How Firms Overcome Weak International Contract Enforcement: Repeated Interaction, Collective Punishment, and Trade Finance*

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Abstract

How do parties engaged in international trade ensure adherence to contracts when contract enforcement is weak? In a dynamic general equilibrium model of matching and repeated interaction, I argue that reputational concern can provide a substitute for formal contract enforcement if the threat of exclusion by the current and potential future partners is effective. However, if trade is infrequent or information of past behavior disseminates poorly trade is constrained. Policy makers can manipulate the matching process by imposing tariffs or restricting the entry of firms and new sources of gains from trade arise. Further, when trade is constrained a bank can provide guarantees - letters of credit - for multiple importers. The bank's additional credibility is endogenously derived from increasing returns to credibility in size.

JEL codes: C73, D83, F12, G21, L11, L14

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1 Introduction

There is widespread evidence that imperfect enforcement of international contracts acts as a barrier to international trade (Rodrik, 2000; Anderson and Marcouiller, 2002). Any international transaction of physical goods must inherently involve the extension of cross-border credit: by the seller when payment is due after receipt of a good; by the buyer when payment is due before receipt; or by a third party, such as a bank. As with any extension of credit, repayment concerns are paramount. Though such concerns also exist for domestic transactions, distance, longer transportation time, and different institutional settings make them more pressing for international transactions. Following a recent increase in the availability of data, empirical evidence has shown that there exists a variety of mechanisms designed to help parties engaged in international trade (partly) overcome these barriers. These include repeated interaction, business networks (Rauch, 2001), tailored contract terms (Antràs and Foley, 2011), bank guarantees such as letters of credit (Ahn, 2011; Schmidt-Eisenlohr, 2012) and non-financial intermediaries (Antràs and Costinot, 2011). Though it is clear that these mechanisms are important we still have limited understanding of how they shape trade flows as well as their importance for the disproportionate drop in international trade during the most recent global recession. The goal of this paper is to analyze these mechanisms in a common framework in a general equilibrium model where firms match. I further analyze the interaction between trade policy and incomplete contract enforcement.

The model is designed to capture four features of modern international trade. First, enforcement of international contracts is imperfect. Second, although firms do repeat interactions with some partners, new partners are frequently required by changes in technology, consumer taste, and so forth. Third, some businesses operate within networks that can facilitate the transmission of information and fourth, they may rely on third parties such as banks and other intermediaries to ensure fulfillment of contracts. The model is used to answer questions such as: When can parties engage in international trade without the aid of third parties? How and when are these various tools used, and how sensitive is their use to financial crises and how might they be affected by government policy.

The paper's contribution is threefold. First, I introduce search frictions, repeated interaction, and imperfect contract enforcement into a two-country discrete-time dynamic symmetric version of Krugman (1980). Production always requires the cooperation of two parties: a final good producer (henceforth *producer*) and an intermediate input supplier (henceforth *supplier*), who are matched by the Diamond–Mortensen–Pissarides matching process widely used in the labor literature (Pissarides, 1985; Mortensen and Pissarides, 1999). The match might end with an exogenous probability and, in addition, each party is free to end it at will. When a supplier extends credit to a producer, the supplier's ability to break the match and preclude future trade provides some encouragement for payment. Furthermore, if information about past behavior travels easily to other potential suppliers, collective punishment can ensure even better contract enforcement. This paper thereby provides a formal treatment of the notion that communication within business (or ethnic networks) can ensure adherence to contracts when international contract enforcement is insufficient (as demonstrated in Gould, 1994; Rauch, 2001). The value of the reputational mechanism depends critically on the effectiveness of transmitting information and on the outcome of the matching process — in particular the ease with which an firm finds a new match. If transmission of information is effective, then the existence of potential new partners facilitates cooperation because there is a greater chance of collective punishment. If transmission of information is ineffective, then the existence of potential new partners hampers cooperation because firms can easily find a new match should the present supplier cease to cooperate.

I compare contracts with payment due before and after receipt and demonstrate that the relative desirability of the contract types is strongly dependent on the outcome of the matching process. When information is effectively transmitted the choice of contracts is a strategic substitute: When payment is due before the shipment of the good, the incentive to deviate is with the supplier who must be given sufficient profit to adhere to the contract. When pre-payment is the prevalent form of contract the profits of a supplier must be higher, which — when transmission of information of deviations is effective — further encourages the use of pre-payment. Contracts are strategic substitutes when information travels poorly.

The paper's second contribution is using the model to consider alternative solutions when reputational concerns are insufficient to overcome contractual imperfections in international trade. Among these alternatives, I include a bank offering to guarantee the payment of producers (through a letter of credit, a typical form of trade finance) and ask the natural question: If a supplier does not trust a foreign producer to pay, why would he trust the producer's bank? Without assuming that banks are inherently more credible, I show that a single bank providing guarantees for multiple producers — as in actual practice — delivers both more frequent interaction and a higher cost of nonpayment, both of which endogenously give banks' guarantees more credibility. Analogous reasoning demonstrates that the biggest and most frequently active party should be given the potential incentive to deviate, in line with the findings of Blum, Claro and Horstmann (2010)

Third, I endogenize the entry of firms by allowing for free entry and show how this affects optimal trade policy: In addition to the standard terms-of-trade argument for imposing a tariff two new sources arise: imposing tariffs reduces the number of home importers relative to foreign exporters which i) improves the probability for a home importer of matching and ii) might reduce constraints from poor contract enforcement. Further, when the matching process features increasing returns to scale symmetric trade liberalization can improve the matching process and improve global welfare. I further consider taxes and subsidies to the entry of firms and show that entry is typically restricted compared to domestic firms and further will feature inefficiently low ratio of international exporters compared with international importers.

In an extension, I demonstrate that two banks mutually confirming each other's guarantees provide even further credibility given that a bank can default only on the net amount outstanding. The model then replicates the most salient features of the industry for bank guarantees: it is highly concentrated; the providers of guarantees are predominantly local banks, banks engaged in long-standing relationships confirm each other's guarantees; and the demand for such guarantees can increase during times of uncertainty.

The role of repeated interaction and reputational concerns has been extensively analyzed in the literature on game theory (see, e.g., Fudenberg and Tirole, 1991). However, the application in this paper is most closely related to the the historical literature on the establishment of private institutions to overcome poor formal contract enforcement. Greif (1993) shows that the 11th-century Maghribi traders' threat of collective punishment allowed them to efficiently employ oversea agents in spite of a lack of formal institutions. Milgrom, North, and Weingast (1990) argue that the law merchant of Champagne fairs of the 12th and 13th century can be seen as endogenously providing information about traders' past behavior thereby facilitating impersonal trade. I take the transmission of information as given and focus on the effect of the transmission of information on welfare and the choice of contracts. Modern analogies can be found in the recent emergence and success of websites such as eBay and Amazon Marketplace, which facilitate transactions between individuals by providing information about users' past behavior.[1]

The question of why banks are more credible guarantors relates to a sub-string of the literature on financial contracting initiated by Diamond (1984), who formally defined the "who monitors the monitor" problem of financial intermediaries. He argued that financing several (not perfectly correlated) projects lowers the overall variance of the bank's portfolio and thereby the enforcement costs of monitoring. In the model presented here, the bank's engagement in numerous relationships is essential too, but for a different reason: more frequent interaction aggregates punishment for reneging. In an entirely different setup, Chemmanur and Fulghieri (1994) capture a similar effect by showing that an investment bank can build its reputation by interacting sequentially with entrepreneurs — a phenomenon that has only recently drawn attention in the international trade literature (exceptions are Thomas and Worrall, 1994 and Marin and Schnitzer, 1995). To my knowledge this is the first paper to incorporate formally both repeated interaction and incomplete contract enforcement into a standard general equilibrium trade model.

The choice between (trade) credit extended by suppliers and credit extended by third parties, such as banks, is of central interest to Peterson and Rajan (1997) and to Burkart and Ellingsen (2004). The latter analyze a model in which suppliers' superior ability to monitor the buyer — and to liquidate assets in the event of nonpayment — can engender the coexistence of both credit types.[2] Two interesting recent papers present theoretical models of contract terms in international trade. Ahn (2011) presents a screening model in which the additional risk of international compared with domestic trade is the more costly screening process for identifying a credible partner. The role of banks in this model is to provide additional screening technology. Ahn shows how economic downturns increase the relative riskiness of international trade and drive up the price of bank guarantees, in line with empirical evidence (Auboin, 2009). Schmidt-Eisenlohr (2012) varies the quality of contract enforcement and financing costs in exporting and importing countries and analyzes the choice of contract terms in a model of asymmetric information about partner creditworthiness. Unlike the papers just cited, I analyze the role

[1] Amazon Marketplace also handles the shipment between buyer and seller, and Lewis (2011) emphasizes the role that eBay Motors plays in reducing the disclosure costs of sellers and providing standard contracts. Similar services are provided by banks in international trade but are not considered here.

[2] Despite some confusion on this score, the concepts of trade credit and trade finance are distinct. *Trade credit* is a well-defined term in the corporate finance literature and usually refers to the extension of credit by a seller to a buyer; it should be distinguished from *trade finance*, which is the extension of credit by a third-party financial institution.

of repeated interaction and the transmission of information of past information, derive the greater credibility of banks endogenously, analyze the conditions under which banks can serve a beneficial role, analyze the interaction between trade policy and incomplete contract enforcement, and argue that both financial and non-financial intermediaries can function as mechanisms for establishing a reputation for honest behavior.

