$ and $D_{b,t}$, we will solve for the market equilibrium by allowing $D_{s,t}$ and $D_{b,t}$ to assume their endogenous values. In what follows, we also assume that $\overline{D} \leq (1+\alpha)$, which implies that at least for some buyer's types it is efficient to trade.[6]

If the uninformed seller makes a price offer p_t, this offer will be accepted by the buyer if and only if $\pi_t - p_t \geq D_{b,t}$. Given that π_t is uniformly distributed on $[\alpha, \alpha+1]$, the seller knows that by offering p_t she will sell the good with probability $(1+\alpha - D_{b,t} - p_t)$.[7] Therefore her expected profit from offering a price p_t is

$$p_t(1+\alpha - D_{b,t} - p_t) + D_{s,t}(p_t + D_{b,t} - \alpha).$$

This profit is maximized by choosing an optimal price

$$p_t^* = \frac{1}{2}(1+\alpha + D_{s,t} - D_{b,t}), \tag{1}$$

which implies that the threshold valuation π_t^* above which a buyer accepts and below which a buyer rejects the optimal seller's offer is

$$\pi_t^* = \frac{1}{2}(1+\alpha + D_t). \tag{2}$$

Since $D_t < (1+\alpha)$ for all D_t, we have that $\pi_t^* > D_t$. Therefore, the existence of private information makes it so that some potential trades – i.e. all those involving buyers with π_t's such that $D_t < \pi_t < \pi_t^*$ – that would generate a positive surplus are not carried out in equilibrium.[8] Also note that equation (2) implies that the probability that trade takes place, and thus the extent of the inefficiency, depend only on the sum of the disagreement payoffs and not on their distribution between the buyer and the seller. In particular, if D_t increases, at least one of the agents adopts a more aggressive

[6]The upper bound $\overline{D}$ on the aggregate disagreement payoffs will depend in equilibrium on the discount rate δ and will be shown to be always less than the value of the highest possible utility generated by a match, i.e. $(1+\alpha)$.

[7]It is straightforward to verify that, provided that $\alpha \leq 1$ as we assume here, it is never optimal for the seller to offer a price $p_t \leq \alpha - D_{b,t}$ that would be accepted by every type of buyer.

[8]Note that this corresponds to the well-known inefficiency generated by a producer with market power in the absence of price discrimination.

bargaining strategy – i.e. sellers offer higher prices and/or buyers are more likely to reject any given offer – and the probability $(1 + \alpha - \pi_t^*)$ that a given representative match results in trade decreases.

We can now use the results above to write the expected value $V_t = V_{s,t} + V_{b,t}$ of a representative match as

$$V_t(D_t) = D_t + \mathrm{E}\left[(\pi_t - D_t)q(\pi_t, D_t)\right], \tag{3}$$

where $q(\pi, D_t)$ is the probability that a buyer of type π_t accepts the seller's optimal offer given their joint disagreement payoffs D_t and is given by

$$q(\pi_t, D_t) = \begin{cases} 1 & \text{if } \pi_t \geq \pi_t^*, \\ 0 & \text{if otherwise.} \end{cases}$$

In the rest of this section we characterize how the expected value V_t of a match depends on D_t. As can be seen from equation (3), a marginal change in D_t affects expected welfare in two opposing ways. On the one hand, for a given probability q of trade, a marginal increase in D_t is welfare enhancing, as it allows the agents to realize a higher payoff when they do not trade. On the other hand, this marginal increase in D_t induces the seller and the buyer to bargain more aggressively and thus reduces the probability q that ex-post efficient trades take place, which is welfare reducing. To understand under which conditions either effect dominates, we compute $\mathrm{E}\left[(\pi - D_t)q(\pi, D_t)\right]$ explicitly in (3) to obtain

$$V_t(D_t) = D_t + \frac{3}{8}(1 + \alpha - D_t)^2. \tag{4}$$

We can use this expression to establish the following lemma.

Lemma 1 *The expected value V_t of a representative match is decreasing in D_t for $(\alpha - D_t) \geq 1/3$ and increasing in D_t for $(\alpha - D_t) \leq 1/3$.*

Proof. This is proved in a straightforward manner by differentiating (4) with respect to D_t to obtain $\partial V_t / \partial D_t = 1/4[1 - 3(\alpha - D_t)]$. ■

The result of Lemma 1 is illustrated graphically in Figure 1, that depicts V_t as a function of D_t. If $D_t \leq \alpha - 1/3$, the value V_t of a representative match is decreasing in the sum D_t of the agents' disagreement payoffs. This is because, when the average

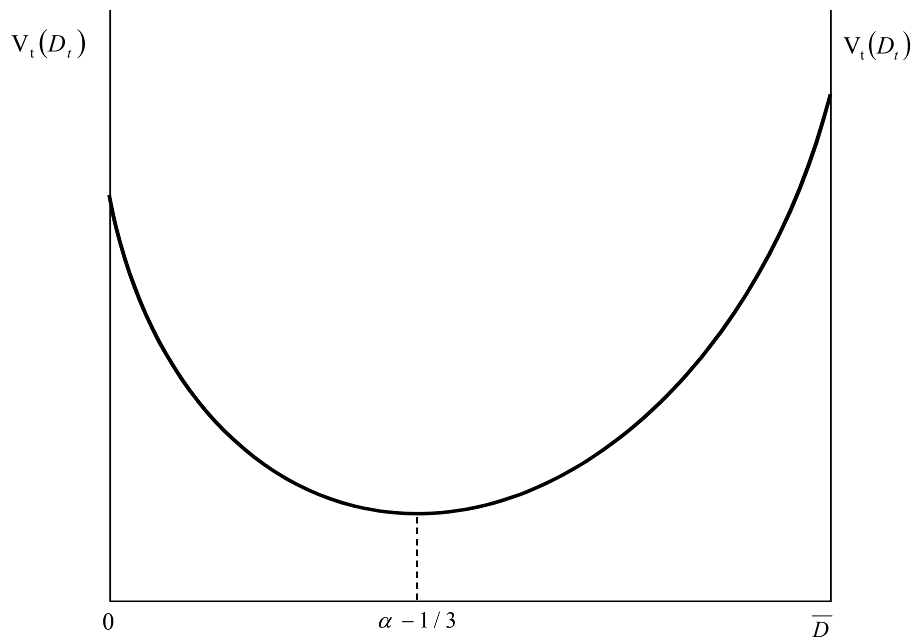

Figure 1: Value of a representative match and disagreement payoffs.