Section 2 discusses the higher risks of international trade and describes the tools used in practice to overcome the risks. Section 3 presents the main model without intermediaries and with fixed number of firms. Section 4 introduces pre-payment and shows when the choice of contract is a strategic substitute or complement. Section 5 introduces banks and non-financial institutions as intermediaries. 6 introduces endogenous entry of firms and analyze trade policy. Section 7 concludes.

2 Risks of International Trade

Firms engaged in international trade face a number of risks that are either not present or less severe for domestic trade. These risks pertain to the specific counterpart (e.g., the risk of its insolvency or fraud) as well as to the country of the counterpart (the possibility of war, political unrest, exchange rate movements, unexpected import bans or tariffs etc.).[3]

The transportation time inherent in most international trade implies that the transactions are of a sequential nature. If a supplier (or more generally an exporter) requires payment after he has made a shipment, typically referred to as an *open account* transaction then he runs the risk of nonpayment by a final good producer (or more generally an importer); conversely if the producer pays before receiving the shipment, a *pre-payment* transaction, then he runs the risk that the supplier — having already secured his payment — will cheat on quality or not make the shipment. If neither party is willing to bear the risk, then a bank can be asked to issue a *letter of credit*, whose workings are illustrated in Figure 1.[4] In place of an open account shipment, the exporter gets a bank (the issuing bank), which is usually located in the same country as the importer, to issue

[3]In addition to the longer transportation time, complications arise from the inclusion of multiple legal systems (Stephan, Roin, and Wallace, 2004), the lack of familiarity with a foreign court, the frequent bias of courts in favor of their own citizens (Clermont and Eisenberg, 1996). Though this does not imply that enforcement problems are more of a problem for all international transactions than for all domestic transactions, it does imply that the international aspect itself weakens enforcement.

[4]Risks of international trade are hardly a new concern. The origins of the letter of credit date back to at least the *letters of payment* of 12th-century Italian city-states (McCullough, 1987).

a letter of credit that guarantees the payment on behalf of the importer and removes the responsibility of collecting from the importer to the issuing bank. As the figure shows, this mechanism replaces one payment obligation — the one between the importer and the exporter — with two — one between the importer and his bank and another between the bank and the exporter.[5]

Should the exporter seek further protection, he can confirm the letter of credit by asking an additional bank (a confirming bank) to issue a guarantee that it will honor the payment — if need be — as well as collect the money directly from the issuing bank. A confirming bank is often located in the exporting country but need not be. The industry standard is for the issuing and confirming bank to in long-standing relationships supporting the importance of repeated interaction. Standard practice is for a confirmed letter of credit to come bundled with liquidity; thus the exporter can obtain credit from the confirming bank (often in the exporting country) *before* shipment and production. This is treated as an extension in Appendix A.2.

Antràs and Foley (2011), Glady and Potin (2011), and Niepmann and Schmidt-Eisenlohr (2013) all find that the choice of contract depends strongly on the institutional quality of the importing country. Antràs and Foley (2011) also find that established relationships (as measured by accumulated previous sales) have a positive effect on the extent to which the exporter uses open account shipments. Distance is also found to be positively related to the use of prepayment.

Glady and Potin (2011) estimate the total value of letters of credit to be around \$2.7 trillion in 2010. The market for letters of credit is highly concentrated, with a few local banks dominating the issuance in each country. In the United States, 75 per cent of the dollar value of issued letters of credit was handled by ten banks in 2005 (Klein, 2006, using data from Documentary Credit World). Rates vary substantially, but they can be as high as 8 per cent of face value for the guarantee alone. A report by the International Chamber of Commerce (2010) finds that rates have increased significantly in developing countries during the recent crisis.[6] Citi Bank, HSBC, and JP Morgan Chase are large international players in confirming letters of credit. Letters of credit

[5]In practice, international sales contracts incorporate elements of both prepayment and open account (say, 20% payment in advance, with balance due upon delivery). Antràs and Foley (2011) document more than a hundred different financing terms in their sample. Convex combinations of open account and prepayment are a natural consequence of the theory presented below but are not explicitly modeled.

[6]Personal communication with Mr. Klein suggests that the market is even more concentrated today. In most countries the market is more concentrated than in the United States, and issuers are usually local banks. Exceptions include certain South American countries (Chile and Argentina), where Santander — a Spanish bank — is dominant, and some Asian countries, where HSBC is dominant.

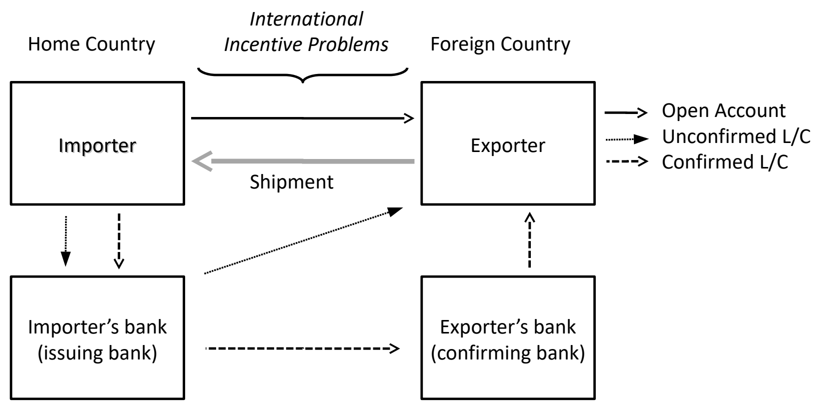


Figure 1: The Letter of Credit. This figure illustrates the one incentive problem of open account, the two incentive problems of an unconfirmed letter of credit (L/C) and the three incentive problems of a confirmed L/C. In each case, there is only one incentive problem between international parties.

usually have a maturity of less than 6 months. For projects of longer maturity, an alternative is insurance from export credit agencies, which are partly government-funded. These account for some 12 per cent of world trade (Gianturco, 2001).

3 The Model

I consider a dynamic, symmetric, two-country model with labor as the only input in production. Time is discrete, $t = 0, 1, ...$, and the stock of labor in each country is fixed at L. I label the countries "home" and "foreign" (marked * when necessary) and describe the conditions in the home country.

3.1 Demand

Preferences of a representative agent are standard and can be represented by a time additive utility function with per-period utility described by a constant elasticity of substitution (CES) utility function

$$U = \sum_{t=0}^{\infty} (\delta^P)^t \left(Q_{t,D}^{\frac{\epsilon-1}{\epsilon}} + \left(\frac{\nu}{1-\nu} \right)^{\frac{1}{\epsilon}} Q_{t,I}^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}}, \tag{1}$$

where $0 < \delta^P < 1$ is the discount factor of a representative agent and $Q_{t,D}$ is a CES aggregator over a continuum of exogenously given potential varieties of a final good produced completely domestically and indexed by $i \in \bar{\mathcal{M}}_{\mathcal{D}}$. $Q_{t,I}$ is a corresponding CES aggregator over final goods produced by international matches with $i \in \bar{\mathcal{M}}_{\mathcal{I}}$. Specifically:

$$Q_{t,z} = \left[\int_{i \in \bar{\mathcal{M}}_z} q_{t,z}\left(i\right)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}, \; z = D, I.$$

The parameter $\sigma > 1$ captures the elasticity of substitution between varieties within an aggregator and $1 < \epsilon \leq \sigma$ captures the elasticity of substitution between Q_D and Q_I.[7] Only a subset of varieties $\mathcal{M}_{t,D} \subseteq \bar{\mathcal{M}}_{\mathcal{D}}$ and $\mathcal{M}_{t,I} \subseteq \bar{\mathcal{M}}_{\mathcal{I}}$ will be active at any given time t. Consumption of variety i of type z at time t is denoted $q_{t,z}\left(i\right)$. For a set of prices $\left(p_{t,z}\left(i\right)\right)_{i,z \in \mathcal{M}_{t,z}}$, utility maximization gives an inverse demand function of

$$p_{t,z}\left(q_{t,z}\left(i\right)\right) = P_{t,z}\left(q_{t,z}\left(i\right)/Q_{t,z}\right)^{-1/\sigma}, \quad i \in \mathcal{M}_{t,z}, \tag{2}$$

where $P_{t,z}$ is the ideal price index for aggregator z, $P_{t,z}^{1-\sigma} \equiv \int_{i \in \mathcal{M}_{t,z}} \left(p_{t,z}\left(i\right)\right)^{1-\sigma} di$, and $Q_{t,z} = \int_{i \in \mathcal{M}_{t,z}} q_{t,z}\left(i\right) di$ is the total quantity sold in home and:

$$Q_{t,D}/Q_{t,I} = \nu(1-\nu)^{-1}(P_{t,D}/P_{t,I})^{-\epsilon}$$

3.2 Production

Each variety at home is produced by a home final good producer either with a home supplier (for the varieties in the set $\mathcal{M}_D$) or with a foreign supplier (for the set $\mathcal{M}_I$). Whether a variety is produced in a domestic or international match is exogenously given. Varieties can only be produced when producers are actively matched with a supplier. At each point in time a producer can at most be connected to one supplier and vice versa. The total mass of producers in a domestic or international match are M_D and M_I, respectively and the mass of suppliers in domestic and international relationships are N_D and N_I. Both producers and suppliers have a probability $0 \leq \delta^S < 1$ of surviving from one period to the next. Since it is presently immaterial whether there are fixed costs of production and whether the producer incurs costs of production, I omit such costs for the sake of clarity and focus on a constant returns to scale (CRS) production

[7] The asymmetry between domestic and international varieties will not play much of a role until Section 6 below and is only introduced here for completeness. For what follows $\epsilon = \sigma$— which constitutes equal substitutability between all varieties— will not change the results.

technology where q units of the intermediate input are needed for q units of final goods. All transportation is costless. I normalize the wage at home to 1 and let foreign wages be w^* such that cost of production are q and qw^*, respectively. All producers and suppliers are wholly owned by domestic residents, and these holdings are completely diversified.

3.2.1 The Matching Process

At any point in time, each producer or supplier can be either matched or unmatched. A match can lead to production (as previously described), but an unmatched producer or supplier must await being matched before producing. This happens through a process that follows the Pissarides (1985) labor market model but with a segregated matching process as producers and suppliers who can potentially be international matches are matched separately from those that can be in domestic matches. This stark dichotomy is not necessary for the main conclusions; however, it serves to center the analysis on issues of weak international contract enforcement and to simplify expressions (because it ignores the extent to which domestic partners would be willing to punish reneging on foreign partners). A more thorough discussion of alternative setups follows Proposition 1 in Section 3.4.[8] Dropping subscripts, I describe the matching process for M producers and N suppliers. Let $\lambda(1, M/N)$ be the steady state fraction of producers that are matched and the fraction of suppliers that are matched $\lambda \cdot M/N$ (the reason for the "1" in the function will become clear below). At the end of the period, these relationships can break exogenously for one of two reasons. Either one of the two parties dies (which happens with independent probability $(1-\delta^S)$) or the parties survive but the relationship is broken (which happens with exogenous probability π_b). An unmatched producer finds a new partner with probability π. Parties can break the relationship endogenously as well, which will be covered below. In steady state the creation of new matches and the destruction of old ones must be equal requiring:

$$\lambda M \left[1 - (\delta^S)^2(1-\pi_b)\right] = \pi \left[(1-\lambda)M + \lambda M(1-(\delta^S)^2(1-\pi_b))\right],$$

where the left hand side is the mass of relationships breaking up with $(\delta^S)^2(1-\pi_b)$ being the fraction that does not. The right hand side is the number of new matches

[8]The dichotomy is imposed exogenously, but it could be given a micro foundation by letting there be two distinct inputs where one country has a comparative advantage in one type of intermediate inputs, say, low-skill labor-intensive inputs. In such a case, producers would primarily rely on either international or domestic suppliers depending on the type of final good produced.

that are formed: $(1-\lambda)M$ is the number of firms who were already unmatched from previous period, whereas $\lambda M(1-(\delta^S)^2(1-\pi_b))$ is the new firms coming into the pool of unmatched firms each period. The fraction of producers who find a match every period is given by

$$\pi(x) = \mu \frac{x}{x+1}, \tag{3}$$

where

$$x = \frac{N/M - \lambda(\delta^S)^2(1-\pi_b)}{1-\lambda(\delta^S)^2(1-\pi_b)}, \tag{4}$$

and x is the relative mass of unmatched suppliers compared with unmatched producers. Most of the results do not depend on the exact functional form of π, but it will simplify the exposition in section 6 below. I can therefore combine expressions and write λ purely as a function of M/N and δ^2.

$$\lambda(1, M/N) = \frac{\pi}{1-(\delta^S)^2(1-\pi)(1-\pi_b)}. \tag{5}$$

Note that the players of a match that breaks up at the end of a period could potentially be matched at the beginning of the next period, whereas other discrete-time specifications of the matching process require that parties wait at least one period as unmatched (Petrongolo and Pissarides, 2001). This difference is immaterial for the analysis presented here, but it facilitates the comparison with model without search frictions because in the limit of $\pi \to 1$, a producer can be active every period, even with a positive probability of a relationship ending ($\pi_b > 0$). I will allow for endogenous entry in Section 6 below.

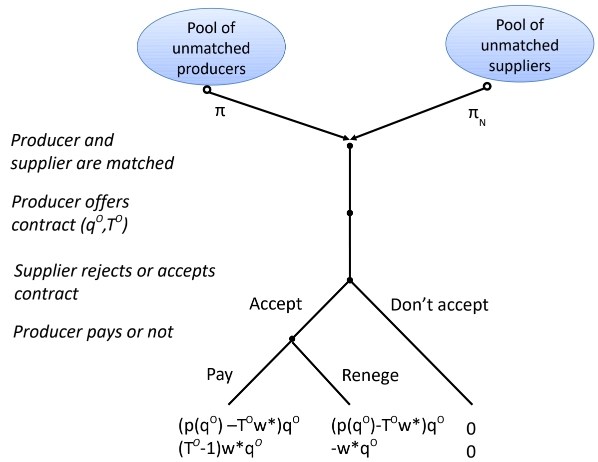
3.3 Incomplete International Contracting

The central concern of this paper is how market forces determine contract enforcement internationally. As already mentioned issues of contract enforcement are generally more severe between international partners than domestic. Presently, I set domestic prices at the unconstrained optimum of a monopolist, $p_D = \sigma/(\sigma-1)$ but when I introduce endogenous entry of firms in Section 6 below I allow prices to be a consequence of bargaining between domestic producers and suppliers.

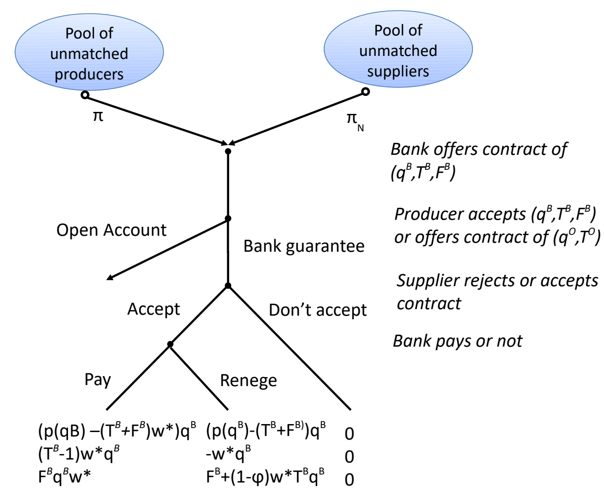
Before describing the full game, I describe a one-shot interaction in an international match between a home producer and a foreign supplier. This interaction is modeled by the extensive game of perfect information illustrated in Figure 2a below (I drop the subscript i). After the two parties are matched, the sequence of events is as follows. First, the producer offers an open account contract, (q, T), thereby requesting the shipment of q units of the intermediate input by the supplier on the promise to pay him Tw^*q upon receipt of the goods. Hence, T should be thought of as a mark up over foreign wages. Second, the supplier decides whether to reject the contract and ship nothing or to accept it and ship the required quantity q. If the supplier rejects both players get zero. Third, if the contract is accepted by the supplier then the producer receives the intermediate inputs and produces the final good which is sold to obtain revenue of $p(q)\,q$ (to easy notation I will write $p(q)$ suppressing the dependency of aggregate variables as described in equation (2).) Fourth, the producer can choose to pay Tw^*q, in which case he gets $(p(q) - Tw^*)q$ and the supplier gets $(T-1)w^*q$. If he chooses to renege on the payment contract enforcement becomes important. I introduce imperfect contract enforcement by following hart (1995): The producer has access to a "diversion" technology capable of diverting the payment of Tw^*q due to the supplier by spending ϕTq units of labor, $0 \leq \phi < 1$, in which case the supplier gets nothing (see also Hart, 1995; Burkart and Ellingsen, 2004).[9] Possible interpretations of the diversion technology include the cost of bribing a local court not to enforce payment or the cost of diverting assets to a different company and then declaring bankruptcy. In either event, I take ϕ as a measure of the quality of the legal institution of the producer (the importer). Note, that with $\phi < 1$ in a one-shot game the producer will always divert leaving nothing for the supplier. Realizing this, the supplier will refuse to make a shipment and no trade can take place.[10]

[9] Attempt by counterparts to renege on payment or to seek renegotiation of contract are a recurring concern for practitioners. The Institute of International Banking Law & Practice (2010) cites a risk manager dealing with Chinese counterparts: "very minor inconsistencies such as punctuation and spelling have been used as grounds for canceling a contract". In addition a survey of American exporters cited therein finds that around half of respondents would not trade with Chinese counterparts even with a letter of credit issued by a Chinese bank.

[10] The stark result that no trade is possible in a one-shot interaction is not necessary for the results that follow, but it substantially simplifies the exposition. In particular, it implies that the minmax value of the producer (zero) is an outcome supportable as a subgame perfect equilibrium in the stage game, such that the maximal punishment by the suppliers involves simple trigger strategies and not also punish-the-punisher strategies, which would substantially complicate the analysis (Fudenberg and Tirole, 1991). An alternative setup would be to consider a court that will enforce the payment of Tw^*q but only with probability ϕ which implies that the expected return to the supplier is $(\phi T - 1)\,w^*q$. Given a wealth constraint of $p(q) \geq T$, a cost to the supplier of $C > max_q\,(\phi p(q) - w^*)\,q$ for taking the producer to court would again result in no trade in the one-shot interaction, and — except for the condition on C — would be analytically identical to the present setting.