gains from trade $(\alpha - D_t)$ are sufficiently large,[9] the probability that the agents fail to trade, and therefore have to resort to their disagreement payoffs, is low. This implies that the expected marginal benefit of an increase in D_t is not very large and is offset by the negative marginal effect that an increase in D_t has on the probability of trade. If, instead, $D_t \geq \alpha - 1/3$, the expected value of a match V_t is increasing in D_t. The reason is that, when the average gains from trade $(\alpha - D_t)$ are sufficiently small, the probability that the agents fail to trade is high, and it is therefore very important that they have high disagreement payoffs D_t. Finally, note that if $\alpha \geq 1/3 + \overline{D}$ the average gains from trade are so large that V_t is everywhere decreasing in D_t, whereas if $\alpha \leq 1/3$ the average gains from trade are so small that V_t is everywhere increasing in D_t.

Having established how the value V_t of a representative match depends on the sum D_t of the disagreement payoffs, we now proceed to endogenize the value of D_t and study how the welfare of a representative agent depends on the level of market

[9]The exact value of the average gains from trade is $[1 + (\alpha - D_t)]^2/2$, that is strictly increasing in $(\alpha - D_t)$.

frictions in the steady-state equilibrium of our matching model.

2.3 Steady-state Market Equilibrium

When we embed the representative buyer-seller pair studied above in our matching market, the disagreement payoffs at time t become endogenous and are given by the discounted expected utility of an agent who is unmatched at the beginning of period $t+1$. Recall that we denote this expected utility by $U_{s,t+1}$ for the seller and by $U_{b,t+1}$ for the buyer, with $U_{t+1} \equiv U_{s,t+1} + U_{b,t+1}$. We can thus set $D_{s,t} = \delta U_{s,t+1}$ and $D_{b,t} = \delta U_{b,t+1}$, which implies that the sum of the disagreement payoffs is $D_t = \delta U_{t+1}$. Equation (3) can therefore be written as

$$V_t = \delta U_{t+1} + \mathrm{E}\left[(\pi - \delta U_{t+1}) q(\pi, \delta U_{t+1})\right]. \tag{5}$$

In order to solve for the steady-state value V of a representative match in equation (5) we still need to derive a relationship between V_t and U_{t+1}. Consider the expected utility $U_{i,t}$ of an agent $i \in \{s, b\}$, who is unmatched at the beginning of period t. This agent finds a match in period t with probability m, in which case his expected utility becomes $V_{i,t}$, or he remains unmatched with probability $(1-m)$, in which case he has to wait until period $t+1$, at the beginning of which he will have expected utility $U_{i,t+1}$. Therefore we can write

$$U_{i,t} = mV_{i,t} + (1-m)\delta U_{i,t+1}. \tag{6}$$

In a steady-state equilibrium $U_{i,t} = U_{i,t+1} = U_i$ and $V_{i,t} = V_{i,t+1} = V_i$, therefore (6) implies the following steady-state relationship between $U = U_s + U_b$ and $V = V_s + V_b$:

$$\delta U = \mu V, \quad \text{where} \;\; \mu \equiv \frac{m\delta}{1 - \delta(1-m)}. \tag{7}$$

In the rest of the paper we study the effects of changes in m for given δ. Since μ is strictly increasing in m, we will focus on changes in $\mu \in [0, \delta]$ rather than directly on changes in m, as this greatly simplifies notation.[10]

[10]Note that although market frictions are lower when m is larger, they vanish completely if and only if $\delta \to 1$. Therefore, if $\delta < 1$, our market does not approach the competitive equilibrium when $m \to 1$.

Before proceeding to analyze how V depends on μ in steady-state, it is useful to establish the following lemma.

Lemma 2 *The steady-state aggregate disagreement payoff $D = \mu V$ of a representative match is everywhere increasing in μ.*

Proof. Consider the steady-state version of equation (5) for $V_t = V$ and $U_{t+1} = U$ at all t. Since (7) implies that in steady-state $\delta U = \mu V$, we can re-write the left hand side of (5) as $V = \delta U/\mu$, and, by rearranging terms, we obtain

$$\frac{\delta U}{\mathrm{E}\left[(\pi - \delta U)q(\pi, \delta U)\right]} = \frac{\mu}{1-\mu}.$$

Since the left and the right hand sides are strictly increasing in δU and μ, respectively, we conclude that in equilibrium $D = \delta U = \mu V$ is increasing in μ. ■

This lemma establishes that a reduction in market frictions makes disagreement less costly for agents, as it increases the value $D = \mu V$ of their continuation utility. Substituting $D = \mu V$ in (4), we obtain

$$V = \mu V + \frac{3}{8}(1 + \alpha - \mu V)^2. \tag{8}$$

Note that since every agent is born as a seller or as a buyer with equal probability and is matched with certainty upon being born, V is (twice) the expected lifetime utility at birth of a representative agent in our economy. We therefore take V as being the appropriate welfare criterion to use in our analysis. In the following proposition we use Lemmas 1 and 2 to characterize the relationship between μ and the steady-state utility V of a representative agent.

Proposition 3 *The steady-state expected utility at birth V of a representative agent is decreasing in μ for $0 \leq \mu \leq \tilde{\mu}$ and increasing in μ for $\delta \geq \mu \geq \tilde{\mu}$, where $\tilde{\mu} = (3\alpha - 1)/(3\alpha + 1)$.*

Proof. The total derivative of V with respect to μ can be written as

$$\frac{\mathrm{d}V}{\mathrm{d}\mu} = \frac{\mathrm{d}V}{\mathrm{d}D}\frac{\mathrm{d}D}{\mathrm{d}\mu}$$

From Lemma 2 we know that $\mathrm{d}D/\mathrm{d}\mu > 0$, therefore sign $(\mathrm{d}V/\mathrm{d}\mu) =$ sign $(\mathrm{d}V/\mathrm{d}D)$. Lemma 1 implies that $\mathrm{d}V/\mathrm{d}D = 0$ if and only if there exists a $D \in [0, \overline{D}]$ such that

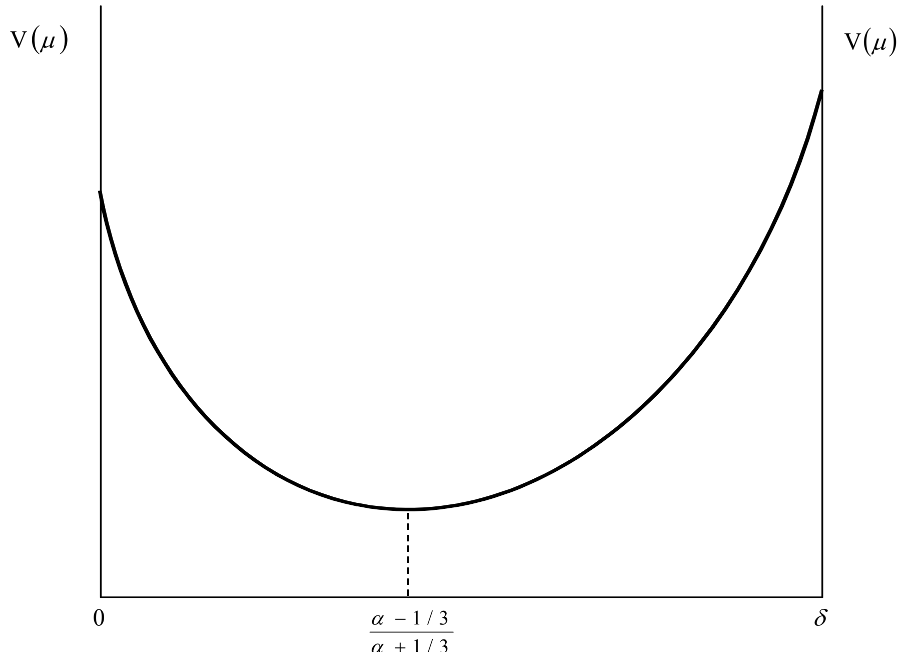

Figure 2: Steady-state welfare and market frictions.

$D = \alpha - 1/3$. In steady-state $D = \mu V$ and we define $\tilde{\mu}$ as that value of μ such that $\tilde{\mu}V = \alpha - 1/3$, which, making use of (8), yields $\tilde{\mu} = (3\alpha - 1)/(3\alpha + 1)$. Finally, note that if $\alpha < 1/3$, then we set $\tilde{\mu} = 0$ and V is everywhere increasing in μ; whereas if $(\alpha - 1/3)/(\alpha + 1/3) > \delta$, then we set $\tilde{\mu} = \delta$ and V is everywhere decreasing in μ. ■

The result of Proposition 3 is illustrated graphically in Figure 2, that depicts the steady-state utility at birth V of a representative agent as a function of μ. The interpretation of Figure 2 is similar to that of Figure 1. If the gains from trade for an average buyer-seller match are sufficiently large, which is the case when $\mu \leq \tilde{\mu}$, the welfare of a representative agent is decreasing in μ. Intutitively, when the average gains from trade are large, most agents trade, therefore the beneficial effect of an increase in μ is not very important relative to its negative effect on the probability of trade. If, instead, the gains from trade in a match are sufficiently small, which is the case when $\mu \geq \tilde{\mu}$, the welfare of a representative agent is increasing in μ. This is because, when the average gains from trade are on average small, there is a high probability that a representative agent does not trade in any given match. It therefore becomes very important that she can easily have another opportunity to trade in the next period, which is the case when μ is high. Finally, note that when $\alpha \geq (1+\delta)/3(1-\delta)$, the average gains from trade are so large that V is everywhere decreasing in μ, whereas if $\alpha \leq 1/3$ the average gains from trade are so small that V is everywhere increasing in μ.

The general message of our analysis is therefore that, in the presence of private information, the effects of an increase in the matching rate on the welfare of a representative agent depends crucially on the average gains from trade in the market. If these are very small, an increase in the matching rate is unambiguously beneficial. If, however, these are very large, the opposite result obtains, because the decrease in the probability of trade caused by an increase in the matching rate has much more severe negative consequences on efficiency. For intermediate values of the average gains from trade, we can instead conclude that the first phases of the transition from no market exchange at all to some limited degree of market exchange can lead to a decrease in the welfare of agents in the economy. In this case, the average agent benefits from an increase in the market matching rate only if this increases very substantially or if it is sufficiently high to start with.

3 A Simple Model with Asset Ownership

So far we have assumed that the seller can engage in production without using any physical assets. Clearly, in the real world firms do use physical assets. We now extend the above model and assume that the seller needs a physical asset to engage in production. We use this framework to analyze how different ownership structures affect the bargain inefficiency described above, derive the optimal ownership structure chosen by agents in market equilibrium, and show how this optimal ownership structure depends on the level of market frictions.

3.1 Structure of the Model with Asset Ownership

The basic structure of the model presented in this section is the same as that introduced in section 1. In particular, the characteristics of buyers and sellers, the matching process, and the rules of the bargaining over the price of the good to be traded – which is now best thought of as a specific input – remain the same as above. However, we now assume that a machine is required to produce one unit of the specific input. In particular, upon having been matched in period t and before private information is revealed, a buyer and seller acquire this machine and contract over who owns it. We allow the agents to choose any ownership structure $A_t \in \mathcal{A}$, where $\mathcal{A}$ denotes the set of all possible ownership structures. Since the agents are risk neutral and liquidity unconstrained, they choose the ownership structure that maximizes their joint surplus and share this surplus evenly.[11] Furthermore, we suppose that the machine depreciates completely after one period, so that a machine purchased in period t is worthless in period $t+1$.[12] After the agents have agreed on a given ownership structure the buyer learns his type and the seller makes a take-it-or-leave-it price offer. If the buyer accepts, the seller uses the machine to produce one unit of the specific input, trade takes place, and both agents leave the market permanently. If the buyer rejects the seller's offer, trade does not take place, and the match is dissolved.