(a) The Particular Stage Game without a Bank



(b) The Particular Stage Game with a Bank

Figure 2: (a) After a match is made, the producer offers the supplier a contract that requires him to ship q units and promises to pay him Tw^*q upon receipt. If the supplier accepts, the producer can divert payment at a cost of $\phi w^*Tq < Tw^*q$. After this, each player can unilaterally decide to break off the relationships returning both to the pools of unmatched players. In a one-shot interaction, the producer will always divert and the supplier will accept no contract with $q > 0$. (b) After a match is made, the bank can offer the producer a bank-guaranteed contract, requiring the supplier to ship q' units to the producer and the bank thereafter to pay $w^*T'q'$ to the producer in exchange for a fee of w^*Fq'. The bank can divert payment at a cost of $\phi w^*T'q' < w^*T'q'$ and would always do this in a one-shot game; once again no trade is possible. π_N is the probability of a supplier matching.

3.4 The Repeated Game

I model the repeated interaction by embedding the stage game described before into an infinitely repeated game of imperfect information (players do not know the game's full history). The set of players is the total set of producers and suppliers as well as "chance" (denoted c): $\bar{\mathcal{M}} \cup \bar{\mathcal{M}}^* \cup \bar{\mathcal{N}} \cup \bar{\mathcal{N}}^* \cup c$. At the beginning of every period, chance chooses the active matches by splitting up active matches with the exogenous probability π_b, replacing a fraction $1-\delta^S$ of firms with new ones and matching unmatched producers and suppliers (as described in Section 3.2.1). Once a match has been made, a producer and a supplier play the stage game of Figure 2a. I refer to this as the "particular stage game" to clarify that the economy features a continuum of such games played simultaneously (or alternatively sequentially but without information about actions in the same stage game, in keeping with the standard for extensive games). Once a particular stage game has been played, each player has the option of ending the relationship — in which case both go back to the pools of unmatched players. Each player knows all actions played in particular stage games that (s)he has been a part of, but does not necessarily know the complete history of the game. After a particular stage game has been played, there is a probability $0 < \varphi \leq 1$ that the outcome is communicated to all other players. If it is not communicated then other players do not know of the outcome nor the original match. The signal is the only way for a player to learn the outcome of a particular stage game that (s)he was *not* a part of. The probability of communication is independent across particular stage games.

The choice of equilibrium concept of this paper is the Perfect Bayesian Equilibrium (PBE).[11] As is typical of games of this structure a large set of PBEs exists. The interest of this paper is not to explore the full set of equilibria but to analyze the interaction between search costs and incomplete contract enforcement. I therefore impose the following set of restrictions on equilibrium strategies:

Criterion. *The equilibrium strategies obey:*

- a) Punishment: If a producer has not paid according to contract after the delivery of goods, all players who are informed of this 'punish' him by refusing to work with him in the future,

- b) Bilateral rationality: the contract terms between a matched pair of producer and supplier are chosen so as to maximize the discounted profits of the producer, except in case of previous non-payment (condition a). A supplier accepts and fulfills a contract that makes him weakly better off,

- c) Independence: the actions of a matched pair of producer and supplier cannot be dependent on previous actions, except in case of previous non-payment (condition a)

Some cost of deviation is necessary to sustain positive trade between producer and supplier. Even without condition a) the cost of search in terms of time would provide some incentives. However, as a part of this analysis will focus on the efficiency of transmission of information I add condition a). Without it, the equilibrium would be captures by the special case of no transmission of information ($\varphi = 0$). Condition b) captures a competitive industry. The fact that all profits are captures by the producer simplifies matters, but is not essential. The supplier is given some bargaining power in section

[11] I employ the concept of PBE rather than the Sequential Equilibrium originally proposed by Kreps and Wilson (1982), because the latter's standard definition admits only games of finite action space (which this game is not).

6 below. In Online Appendix I, I demonstrate that, for the steady-state distribution of the matching process, there exists a unique equilibrium under these strategies supportable as a PBE. The structure of this equilibrium is stationary and features trigger strategies. In the following I describe the nature of the equilibrium leaving a complete formal definition of the game to Appendix I (I focus on the interaction between home international producers, M_I, and foreign international producers, N_I^*. Analogous results hold for foreign international producers and home international suppliers).

Recall that households hold perfectly diversified portfolio implying risk-neutral firms, and let the per-period profits obtained in the steady state PBE with the highest welfare be $\Pi_M \equiv (p(q) - Tw^*)q$ for producers and $\Pi_N \equiv (T-1)w^*q$ for suppliers with (q, T) being the contract proposed for international transactions in equilibrium such that T is to be interpreted as the markup the supplier gets over his cost of production, w^*. Consider an international match in which neither party has previously deviated from the equilibrium strategy profile. Let V denote the corresponding value function for a matched producer (who will honor the contract) at the time when the producer offers a contract:

$$V = \Pi + \delta \left[(1 - \pi_b) \delta^S V + \left(1 - (1 - \pi_b)\delta^S\right) V^H \right], \tag{6}$$

where $\delta \equiv \delta^P \delta^S$ combines the probability of survival and the preference discount factor into a combined discount factor. The value of being matched is the sum of this period's profits, Π, and the discounted value of next period's value function. If the firm is alive in the next period the relationship continues with probability $(1-\pi_b)\delta^S$ which combines the probability of the partner surviving with the probability of the relationship not exogenously breaking up. With the remaining probability $1-(1-\pi_b)\delta^S$ the relationship ceases and the firm continues to the pool of unmatched players. The term V^H denotes the value of being an "honest" unmatched producer — that is, of there being no public knowledge of any previous deviation from the equilibrium strategy. I therefore have:

$$V = \frac{\Pi + \left(1 - (1 - \pi_b)\delta^S\right) \delta V^H}{1 - \delta^S \delta \left(1 - \pi_b\right)} \tag{7}$$

This expression reflects that the value of being in a relationship is the expected discounted profits *plus* a term, $\delta / \left(1 - \delta\delta^S \left(1 - \pi_b\right)\right) V^H$, which captures the value of being unmatched should the relationship break up, multiplied by the probability $(1-(1-\pi_b)\delta^S)$ of this happening. The value of being unmatched and honest is given by $V^H = \pi V^O + \delta \left(1 - \pi\right) V^H$, since with probability π a match will be found within this period. That equation is readily solved to yield:

$$V^H = \frac{\pi \Pi}{(1-\delta)\left(1-\delta\delta^S(1-\pi_b)(1-\pi)\right)} = \frac{\lambda(\delta^P, M/N)\Pi}{1-\delta}, \tag{8}$$

where $\lambda(\delta^P, M/N)$ can be interpreted as the fraction of periods a producer will be matched, appropriately discounted for the fact that he starts unmatched (with $\lambda(\delta^P, M/N) < \lambda(1, M/N)$ and when $\delta^P \to 1$ this becomes immaterial and two expressions are equivalent).

The central incentive constraint of the open account game involves the producer's decision concerning whether to divert payment. If he does, then the supplier will terminate the relationship and with probability φ it will be publicly known that the producer deviated. Although the present supplier will know that the producer is dishonest in any case, the probability of matching with him again is zero.[12] Hence the incentive constraint is:

$$V \geq \Pi + (1-\phi)\, Tq + \delta \left[\varphi V^{Dis} + (1-\varphi)\, V^H\right], \tag{9}$$

where V_M^{Dis} is the value to a producer who is publicly known for being dishonest. Since exclusion is the worst possible punishment condition a) requires: $V_M^{Dis} = 0$. I can now use equation (9) to write

$$\frac{\delta\delta^S\,(1-\pi_b)}{1-\delta\delta^S\,(1-\pi_b)}\Pi + \delta\,(\varphi - \bar{\varphi})\, V^H \geq (1-\phi)\, Tw^* q, \tag{10}$$

where $\bar{\varphi} \equiv (1-\delta)(1-\pi_b)\delta^S/(1-\delta(1-\pi_b)\delta^S)$. The right-hand side is the immediate gain from not paying the obligation of Tw^*q to the supplier, while the left-hand side is the corresponding loss from punishment. The value of communication, φ, is central to whether the existence of alternative partners encourages or discourages cooperation and will play an important role in the rest of the paper. Note first that, without alternative partners (say, for a zero probability of a producer to match again: $\pi = 0$ so $V^H = 0$), the condition is completely standard: the expected discounted value of future cooperation with the present supplier must be higher than the immediate gain from deviation. The

[12] In this equilibrium there are no defaults on the equilibrium path. There several ways this could be incorporated into the present model. The most direct would be to introduce i.i.d. shocks to the demand functions facing the producers. Then, ex post after a particularly negative shock to demand for the producer, it might be optimal to default while keeping the participation constraint for the suppliers. Such a setting would introduce interesting issues concerning the optimal length of time to punish a deviation for the producer akin to a large literature on sovereign defaults.

term $\delta\left(\varphi-\bar{\varphi}\right)V^{H}$ adds the effect of the parties operating in a market with additional potential partners and has an ambiguous sign. If the effectiveness of communication is poor ($\varphi<\bar{\varphi}$) then the existence of other partners acts to discourage cooperation because the producer can potentially match with a new supplier, who is unlikely to be informed about her previous behavior. If the effectiveness of communication is high ($\varphi>\bar{\varphi}$) then the existence of alternative relationships encourages honest behavior because such behavior guarantees positive trade not only with the present partner but with all future partners. I shall refer to $\varphi<\bar{\varphi}$ as poor transmission of information, and to $\varphi\geq\bar{\varphi}$ as good transmission of information, irrespective of $\varphi's$ absolute value. The value of $\bar{\varphi}$ depends crucially on the exogenous probability π_b that an existing relationship breaks up: If $\pi_b=0$ and $\delta^S=1$ then $\bar{\varphi}=1$ and the existence of other relationships is always detrimental to cooperation: the value of other relationships is of no value to cooperating partners but the producer could potentially find a new uninformed partner after diverting payment.[13]