In contrast to the model of section 2, we now allow the agents to use the machine to produce a general purpose input after the match has been dissolved. This general purpose input can only be transacted with third parties on a competitive market. We also assume that contracts specifying the allocation of property rights on the asset cannot be renegotiated after private information is revealed.[13] The payoffs that the agents realize by producing and selling the general purpose input depend therefore on who owns the machine, that is they depend on the contractually specified ownership structure. As will be explained further below, this might be the case because the machine can be specific to the human capital of one of the parties. We denote these payoffs by $a_{b,t} = a_b(A_t) \geq 0$ for the buyer and $a_{s,t} = a_s(A_t) \geq 0$ for the seller, assume that they are commonly known, and define the aggregate payoff as $a_t = a(A_t) \equiv a_b(A_t) + a_s(A_t)$. Furthermore, we denote by $\overline{A}$ and $\underline{A}$ the ownership structures that maximize and minimize $a(A_t)$, respectively, define $\overline{a} \equiv a(\overline{A})$ and $\underline{a} \equiv a(\underline{A})$, and assume that $\overline{a}/(1-\delta) < (1+\alpha)$, so that trading the specific input instead of producing the general purpose input at all times is profitable for at least some types. After having realized these payoffs from transacting with third parties, the buyer and the seller

[11] Note that, since at the time of contracting over the ownership of the asset the agents have no private information yet, the results of the model do not depend in any way on the specific sharing rule that they adopt at this stage.

[12] We make this assumption in order to simplify the anaysis. It should, however, be noted that this assumption has some important consequences, as it makes the choice of the ownership structure by a given supplier-downstream firm match in a given period independent of the distribution of ownership structures that will prevail in the market in the future. In this sense, our analysis does not capture the market-thickness effects studied in McLaren (2000) and Grossman and Helpman (2002). An extension of our model in this direction is left for future research.

[13] See Matouschek (2002) for a discussion of this assumption.

remain in the market until period $t+1$ and the sequence of events that we have just described repeats itself.

Note that we continue to assume that any agent who is not matched in period t realizes a zero payoff in that period. Thus agents who are matched but decide not to trade realize weakly higher payoffs than agents who are not matched. Although we do not model them explicitly, there are a number of straightforward justifications for this assumption. For instance, one can imagine that the agents make contractible, asset-specific investments after they agree on the ownership distribution but before they bargain over the price of the good and that these investments make the asset more valuable outside of the relationship.[14]

3.2 Market Equilibrium with Asset Ownership

In this model the ownership structure only determines the disagreement payoffs that the agents realize when they are matched but do not trade. The aggregate disagreement payoffs of a buyer and a seller that are matched at time t and have agreed on ownership structure A_t are given by

$$D_t = a_t + \delta U_{t+1}. \tag{9}$$

The aggregate disagreement payoffs D_t now depend both on the 'outside value of the asset' a_t, that the agents can choose at the beginning of period t by contracting over the ownership structure, and on the level of the continuation utility δU_{t+1}, that the agents take as given. In what follows we solve for the optimal outside value a_t of the asset rather than the optimal ownership structure A_t. That is, we proceed as if the agents could contract directly over the outside value of the asset and solve for that $a_t \in [\underline{a}, \overline{a}]$ that they agree on in equilibrium. Once we have done this, it will be straightforward to back out the optimal ownership structure that gives rise to this payoff and that is thus chosen in equilibrium.

Consider a buyer and a seller who are matched in period t and have contracted over the outside value a_t of the asset at the beginning of the period. Given the aggregate disagreement payoff D_t that this implies, the seller offers the price p_t^* given by (1),

[14] An alternative justification would be to assume that purchasing the machine is profitable if agents are matched (since there is a chance that they realize a profitable trade with each other) but it is not profitable if they are not matched (the return that can be obtain from transacting the general purpose input with third parties does not in itself cover the cost of the machine).

and therefore the expected value of this representative buyer-seller match is as given in (4). Since the buyer and the seller are risk neutral and liquidity unconstrained they agree ex-ante on the ownership structure that maximizes the expected value V_t of their match, that is they choose $a_t = a_t^*$ such that

$$a_t^* = \arg\max_{a_t \in [\underline{a}, \overline{a}]} V_t(a_t + \delta U_{t+1}).$$

We focus on steady-state equilibria in which every buyer-seller pair chooses the same a_t^* and p_t^* at all t, that is on equilibria in which $a_t^* = a_{t+1}^*$, $p_t^* = p_{t+1}^*$, $U_t = U_{t+1}$, and $V_t = V_{t+1}$ at all t. Before proceeding to solve for the steady-state equilibrium of the model, it is useful to establish the following lemma.

Lemma 4 *The optimal outside value of the asset chosen by the agents at time t is $a_t^* = \overline{a}$ if and only if*

$$\delta U_{t+1} \geq \alpha - \frac{\underline{a} + \overline{a}}{2} - \frac{1}{3},$$

and $a_t^* = \underline{a}$ otherwise.

Proof. From the proof of Lemma 1 it is straightforward to verify that $V_t(D_t)$ is convex. Since $D_t = a_t + \delta U_{t+1}$, this implies that, for any given δU_{t+1}, V_t is maximized at either $a_t^* = \underline{a}$ or $a_t^* = \overline{a}$. Therefore, the optimal outside value of the asset chosen by the agents at time t is $a_t^* = \overline{a}$ if and only if

$$V_t(\overline{a} + \delta U_{t+1}) \geq V_t(\underline{a} + \delta U_{t+1}),$$

and $a_t^* = \underline{a}$ otherwise. Making use of (4) we therefore conclude that $a_t^* = \overline{a}$ if and only if

$$\delta U_{t+1} \geq \alpha - \frac{\underline{a} + \overline{a}}{2} - \frac{1}{3},$$

and $a_t^* = \overline{a}$ otherwise. ■

Figure 3 gives an intuitive representation of the result obtained in Lemma 4. This figure is essentially the same as Figure 1 and depicts the value of a buyer-seller match $V_t(D_t)$ as a function of the disagreement payoffs, that are now given by $D_t = a_t + \delta U_{t+1}$. Note that the agents take their continuation utility δU_{t+1} as given and choose contractually the optimal outside value a_t of the asset. First, it is clear that, for any given δU_{t+1}, the agents always maximize V_t by choosing either $a_t = \underline{a}$ or $a_t = \overline{a}$. To