For open account transactions, the only constraint for the producer is to ensure cooperation. Hence the payment to the supplier that maximizes efficiency is $T=1$; when combined with equation (8) this yields an incentive constraint of:

$$\alpha\left(p/w^{*}-1\right)q\geq\left(1-\phi\right)q, \tag{11}$$

with

$$\alpha\equiv\frac{\delta\delta^{S}\left(1-\pi_{b}\right)}{1-\delta^{S}\delta\left(1-\pi_{b}\right)}+\frac{\delta}{\left(1-\delta\right)}\lambda(\delta,M/N)\left(\varphi-\bar{\varphi}\right)\leq\frac{\delta}{1-\delta}. \tag{12}$$

which gives a *lower* limit on markup and thereby restricts sales (if the limit is higher than the monopoly markup of $\sigma/(\sigma-1)$). The gain from reneging is proportional to payment and therefore to quantity, whereas the reputational cost from reneging is proportional to future profits and hence is concave in quantity. The trade-off is illustrated in Figure 3a, where the profit-maximizing quantity reached for a price of $p_D=\sigma/(\sigma-1)$ is not incentive compatible and where the lowest price that satisfies the incentive constraint of inequality (11) is $p/w^{*}-1=(1-\phi)/\alpha$ for the corresponding shipment q. The ability

[13] Bernheim and Whinston (1990) and Opp (2012) also find that joint punishment can improve enforcement. They differ in that players might operate in multiple industries at the same time and deviation in one can be punished in all industries. As noted by Bernheim and Whinston (2012), however, if industries are symmetric then both gains and punishment from deviations are scaled proportionally and incentives to deviate remain the same. The sequential nature of this model implies that when the transmission of information is sufficiently good, enforcement is always improved by the presence of alternative partners.

of reputational concerns to overcome imperfect contract enforcement is captured by a single parameter of *reputational concern*, α. It is the sum of two terms. The first term is always positive and reflects the usual value of repeated interaction within a relationship, where the chance of the relationship breaking up implies an effective discount factor of $\delta\delta^S(1-\pi_b)$. The second term reflects the value of alternative partners and will be positive if effectiveness of communication is good and negative if it is poor. For future reference, I note that $\alpha \leq \delta/(1-\delta)$; that is, the reputational concerns are always (weakly) lower than the reputational concerns of an isolated two-player game with no exogenous breakup.[14]

To close the model I need a labor market clearing condition for home and foreign:

$$\lambda_D M_D q_D + \lambda_I^* M_I^* q_I^* = L,\ \lambda_D^* M_D^* q_D^* + \lambda_I M_I q_I = L, \tag{13}$$

where $\lambda_D \equiv \lambda(1, M_D/N_D)$ and $\lambda_I = \lambda(1, M_I/N_I^*)$ and analogously for foreign values λ_D^* and λ_I^* and international products sold in foreign, q_I^*, must be produced in home. Further, a trade balance:

$$\lambda_I T_I w^* M_I q_I = \lambda_I^* T_I^* M_I^* q_I^*,$$

The left hand side is the total expenditure of home international producers on imports: A mass of $\lambda_I M_I$ home producers are matched, they each purchase q_I at a price of $T_I w^*$. The right hand side is the corresponding number for foreign international producers. Until Section 6, I only consider symmetric perturbations to the equilibrium and can therefore keep symmetry which keeps $w^* = 1$.

Proposition 1. *The PBE satisfying conditions a)-c) has a unique allocation of production that satisfies the following conditions ("O" for open account).*[15]

(i) Prices of the international relationships are

$p^O = max\{1 + (1-\phi)/\alpha, \sigma/(\sigma-1)\}$ *and suppliers in international relationships are paid* $T^O = 1$, *and* α *as defined in equation 12.*

[14] In the present setting, better contract enforcement always improves welfare by improving allocative efficiency — although this simple result might not hold in a more general model. With three countries, an improvement in contract enforcement between two of them would have effects analogous to those described in the literature on trade creation and trade distortion ensuring ambiguous effects on welfare. A similar point is made by Rauch and Casella (1998) with regard to a "search and matching" trade model with bilateral improvements in search efficiency.

[15] Again, I consider a symmetric setting so $N_I = N_I^*$.

(ii) Per-period welfare per worker is given by

$$v(p^O, p_D) = \frac{\left\{ [\lambda_D M_D]^{\frac{\epsilon-1}{\sigma-1}} + \frac{\nu}{1-\nu} [\lambda_I M_I]^{\frac{\epsilon-1}{\sigma-1}} \left[p^O/p_D\right]^{1-\epsilon} \right\}^{\frac{\epsilon}{\epsilon-1}}}{[\lambda_D M_D]^{\frac{\epsilon-1}{\sigma-1}} + \frac{\nu}{1-\nu} [\lambda_I M_I]^{\frac{\epsilon-1}{\sigma-1}} [p^O/p_D]^{-\epsilon}}, \tag{14}$$

- Per-period welfare is strictly decreasing in p^O whenever $p^O > p_D$

(iii) The value of reputational concerns, α, (and consequently welfare) is increasing in the discount factor (δ^P) and the efficiency of communication (φ) and is decreasing in the probability of a relationship breaking up (π_b). Furthermore α is increasing in the probability of a producer finding one, π, if and only if $\varphi > \bar{\varphi}$, where $0 \leq \bar{\varphi} \equiv (1-\delta)(1-\pi_b)\delta^S/(1-\delta(1-\pi_b)\delta^S) \leq 1$.

(iv) For good transmission of information, $\varphi > \bar{\varphi}$,

- more suppliers improve welfare : $dv/dN_I^* > 0$.

- An increase in mass of producers, M_I, has an ambiguous effect on welfare but $lim_{M_I/N_I \to 0} dv/dM_I > 0$. Further, there exists an ϵ' such that for all

$\epsilon < \epsilon' : lim_{M_I/N_I^* \to \infty} dlogv/dlogM_I < 0$

(v) For poor transmission of information, $\varphi < \bar{\varphi}$,

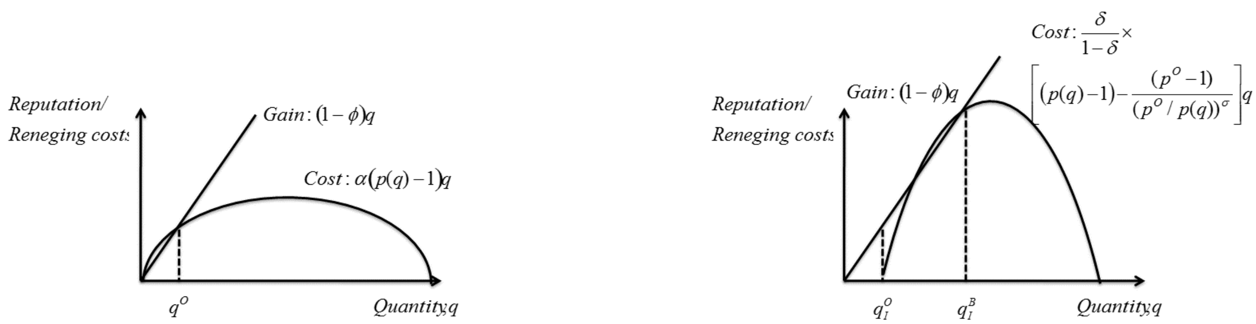
- more producers improve welfare: $dv/d\bar{M} > 0$.

- An increase in mass of suppliers, M_I, has an ambiguous effect on welfare but $lim_{M_I/N_I \to \infty} dv/dN_I^* > 0$. Further, there exists an ϵ' such that for all

$\epsilon < \epsilon' : lim_{M_I/N_I^* \to 0} dlogv/dlogN_I^* < 0$

Proof. See Appendix I □

The sharp division between producers who deal only with domestic partners and those who deal only with international partners facilitates the exposition, though the qualitative effects would still be present in a more general model. Consider an alternative setting of a single matching function such that there is positive steady-state probability of ending up with a domestic or international partner for either producers or suppliers. If domestic suppliers are willing to punish nonpayment to foreign suppliers then the incentives for cooperation are even stronger, though they are weaker if domestic suppliers are not willing. In either case, analogous results to those in Proposition 1 still hold (available from the author on request). Moreover, the exogenous restriction to either domestic or international matches implies that firms are prohibited from breaking off an international match and then finding a domestic one. Such considerations would be of interest for future research.



(a) Open Account

(b) Bank Guarantee

Figure 3: The Incentive to Renege: (a) The gain from diverting payment is proportional to quantity shipped, whereas the cost is proportional to future profits and so is concave in quantity. The profit-maximizing quantity (peak of the cost curve) cannot be reached without reneging; the highest quantity supportable is q^O under open account. (b) The cost of reneging is steeper with a bank guarantee because size makes banks more credible, but the intercept is lower because the producer must be compensated; here the highest quantity supportable is q^B.

Parts (iv) and (v) make clear that the effect of changes in the mass of producers and suppliers (M_I and N_I^*, respectively) depends on the transmission of information (φ). An increase in the total mass of either producers or suppliers always increases the number of steady-state matches which increases welfare through the standard love-of-variety channel. The matching process introduces an additional effect on incentives. Consider the case where communication is good, $\varphi > \bar{\varphi}$, and increase the number of suppliers N_I^*. In addition to the love-of-variety effect, this increase will improve an unmatched producer's odds of finding a new match and thus the incentives for cooperation. Welfare increases both through the love-of-variety channel and through the expansion of international trade from better incentives.