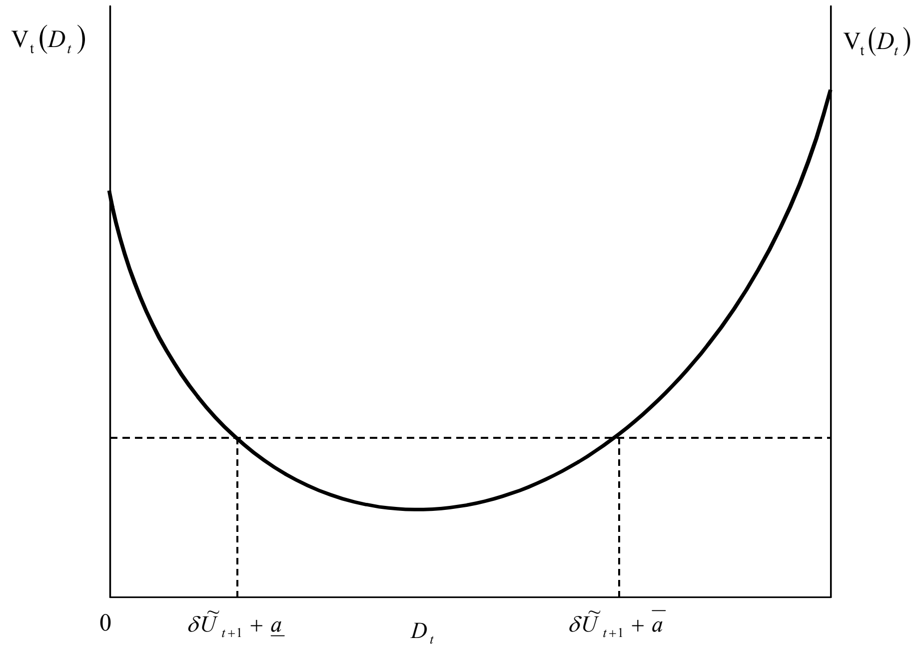

Figure 3: $\delta\tilde{U}_{t+1}$ and the otimal outside value a of the asset.

see which of these two values is optimal, consider that value $\delta\tilde{U}_{t+1}$ of the continuation utility at which the value of a buyer-seller match is the same for $a_t = \underline{a}$ and for $a_t = \overline{a}$. If $U_{t+1} > \tilde{U}_{t+1}$ the value V_t of the relationship is higher for $a_t = \overline{a}$ than for $a_t = \underline{a}$, since the distance $(\overline{a} - \underline{a})$ remains constant. The opposite result obtains when $U_{t+1} < \tilde{U}_{t+1}$.

Having established how the value of the continuation utility δU_{t+1} affects the choice of the optimal outside value of the asset, we proceed to solve for the steady-state equilibrium of the model. In a steady-state equilibrium $\delta U_{t+1} = \delta U = \mu V$. Furthermore we know from Lemma 2 – which can be shown to hold also in the model of this section – that μV is everywhere increasing in μ. Therefore the continuation utility is increasing in μ, and changes in μ will have an effect on a_t^*. The following proposition characterizes how the optimal outside value of the asset chosen by the agents depends on the level of market frictions μ.

Proposition 5 *The unique steady-state equilibrium outside value of the asset is*

$$a^* = \begin{cases} \underline{a} & \text{if } \mu \in [0, \tilde{\mu}], \\ \overline{a} & \text{if } \mu \in [\tilde{\mu}, \delta]. \end{cases}$$

where

$$\tilde{\mu} \equiv \frac{\alpha - (\overline{a} + \underline{a})/2 - 1/3}{2 + 6\alpha + (9/16)(\overline{a} - \underline{a})^2}.$$

Proof. In a steady-state equilibrium $\delta U_{t+1} = \delta U = \mu V$ at all t, thus Lemma 4 implies that $\overline{a}$ is a steady-state equilibrium if and only if

$$\mu V \geq \alpha - \frac{\underline{a} + \overline{a}}{2} - \frac{1}{3}, \tag{10}$$

where V solves the steady-state version of (4) for $D = \overline{a} + \mu V$. Since μV is strictly increasing in μ, this implies that $\overline{a}$ is a steady-state equilibrium outside value of the asset if and only if $\mu \geq \max\{0, \tilde{\mu}\}$. An analogous reasoning shows that $\underline{a}$ is a steady-state equilibrium outside value of the asset if and only if $\mu \leq \min\{\tilde{\mu}, \delta\}$. Finally, in the knife-edge case in which $\mu = \tilde{\mu}$, both $\underline{a}$ and $\overline{a}$ constitute an equilibrium. The equilibrium is otherwise unique. ■

Proposition 5 implies that the ownership structure chosen by the agents in a steady-state equilibrium depends crucially on the expected gains from trade in a representative buyer-seller relationship. These gains from trade are large if market frictions are severe and if the profit from producing and trading the specific input with the current partner over producing and trading the general purpose input with third parties are on average high – i.e. if $[\alpha - (\underline{a} + \overline{a})/2]$ is high. That is, the gains from trade are large (small) when μ is small (large) relative to $\tilde{\mu}$. Recall that in our model when the average gains from trade are large, the agents are very likely to trade and the total effect of an increase in the disagreement payoffs on the value of a representative match is negative. Therefore when the average gains from trade are large – i.e. when $\mu \leq \tilde{\mu}$ – the agents optimally agree on an ownership structure that further decreases the value of their disagreement payoffs and thus further reduces the incentives for opportunistic behavior. They do so by choosing an inflexible ownership structure that minimizes the payoffs from trading with third parties, that is by choosing $a = \underline{a}$. On the contrary, if the gains from trade are small – i.e. if $\mu \geq \tilde{\mu}$ – then the agents are very likely to disagree, and it is therefore very important for them to adopt an ownership structure that maximizes their profit from trading with third parties, which they do by choosing $a = \overline{a}$.

3.3 Vertical Integration and Outsourcing

So far we have discussed ownership structures in abstract terms without describing what particular type of ownership structures could minimize or maximize aggregate disagreement payoffs. We have shown that when market frictions fall, the equilibrium vertical structure of production changes from inflexible to flexible. We now discuss what particular types of ownership structure can give rise to these different degrees of flexibility. Suppose, for instance, that the machine is specific to the seller's human capital, that is the seller is more efficient than the buyer at using it. This may be the case because the seller makes human capital investments to learn how to best use it. Then the outside value a of the asset is maximized if the seller owns the machine, that is if the production process is characterized by outsourcing, since if the agents fail to trade the specialized input, the seller can still use the machine efficiently to produce the general purpose input that he can transact with third parties, obtaining a payoff of $\overline{a}$. Conversely, the outside value of the asset is minimized if the buyer owns the asset, that is if production is carried out by a vertically integrated firm. In this case, if trade between the agents breaks down, the buyer does not know how to use the machine efficiently and the seller does not have access to the machine, with the consequence that the machine is worthless outside the relationship (hence $\underline{a} = 0$).

In this instance, Proposition 5 implies that the agents choose to vertically integrate if market frictions are severe, i.e. if $\mu \leq \tilde{\mu}$, whereas they choose to resort to outsourcing if $\mu \geq \tilde{\mu}$. In our model, outsourcing has the disadvantage of increasing the probability of opportunistic behavior by the agents, leading to possible disruptions in the production process, but it also has the advantage of giving the parties more flexibility in exploiting outside market opportunities. When market frictions fall, the latter becomes relatively more important than the former and we should observe a larger number of industries to be characterized by outsourcing.

In section 2 we have shown that globalization, by reducing market frictions, increases the probability that bilateral trade breaks down and thus makes existing relationships less stable. In the present section we have shown that a reduction in market frictions also induces firms to change the organization of production from vertical integration to outsourcing . Note that this organizational response by firms 'amplifies' the effects of globalization on the instability of existing relationships. The reason is that, when μ grows above $\tilde{\mu}$, firms switch from in-house production to outsourcing, which makes disagreement even less costly and thus even more frequent. Notwithstanding the increase in observed instability that it implies, from a normative point of view this organizational change is welfare improving, as firms always choose the ownership structure that maximizes the value of productive relationships. Also note that our analysis of the welfare implications of a fall in market frictions presented in section 2 is not essentially altered by this change in the vertical structure of firms, as it is still the case that a moderate fall in market frictions can cause welfare losses when the initial level of frictions is high.

4 A General Model

The above analysis provides a very simple framework to analyze how bilateral bargaining inefficiencies depend on market frictions and what this implies for the optimal vertical structure of firms. The model contains two key simplifying assumptions. First, it assumes that, at the bargaining stage, the uninformed agent makes a take-it-or-leave-it offer. This assumption allowed us to model bargaining inefficiencies even when there is only one-sided asymmetric information. One may wonder, however, why the agents cannot agree ex-ante to use to another, more efficient, bargaining game. For instance, they could solve any ex-post bargaining inefficiency by committing ex-ante to a bargaining game in which the informed agent gets to make a take-it-or-leave-it offer. If this were possible, exchange would always be efficient and reductions in the search frictions would be unambiguously welfare improving. Also, agents would always agree on the ownership structure that maximizes their aggregate disagreement payoff. While ex-ante contracting over the ex-post bargaining game can resolve the bargaining inefficiency in the case of one-sided asymmetric information, this may not be the case once both agents have private information (see Myerson and Satterthwaite (1983)). We now extend the analysis of sections 2 and 3 and show that our key results continue to hold if the agents can contract ex-ante over the ex-post bargaining game once we allow for two-sided asymmetric information.

A second simplifying assumption in the above model is that the buyer's valuation is uniformly distributed. We now also extend the analysis by allowing for more general distributions of the agents' gains from trade.

4.1 The Structure of the General Model

The market matching process of the general model in this section is identical to that of the simple model presented in sections 2 and 3. However, we now allow for more general distributions of the buyers' and sellers gains from trade and for two-sided private information about the realizations of these gains from trade. Furthermore, we assume that upon being matched in period t a buyer and a seller can contract over the bargaining game that they will play ex-post to determine the terms of trade. We allow the agents to choose any balanced budget bargaining game. Since the agents are liquidity unconstrained and risk-neutral they choose the bargaining game that maximizes the expected value V_t of their match. After the agents have contracted over the bargaining game, the buyer privately learns his valuation $\pi \in [\underline{\pi}, \overline{\pi}]$ and the seller privately learns her cost $c \in [\underline{c}, \overline{c}]$. The buyer's valuation π and the seller's costs c are drawn from the cumulative distributions $F(\pi)$ and $G(c)$, respectively, with continuous and strictly positive density functions $f(\pi)$ and $g(c)$. We also assume that these distributions satisfy the monotone hazard rate condition, with $f(\pi)/[1 - F(\pi)]$ being increasing at all π and $g(c)/G(c)$ being decreasing at all c. Finally, we assume that $\overline{\pi} - \underline{c} > 0$ and $\underline{\pi} - \overline{c} < 0$, so that the agents cannot be certain about the existence of gains from trade, but can expect these to exist in at least some matches.

After having privately learned their types, the buyer and the seller can decide whether or not to participate in the bargaining game over which they have contracted ex-ante. If either of the agents decides not to participate, the match is dissolved and both agents remain in the market until period $t+1$. If both agents decide to participate, they make offers according to the rules specified in the contractually chosen bargaining game. If these offers lead to agreement, the good is exchanged and both agents leave the market permanently. If instead bargaining results in disagreement, trade does not take place, the match is dissolved, and the seller and the buyer remain in the market until period $t + 1$.

4.2 Disagreement Payoffs and the Expected Value of a Match

As in section 2, we proceed by focusing on a representative match at time t and initially treat the disagreement payoffs $D_{b,t}$ and $D_{s,t}$, with $D_t \equiv D_{b,t} + D_{s,t}$, as given. In the next sections we will then allow the value of D_t to be endogenously determined in market equilibrium.