However, an increase in the mass M_I of producers will reduce the chances of finding a new match for any given producer; it will increase the number of varieties but will decrease incentives. For a low ratio of produces to suppliers (low M_I/N_I^*) the former effect dominates, whereas for a high number of producers the latter effect might dominate. For poor communication, $\varphi < \bar{\varphi}$, the incentive effect works in the opposite direction: a higher mass M_I discourages deviation because a producer can then more easily find a new match should he break the current one by deviating.[16]

3.4.1 Relation to the Empirical Literature

The equilibrium described above admits a gravity equation for total exports from home to foreign:

$$log\left[\lambda_I M_I q_I\right] = -log\left[1 + \left[\lambda_I M_I\right]^{-\frac{\epsilon-1}{\sigma-1}}\left[\lambda_D M_D\right]^{\frac{\epsilon-1}{\sigma-1}}\left[\frac{\alpha + (1-\phi)}{\alpha}\frac{\sigma-1}{\sigma}\right]^{\epsilon}\right]^{-1} + log(L),$$

where exports are a positive function of α, the quality of contract enforcement (ϕ), and the size of the economy (L). It follows straightforwardly that total trade depends positively on the quality of legal institutions (ϕ) as documented in Anderson and Marcouiller (2002) and others. Furthermore, total trade depends positively on the easy of communication $(dlog\left(\lambda_I M_I q_I\right)/d\alpha)(d\alpha/d\varphi) > 0)$, consistent with an existing empirical literature: Gould (1994) finds that trade of a country with the United States is positively correlated with recent immigration into that country, and Rauch (1999) finds a positive link between trade and colonial links. Rauch and Trindade (2002) document a similar link between Chinese trade and the size of ethnic Chinese populations. In an extensive survey, Rauch (2001) argues that business networks use information flow to overcome informational trade barriers by establishing the first contact between business partners, and to ensure enforcement of contracts by communicating information of past bad behavior, the latter being the focus on this paper.[17] Rauch and Trindade (2002) demonstrate that the effect of ethnic networks is stronger for differentiated products and argue that, whereas finding a match is more difficult for differentiated products than for products traded on an organized exchange, "the threat of community sanctions should deter equally shipments of debased metals, rotting fruit, or stockings with runs"; these authors conclude that their finding supports the search role of networks. Though, it seems clear that networks serve both the role of encouraging informational flow and enforcement, it is worth noting that, if diverting payment for differentiated products (say, by claiming that they fail to meet specifications) is easier than for homogeneous

[16] A similar argument can be made as regards the efficiency of the matching process, μ. An increase in μ will make it easier for both types of players to find a match, and the number of steady-state matches will increase. However, when transmission of information is poor it is straightforward to demonstrate that, for low M_I/N_I^*, the effects of more steady-state matches can be dominated by a greater likelihood of finding a new match, in which case a better search technology reduces welfare.

[17] The model presented here suggests another role of business communities: restricting entry, which (as demonstrated in lemma 1) can be welfare enhancing.

products, then Rauch and Trindade's (2002) result is equally consistent with the present model since $\partial^2 log(\lambda_I M_I q_I)/(\partial\phi\partial\varphi) \leq 0$. In fact, Ranjan and Lee (2007) do find that contract enforcement issues are more important for differentiated products.

4 Choice of Contracts

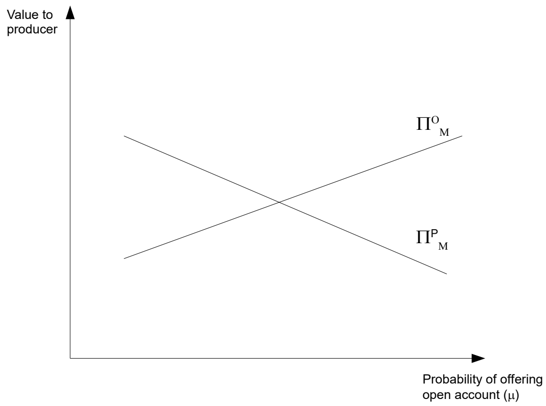
So far the model has only allowed for open account contracts which require the payment after the delivery of goods. In practice, a plethora of contracts exists. In the following, I introduce pre-payment contracts — which require the payment before the payment of the good — and analyze the choice that producers make between these two contracts, in particular its dependency on the contract choice of other players. I add to the choice set of producers the possibility of offering pre-payment contracts. Since the supplier receives the money up front, the incentive problem changes from that of the producer diverting payment to that of the supplier shipping goods of lower quality (or, equivalently shipping no goods). Much as in the open account setting, the supplier has access to a technology that at the cost of ρq $(0 \leq \rho < 1)$ can produce a low-quality intermediate input that is of no value to the producer.[18] The particular stage game is such that; after a match has been made, the supplier offers a contract (q, T); if the producer accepts (by paying Tq) then the supplier can choose whether or not to ship low-quality goods. If he delivers goods of high quality then the profits are, as before, $\Pi_M = (p(q) - T) q$ and $\Pi_{N^*} = (T - 1) q$; if he delivers goods of low quality then the producer's and the supplier's profits are 0 and $(T - \rho) q$, respectively.[19] As with the previous setup, in a one-shot interaction the supplier would always ship a good of low quality and no trade can take place.

A unique equilibrium need not exist. Consider an equilibrium in which each producer offers an open account with probability $\mu \in [0, 1]$ and pre-payment contract with probability $1 - \mu$. Then for reasons analogous to above the incentive constraint for a producer under open account is:

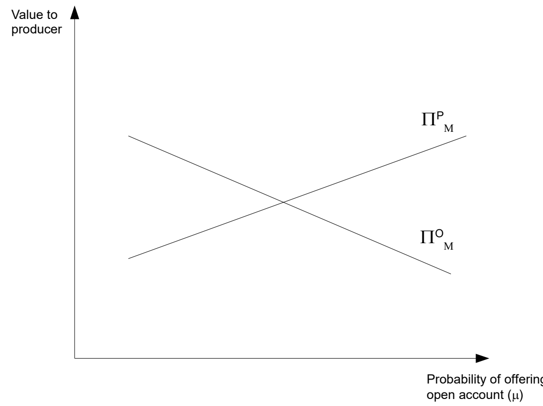
$$\frac{\delta\delta^S(1-\pi_b)}{1-\delta\delta^S(1-\pi_b)}\Pi_M^O + \delta\frac{(\varphi-\bar{\varphi})}{1-\delta}\lambda(\delta^P, M_I/N_I^*)\left[\mu\Pi_M^O + (1-\mu)\Pi_M^P\right] \geq (1-\phi)T^O q^O, \quad (15)$$

[18] As argued in footnote 10, I could explicitly model probabilistic court enforcement. Nothing of substance would change in such a setup.

[19] I continue to consider symmetric equilibria, so formally foreign exists in the same equilibrium as home. This does not change the basic point of multiple equilibria in the domestic setting but avoids complications from the local choice of equilibrium affecting the terms of trade.



(a) Strategic Complements: Good Communication ($\varphi > \bar{\varphi}$)



(b) Strategic Substitutes: Poor Communication ($\varphi < \bar{\varphi}$)

Figure 4: Plot a: The curve labeled Π_M^O shows the value for a producer of offering an open account contract as a function of the fraction of other producers who do so, μ. Π_M^P is the corresponding value of offering a pre-payment. When all others offer open account this is optimal for the producer whereas if all others offer pre-payment this is optimal. In combination with an intermediate equilibrium this implies that there are three equilibria. Plot b: demonstrates the case where communication is poor. Here only one intermediate equilibrium exists.

where Π_M^O, as before is the per-period profits of a producer on open account and Π_M^P is the per-period profits on pre-payment. Let Π_{N*}^O and Π_{N*}^P be the corresponding per-period profits for the supplier and write the corresponding incentive condition for a supplier when using pre-payment as:

$$\frac{\delta\delta^S(1-\pi_b)}{1-\delta\delta^S(1-\pi_b)}\Pi_N^P+\delta\frac{(\varphi-\bar{\varphi})}{1-\delta}\lambda(\delta^P, M_I/N_I^*)M_I/N_I^*\left[\mu\Pi_{N*}^O+(1-\mu)\Pi_{N*}^P\right]\geq(1-\rho)T^Pq^P. \tag{16}$$

I consider parameters for which unconstrained trade cannot take place under either contract form. I add the participation constraint of $V_{N*}^O \geq V_{N*}^H$ which ensures that a supplier would rather stay in a match using open account than break it up and return to the pool of unmatched firms in search for a pre-payment contract.

Figure 4 illustrates the equilibria. Assume first that information travels well, $\varphi > \bar{\varphi}$, and consider the choice for a producer of whether to offer pre-payment or open account. If all producers offer pre-payment we must have $\Pi_{N*}^P > 0$ and the outside option of the supplier is positive. When information travels well, a positive outside option increases the incentive to cooperate and the use of pre-payment contracts becomes relatively more attractive. Hence, when information travels well, the choice of contract are strategic complements. As a consequence there exists parameter values for which both $\mu = 0$ and $\mu = 1$ are equilibria. In addition, there exists one (and only one) mixed equilibrium where producers choose open account with a positive probability of less than 1 (or alternatively a fixed share always plays open account). For remaining parameter values there exists a unique equilibrium with either $\mu = 0$ or $\mu = 1$.