As explained above, upon being matched, the buyer and the seller choose that bargaining game, among all possible budget balanced bargaining games, that maximizes the ex-ante value of their match. Instead of studying the very large set of all possible indirect budget balanced bargaining games from which the agents can choose, we can restrict our attention, without loss of generality, to the set of all Bayesian incentive-compatible direct mechanisms. This is because of the well-known Revelation Principle which states that, for any Bayesian Nash equilibrium of any bargaining game, there exists a Bayesian incentive compatible direct mechanism that leads to the same outcome (see Myerson (1979, 1981)). Following this logic, we suppose that, after having privately learned their types, the buyer and the seller make announcements $\widehat{\pi}$ and $\widehat{c}$, respectively, of their valuation and cost parameters. Given these announcements, a direct mechanism specifies the probability $q(\widehat{\pi},\widehat{c})$ that trade takes places and the expected price $p(\widehat{\pi},\widehat{c})$ that the buyer has to pay if trade takes place. The agents therefore choose ex-ante that direct mechanism that maximizes the value V_t of their match, that is they choose that $\langle q(\cdot),p(\cdot)\rangle$ that solves

$$\max_{\langle q(\cdot),p(\cdot)\rangle} V_t = D_t + E_{\pi,c}\left[(\pi - c - D_t)q(\pi,c)\right] \tag{11}$$

subject to incentive compatibility and interim individual rationality constraints (to be specified below).

The incentive compatibility constraints ensure that each agent finds it optimal to make truthful announcements of his or her type and the interim individual rationality constraints ensure that, after privately learning their types, the agents prefer participating in the bargaining game to realizing their disagreement payoffs.

The next lemma, which follows directly from Myerson and Satterthwaite (1983), formally describes the incentive compatibility and interim individual rationality constraints mentioned above.

Lemma 6 (Myerson and Satterthwaite, Theorem 1) *There exists a transfer rule $p(\cdot)$ such that the mechanism $\langle q(\cdot),p(\cdot)\rangle$ is interim individually rational and incentive compatible if and only if $E_c\left[q(\pi,c)\right]$ is non-decreasing in π, $E_\pi\left[q(\pi,c)\right]$ is non-increasing in c, and*

$$E_{\pi,c}\left[\left(\pi - c - D_t - \frac{1-F(\pi)}{f(\pi)} - \frac{G(c)}{g(c)}\right)q(\pi,c)\right] \geq 0 \tag{12}$$

Proof. This lemma corresponds to Theorem 1 in Myerson and Satterthwaite (1983) and we refer the reader to their proof. Note that Myerson and Satterthwaite denote the seller's reservation price by v_1 and the buyer's reservation price by v_2. In our case these are given by $c + D_{s,t}$ and $\pi + D_{b,t}$, respectively. ■

The following lemma, that also follows directly from Myerson and Satterthwaite (1983), describes the optimal trading rule that solves (11).

Lemma 7 (Myerson and Satterthwaite, Theorem 2) *The optimal mechanism that solves (11) is given by*

$$q(\pi, c) = \begin{cases} 1 & \text{if } \pi - c \geq D_t + \frac{\lambda(D_t)}{1+\lambda(D_t)} \left(\frac{1-F(\pi)}{f(\pi)} + \frac{G(c)}{g(c)} \right) \\ 0 & \text{otherwise,} \end{cases}$$

where the multiplier $\lambda(D_t) > 0$ *is such that (12) holds with equality.*

Proof. This lemma corresponds to Theorem 2 in Myerson and Satterthwaite (1983) and we again refer the reader to their proof. ■

Note that the probability $q(\pi, c)$ that a buyer with valuation π and a seller with cost c trade is decreasing in D_t. In other words, when D_t increases some marginal types with low π's or high c's do not trade anymore. To emphasize this dependence of q on D_t, in what follows we will write $q(\pi, c, D_t)$. Having made this observation, we can write the expected value of a representative buyer-seller match as

$$V_t(D_t) = D_t + \mathrm{E}_{\pi,c} \left[(\pi - c - D_t) q(\pi, c, D_t) \right], \tag{13}$$

where $q(\pi, c, D_t)$ is defined in Lemma 7. Note the similarities between equation (13) and equation (3) in the simple model of section 2. The interpretation of this two equations is also very similar. In particular, inspection of (13) shows that a marginal change in D_t, just as in equation (3), affects expected welfare in two opposing ways. On the one hand, for a given probability of trade q, a marginal increase in D_t is welfare enhancing, as it allows the agents to realize a higher payoff when they happen not to trade. On the other hand, however, this marginal increase also reduces the probability q that trade takes place. The reason is that, as D_t increases, the interim participation constraint (13) becomes more binding which, in turn, reduces the set of trading rules on which the agents can agree. As a result, the probability of trade is reduced as the aggregate disagreement payoff is increased. The next lemma, which follows directly from Matouschek (2002), characterizes the shape of $V_t(D_t)$ in some more detail.

Lemma 8 (Matouschek, Proposition 5) $V_t(D_t)$ *is quasi-convex.*

Proof. This lemma follows directly from Proposition 5 in Matouschek (2002) and we refer the reader to his proof. ■

4.3 Market Equilibrium in the Pure Exchange Model

The analysis of the steady-state market equilibrium in this section is very similar to that in section 2.3, to which the reader is referred for an intuitive discussion of the results that follow.

In market equilibrium $D_t = \delta U_{t+1}$, and in a steady-state equilibrium $D_t = \delta U = \mu V$. It is straightforward to verify that lemma 2 applies also in the more general model of this section, and therefore $D = \mu V$ is everywhere increasing in μ. This results, together with quasi-convexity of $V(D)$, establishes the following proposition.

Proposition 9 *The steady-state expected utility at birth V of a representative agent is quasi-convex in $\mu \in [0, \delta]$; that is, there exists a $\tilde{\mu}$ such that $V(\mu)$ is decreasing for all $\mu \in [0, \tilde{\mu}]$ and increasing for all $\mu \in [\tilde{\mu}, \delta]$.*

Proof. Proving that $V(\mu)$ is quasi-convex amounts to proving that any interior extremum of V is a minimium. The total derivative of V is

$$\frac{\mathrm{d}V}{\mathrm{d}\mu} = \frac{\mathrm{d}V}{\mathrm{d}D}\frac{\mathrm{d}D}{\mathrm{d}\mu}.$$

Lemma 2 implies that $\mathrm{d}D/\mathrm{d}\mu > 0$, therefore $\mathrm{d}V/\mathrm{d}\mu = 0$ if and only if $\mathrm{d}V/\mathrm{d}D = 0$. Evaluating the second derivative of V with respect to μ at that value of $D = \mu V$ for which $\mathrm{d}V/\mathrm{d}D = 0$, we obtain

$$\frac{\mathrm{d}^2V}{\mathrm{d}\mu^2} = \frac{\mathrm{d}^2V}{\mathrm{d}D^2}\left(\frac{\mathrm{d}D}{\mathrm{d}\mu}\right)^2.$$

This must be strictly positive at that value of D for which $\mathrm{d}V/\mathrm{d}D = 0$, since $V(D)$ is quasi-convex (Lemma 8). This proves that any stationary point of $V(\mu)$ must be a minimum. ■

4.4 Market Equilibrium with Asset Ownership

The analysis in the present section is very similar to that in section 3.2. The only difference between that section and the present one is in the bargaining game played by the buyer and the seller to determine the price of the specialized input and in the distribution of their valuations for this input. Therefore, once again, here we only show that the qualitative results of section 3.2 still hold in the present more general model and refer the reader to that section for an intuitive discussion.

The following proposition shows that, also in the general model of the present section, there exists a critical value $\tilde{\mu}$ of the market matching rate below which the agents choose that ownership structure $\underline{A}$ that minimizes the outside value of the asset (vertical integration), and above which the agents choose that ownership structure $\overline{A}$ that maximizes the outside value of the asset (outsourcing).

Proposition 10 *There exists a $\tilde{\mu} \in [0, \delta]$ such that the unique steady-state equilibrium outside value of the asset is*

$$a^* = \begin{cases} \underline{a} & \text{(integration)} \quad \text{if } \mu \in [0, \tilde{\mu}], \\ \overline{a} & \text{(outsourcing)} \quad \text{if } \mu \in [\tilde{\mu}, \delta]. \end{cases}$$

Proof. The first part of the proof is almost identical to the proof of Lemma 4. We know from Lemma 8 that $V_t(D_t)$ is quasi-convex. Since $D_t = a_t + \delta U_{t+1}$, this implies that, for any given δU_{t+1}, V_t is maximized at either $a_t^* = \underline{a}$ or $a_t^* = \overline{a}$. The optimal outside value of the asset chosen by the agents at time t is $a_t^* = \overline{a}$ if and only if

$$V_t(\overline{a} + \delta U_{t+1}) \geq V_t(\underline{a} + \delta U_{t+1}), \tag{14}$$

and $a_t^* = \underline{a}$ if and only if

$$V_t(\overline{a} + \delta U_{t+1}) \leq V_t(\underline{a} + \delta U_{t+1}). \tag{15}$$

Quasi-convexity of $V_t(\cdot)$ implies that, if there exists $\delta \tilde{U}_{t+1}$ such that

$$V_t(\overline{a} + \delta \tilde{U}_{t+1}) \geq V_t(\underline{a} + \delta \tilde{U}_{t+1}), \tag{16}$$

then, for all $U_{t+1} > \tilde{U}_{t+1}$, (14) holds with strict inequality and (15) does not hold, implying that $a_t^* = \overline{a}$ is the unique optimal outside value of the asset. Analogously, if there exists $\delta \tilde{U}_{t+1}$ such that

$$V_t(\overline{a} + \delta \tilde{U}_{t+1}) \leq V_t(\underline{a} + \delta \tilde{U}_{t+1}), \tag{17}$$

then, for all $U_{t+1} < \tilde{U}_{t+1}$, (15) holds with strict inequality and (14) does not hold, implying that $a_t^* = \underline{a}$ is the unique optimal outside value of the asset.

In a steady-state equilibrium we have that $\delta U_{t+1} = \delta U = \mu V$ at all t, and we know from Lemma 2 that $\delta U_{t+1} = \mu V$ is strictly increasing in μ. Define $\tilde{\mu}$ as that unique value of μ such that $\tilde{\mu} V = \delta \tilde{U}_{t+1}$. The steps above therefore imply that, for all $\mu > \tilde{\mu}$, $a^* = \overline{a}$ is the unique steady-state equilibrium outside value of the asset, whereas , for all $\mu < \tilde{\mu}$, $a^* = \underline{a}$ is the unique steady-state equilibrium outside value of the asset. In the knife-edge case in which $\mu = \tilde{\mu}$, both $a^* = \overline{a}$ and $a^* = \underline{a}$ are steady-state equilibrium outside values of the assets. ■

Note that Proposition 10 implies that, if $\tilde{\mu} = 0$, then outsourcing (i.e. $a^* = \overline{a}$) is an equilibrium for all $\mu \in [0, \delta]$. Conversely, if $\tilde{\mu} = \delta$, then vertical integration (i.e. $a^* = \underline{a}$) is an equilibrium for all $\mu \in [0, \delta]$. If however $\tilde{\mu}$ is between these two extreme values, then the optimal organization of firms changes from vertical integration to outsourcing of production as the market matching process becomes more effective, i.e. as μ increases. The analysis of section 3 seems to suggest that this can be the case if the average gains from trade assume intermediate values. This can indeed proven to be the case also under the very general assumptions of this section about the choice of the bargaining game, provided that π and c are uniformly distributed.

5 Conclusions

In this paper we have presented an analysis of the effects of globalization on welfare and on the vertical structure of firms. We have done so by means of a random matching model in which agents have private information about the potential gains from bilateral trade. In this setting, we have interpreted globalization as a fall in market frictions and shown that, by reducing the probability that agents agree on efficient trades, it can lead to welfare losses. In particular, these welfare losses are more likely to occur in markets with initially high matching frictions and in which the potential gains from trade are high. As regards the vertical structure of production, we have shown that firms respond to the increase in instability caused by a fall in market frictions by adopting more flexible organizational forms, for instance by abandoning vertically integrated structures and outsourcing production stages involving the use of supplier specific assets. This organizational response by firms, in turn, further increases the observed instability of existing vertical relationships.

Note that, in our model, the vertical structure adopted by a given pair of agents depends on the costs involved in finding alternative trading partners, i.e. on the level of market frictions, but not on the vertical structure chosen by other pairs of agents in market equilibrium. In other words, in order to emphasize in asimple way the importance of the vertical structure of production in minimizing the inefficiencies caused by private information, we have deliberately developed a model that does not generate thick-market externalities. McLaren (2000) and Grossman and Helpman (2001, 2002) show that these thick-market externalities can be another important factor in determining the vertical structure of production in market equilibrium. We believe that an extension of our model in this direction would enrich, but not alter, the results that we have obtained in this paper and we leave it for future research.

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