Alternatively, consider the case where information travels poorly, $\varphi < \bar{\varphi}$. If all other producers offer pre-payment the outside option of the supplier is positive. Since information travels poorly this reduces the incentive to adhere to a pre-payment contract and makes pre-payment less attractive. As a consequence, choice of contracts is a strategic substitute and for $\varphi < \bar{\varphi}$ there exist parameter values for which only a mixed equilibrium is possible.

Finally, a higher M_I/N_I^* (and symmetrically higher M_I^*/N_I) increases the probability of a supplier finding a match. When $\varphi > \bar{\varphi}$ this increases the parameter space for which pre-payment is preferable.

These results are summarized in the proposition below:

Proposition 2. *Consider the equations (15) and (16) and consider parameters for which unconstrained trade is not possible. Then*

i) If $\varphi > \bar{\varphi}$ such that communication is high:

- There exists a set of parameters for which there are three equilibria: 1) All producers choose pre-payment terms ($\mu = 0$), 2) All producers choose open account terms ($\mu = 1$), 3) A mixture of contracts is used and each producer is indifferent between the two. The equilibria cannot in general be welfare-ranked. For the remaining parameters there is only one equilibrium.

- The set of parameters for which only the use of pre-payment is a possible equilibrium is increasing in the mass of producers, M_I and decreasing in the number of suppliers, N_I^*.

ii) If $\varphi < \bar{\varphi}$ such that communication is high:

- There exists a set of parameters for which only a mixed equilibrium exist and the producer is indifferent between open account and pre-payment. For the remaining parameters there is only one equilibrium, either only pre-payment or only open account.

- The set of parameters for which only the use of pre-payment is a possible equilibrium is decreasing in the mass of producers, M_I and increasing in the number of suppliers, N_I^*.

iii) If $\varphi = \bar{\varphi}$ only one equilibrium exists: Either everybody uses pre-payment or *everybody uses open account.*

Having introduces pre-payment contracts I now consider a third widely used form of contract: the letter of credit intermediated by banks.

Proof. See Appendix C $\square$

5 Banks in International Trade

This section demonstrates that banks — through more frequent interaction with multiple players — can provide guarantees (letters of credit) when the parties cannot themselves ensure efficient trade. Appendix B makes an analogous argument for large non-financial intermediaries such as trading companies in guaranteeing the quality of shipments. As discussed in Section 2 the use of a letter of credit introduces two payment obligations in place of one. However, with perfect domestic contract enforcement and only one international payment obligation I can restrict attention to the payment obligation of the banks towards the supplier(s). I analyze the case of a letter of credit which is not backed up by a confirming bank in the exporting country. The confirmed letter of credit is treated in section A.2

5.1 The Bank's Problem

I incorporate a simple extension of the model presented in Section 3.3 to allow for a bank in each country. This assumption is not made solely for analytical convenience. As discussed in the Introduction, this is a highly concentrated industry with either a single player or a few dominating players in each country (Klein, 2006).

The set of players is extended to $B \cup B^* \cup \bar{\mathcal{M}} \cup \bar{\mathcal{M}}^* \cup \bar{\mathcal{N}} \cup \bar{\mathcal{N}}^* \cup c$, where B is a single bank in the home country and B^* is a single bank in the foreign country. The matching process remains the same; the only change is that, for each particular stage game, the bank is introduced as an additional player and is allowed the first move (see Figure 2b). For each such game the bank makes an offer to the producer — a letter of credit — consisting of three elements (q', T', F), where (q', T') denotes quantity and payment (per-unit) to the supplier and F is the (per unit) fee to the bank. If the producer rejects the bank's offer then he can offer an open account contract (q, T) to the supplier, and thereafter the producer decides whether to accept this with the individual stage game continuing as previously described. If the producer accepts the bank's offer, then he offers (q', T') to the supplier under the mutual understanding that payment is guaranteed by the bank through the letter of credit. The supplier then makes the shipment and, upon receipt, the producer is obligated to pay the bank $(F + T')\, q$ and the bank is obligated to pay the supplier $T'q'$ (recall that this obligation is the only international one). In this scenario, the per-period profits are thus $(p\,(q') - T' - F)\, q'$, $(T' - 1)\, q'$ and Fq' for the producer, the supplier, and the bank, respectively.

To emphasize that additional reputational concerns arise endogenously, I let the bank have access to the same diversion technology as the producers: by employing $\phi T'q'$ units of labor the bank can avoid the payment of $T'q'$. As in the open account game, no one-shot interaction can lead to trade: it always pays for the bank to divert payment and so the supplier, anticipating this, rejects any contract. Furthermore, as with a single producer, if the bank diverts on *one* supplier (of measure 0) then there is a probability φ that *all* suppliers (of potentially positive measure) will find out — independently for each time the bank diverts payment. The assumption that $\varphi > 0$ when combined with the independence of signals implies that, if the bank defaults on a positive mass of suppliers all agents will know (almost surely).[20] The bank is jointly owned by all domestic residents, and it inherits the discount factor (δ) of the representative agent.

Models of this type feature a large set of equilibria, including some that give lower utility to producers and suppliers than in the open account equilibrium without the bank. I restrict attention to equilibria in which producers and suppliers are at least as well off as in the open account equilibrium.

I impose the criterion on the equilibrium that producers should always be able to bypass the bank and offer open account transactions without this being considered a deviation.[21]

Criterion. *Final good producers can choose open account shipment with price p^O.*

The structure of the equilibrium that maximizes total welfare is very similar to the one of Proposition 1 and is omitted. Again it is stationary. If banks can provide a service

[20] Consider the analogous discrete setting, in which a bank guarantees the sales $T^B M_I$ and each firm has sales of $T^B \Delta$. With independent signals if the bank defaults on all obligations there is a probability $1 - (1 - \phi)^{M_I/\Delta}$ that it will be public knowledge that the bank has deviated at least once. Taking the limit of $\Delta \to 0$ gives the continuous case with a corresponding probability of 1.

[21] This is more restrictive than needed for what follows. What is essential for the qualitative results (in particular Lemma A.1) is that the bank cannot capture the entire surplus and what the producer captures is increasing in the level of contract enforcement. As this is not a model of adverse selection, issues such as those presented by Lizzeri (1999) — where lack of certification by a third party signals low quality — do not arise.

they will do so for all in the equilibrium that maximizes total welfare. Denote equilibrium value 'B' for bank and let the equilibrium contract for international shipments be (q^B, T^B, F^B). The corresponding value function of the bank if it honors the contract can be written as:

$$W = \lambda_I M_I q^B F^B + \delta W = \frac{\lambda_I M_I q^B F^B}{1-\delta},$$

since the bank guarantees the mass of $\lambda(1, M/N)M_I$ active producers engaged in international trade. In complete analogy with Section 3.4, the value functions of producers and suppliers, V_x^B, $x = M, N$, are as in equations (7) and (8) except that profits now correspond to the contract (q^B, T^B, F^B).

To derive the appropriate incentive constraints, consider first the case in which the bank diverts the payment due to just one supplier. Because a single supplier is of measure 0, the bank's gain from deviating is also of measure 0. Given the positive probability ($\varphi > 0$) that any deviation will be communicated to all suppliers, any strictly positive punishment cost will make such deviation undesirable, and if the bank deviates it will do so on all suppliers. Because punishment by exclusion remains possible, such deviation will return a future value of zero. Thus the bank's incentive constraint is

$$\frac{\delta}{1-\delta}\lambda_I M_I q^B F^B \geq \lambda_I M_I \left(1-\phi\right) T^B q^B + \delta \cdot 0, \tag{17}$$

since the value of continuing the relationship must be higher than the gain from diverting. Imposing that producers can use open account, charge p^O, and sell $(p^O/p(q^B))^{-\sigma} q^B$ delivers the following proposition:

Proposition 3. *In the game with a bank, the perfect Bayesian equilibrium with the highest welfare has the unique allocation of production as follows.*

Let $\mathcal{P} \subset R^+$ be the set of p for which the inequality

$$\frac{\delta}{1-\delta}\left[p - 1 - \left(p^O - 1\right)\left(p^O/p\right)^{-\sigma}\right] \geq (1-\phi) \tag{18}$$

holds. If $\mathcal{P} = \oslash$, then no equilibrium with banks is possible and the PBE with the highest welfare is that of Proposition 1*. In this case, welfare is identical to the open account economy.*

If $\mathcal{P} \neq \oslash$, then $p^B = max\{p_D, min\{\mathcal{P}\}\}$ and $T^B = 1$. In this case the following statements hold.

(i) p^B is increasing in the quality of communication (φ) but is decreasing in the

probability of a relationship breaking up (π_b); p^B is increasing in M_I/N_I^* if and only if $\varphi > \bar{\varphi}$.

(ii) Welfare per worker is given by

$$v(p^O, p_D) = \frac{\left\{[\lambda_D M_D]^{\frac{\epsilon-1}{\sigma-1}} + \frac{\nu}{1-\nu}[\lambda_I M_I]^{\frac{\epsilon-1}{\sigma-1}}\left[p^B/p_D\right]^{1-\epsilon}\right\}^{\frac{\epsilon}{\epsilon-1}}}{[\lambda_D M_D]^{\frac{\epsilon-1}{\sigma-1}} + \frac{\nu}{1-\nu}[\lambda_I M_I]^{\frac{\epsilon-1}{\sigma-1}}[p^B/p_D]^{-\epsilon}}, \tag{19}$$

and is decreasing in p^B

Equation (18) is again a limit on the markup for analogous reasons as for the open account economy, but differs from equation (11) due to two effects, illustrated in Figures 2a and 2b:

The *size* effect, reflected in $\delta/(1-\delta) \geq \alpha$, comes from the bank guaranteeing multiple producers, which improves credibility for two reasons: The bank interacts every period, whereas the inefficiency of the matching process is such that a producer does not expect to interact every period. This difference raises the effective discount factor for the bank. In addition, the issue of simultaneous guarantees for *multiple* producers increases the possibility of collective punishment because multiple diversions of payment increases the probability of such behavior being communicated. In effect, size makes deviations more visible. In Figure 2b this effect is illustrated by a steeper cost of diverting payment. Only in two special cases will $\delta/(1-\delta) = \alpha$. The first is when producer and supplier are exogenously matched with no chance of the relationship exogenously ending ($\delta^S(1-\pi_b) = 1$) nor of the producer finding a new partner if it is ended by choice ($\pi = 0$). The second special case is when a new partner is found with probability 1 and communication is perfect, $\pi = \varphi = 1$, which completely undermines the size advantage of the bank. This explains why a bank cannot credibly guarantee the payment of just one producer.[22]

The *rent* effect counters the size effect: the bank must ensure that the producer receives the same profits with a letter of credit as he would have with an open account transaction. This leaves less rent for the bank, which reduces the incentive for honoring

[22]The increased credibility from the guaranteeing of multiple contracts is related, but distinct from the mechanism of Diamond (1984). In that paper a bank finances multiple entrepreneurs with risky projects and the law of large numbers ensures that the overall portfolio is less risky reducing monitoring costs. In Ramakrishnan and Thakor (1984)'s work on financial intermediation multiple draws also guarantees less variance of the underlying payoff distribution. In the present paper, however, the underlying sales is non-stochastic, and though the multiple draws from a distribution plays a role it is to facilitate the communication of a deviation.

the contract. The importance of rents for sufficient reputation has been discussed in the context of banks (for a review, Allen and Gale, 2000, chapter 8) and in the context of brand labels by Klein and Leffler (1981). In both contexts, a crucial issue is whether or not competition is good for efficiency. In fact, an earlier version of this paper showed that, in a model where banks are engaged in competition of the Hotelling variety, competition hurts profits sufficiently to reduce overall welfare (Olsen, 2011). The rent effect implies that small perturbations in parameters might leave the bank with insufficient reputational concerns for any equilibrium with a bank to exist and create a discontinuity. See Appendix A.1 for details.

The crucial difference between the agency problems of open account and prepayment make it clear why letters of credit are better substitutes for open account: banks have little expertise in enforcing quality from the exporter, whereas intermediaries (trading companies) often have special knowledge and branches located in the country of the exporter. Analogously to Proposition 3, I can extend the model of prepayment by allowing for a large intermediary (trading company), in each country, that is wholly owned by domestic residents (details in Appendix B). Once again, the extent of the intermediary's role depends on how well firms can trade internationally *without* the intermediary. For products with high turnover (high π_b) or when information about past performance is poorly communicated (low φ) the trading companies serve a natural function. Such intermediaries will be large — consistent with the findings in Ahn, Khandelwal, and Wei (2011) — so that they can credibly guarantee the shipment of high-quality goods, and they will specialize in a few markets (and be located in the exporter's country) so that they can better enforce sufficient quality. These facts are consistent with the role of many intermediaries that facilitate exports from developing countries. They will also need to secure substantial rents to be credible which suggests that the widespread complaints about the exploitative nature of trading companies might have to be qualified. Feenstra and Hanson (2004) document the important role that Hong Kong intermediaries play in intermediating trade between China and the rest of the world. They attribute this to intermediaries role in facilitating contact as well as guaranteeing quality and further show that the intermediaries charge a higher markup for differentiated products consistent with the theory presented here. Ahn and coauthors show that currently intermediaries account for about 20 per cent of both Chinese exports and imports. They argue that such intermediaries allow a large set of firms to export indirectly when they cannot afford to do so directly (Akerman, 2012 and Bernard, Grazzi and Tomasi, 2014 also focus on the role of intermediaries as overcoming fixed costs of exporting). These authors focus on the exogenous fixed costs of exporting, but the model presented here suggests an alternative explanation: many Chinese firms cannot engage credibly in international trade, so these intermediaries are needed as facilitators. Much as before, there are two requirements of effective functioning: the intermediary must be better (than are the partners themselves) at enforcing quality and payment from from suppliers, which suggests that they should be located in the same country; and they must be large enough to engage credibly in international trade. These requirements comport with empirical facts: such intermediaries are larger than and focus more narrowly on particular countries than firms that export directly.

The transmission of information also interacts with the relative probabilities of finding a match. Consider a market with many producers and few suppliers, such that the probability of finding a new match is high for the supplier. With good transmission of information ($\varphi > \bar{\varphi}$) this encourages the use of pre-payment because the cost of reneging will be higher for the supplier. An argument analogous to that in these case of bank guarantees establishes the greater credibility of a player who interacts with multiple partners.[23] When combined, these two results suggest that the incentive to deviate should be put on the larger or more frequently interacting partner. This argument is consistent with the findings of Blum et. al. (2010), who find that trade with Chile almost always includes at least one "large" player, and with those of Antràs and Foley (2011), who find that the large American exporter they studied extends open account conditions more frequently to firms with which it has interacted frequently in the past.

The analysis so far has analyzed the choice of contracts taking the set of firms as given. In the following I endogenize the choice of entry.

6 Endogenous Entry of firms

In the preceding sections the set of firms was taken as exogenous. In the following I allow for endogenous entry of firm. To do this, I extend the model along a number of dimensions. For concreteness, in the following I consider only pre-payment contracts

[23]The present paper makes this point in a rather stark matter by assuming that individual firms can have only one trading partner, whereas banks serve a continuum of firms. The present model could be extended to allow for firms to trade with several partners — along the lines of Acemoglu and Hawkins (2010) — in which case firms who trade with more partners would be better able to build reputational concerns.

(and drop super-scripts 'P''). Little of substance is lost in this. In the following I consider the interaction between international home producers and foreign international suppliers and discuss below how this differ from the other types of relationships.

First, new firms have to pay an upfront cost of f in labor units to enter. I only consider steady states which ensures that a free entry condition of $V_x^H = f,\, for\, x = N, M$ and $V_{x^*}^H = w^* f$ for $x^* = M_I^*, N_I^*$ is binding. For a home international producer this can be written as:

$$f = \frac{1}{1-\delta}\lambda(\delta^P, M_I/N_I^*)\Pi_M = \frac{1}{1-\delta}\lambda(\delta^P, M_I/N_I^*)\frac{1}{\sigma-1}T_I q_I w^* \tag{20}$$

Since entry costs are paid in domestic labor, but production is done with foreign labor the foreign wage only appears on the right hand side.

For the foreign international supplier the free entry condition is:

$$w^* f = \frac{1}{1-\delta}\lambda(\delta^P, M_I/N_I^*)M_I/N_I^*\Pi_{N^*} = \frac{1}{1-\delta}\lambda(\delta^P, M_I/N_I^*)M_I/N_I^*(T_I - 1)q_I w^*, \tag{21}$$

which consequently does not depend (directly) on w^*.

Taking the ratio of equation (20) and (21) I find:

$$w^* = (\sigma-1)\frac{T_I - 1}{T_I}\frac{\lambda(\delta^P, M_I/N_I^*)M_I/N_I^*}{\lambda(\delta^P, M_I/N_I^*)} = (\sigma-1)\frac{T_I - 1}{T_I}\frac{M_I}{N_I^*}. \tag{22}$$

where, all else equal, higher foreign wages will discourage the entry of firms abroad and is associated with relatively more home international producers than foreign international suppliers. Furthermore, a higher payment to suppliers, T_I, will encourage more entry of foreign suppliers and increase M_I/N_I^*.

Second, bargaining between the two parties take place using symmetric Nash bargaining (weight of 1/2). That is, the producer and supplier solve the problem of:

$$max_T log(V_M - V_M^H) + log(V_{N^*} - V_{N^*}^H), \tag{23}$$

where from equation (7) above:

$$V_M = \frac{\Pi_M + \delta\left(1-(1-\pi_b)\delta^S\right)V_M^H}{1-\delta\delta^S(1-\pi_b)},\ V_{N^*} = \frac{\Pi_{N^*} + \delta(1-(1-\pi_b)\delta^S)V_{N^*}^H}{1-\delta\delta^S(1-\pi_b)},$$

and the parties take V_M^H and $V_{N^*}^H$ as given.

If the problem were not constrained this would lead to a payment to the supplier of:

$$\frac{T_I}{T_I - 1} = \sigma + (\sigma - 1)\frac{1 - \lambda(\delta^P, M_I/N_I^*)M_I/N_I^*}{1 - \lambda_I}, \tag{24}$$

which shows that higher M_I/N_I^* (which decreases $\lambda(\delta^P, M_I/N_I^*)$ and increases

$\lambda(\delta^P, M_I/N_I^*)M_I/N_I^*$) increases the likelihood for a supplier of finding a match, improves her outside option, and consequently requires a higher payment T_I. Note, that T_I does not depend directly on relative wages, w^*.

In general the problem is constrained by the incentive constraints of the supplier which, using the definition of V_{N^*} and equation (16) can be written as:

$$T_I\left[\frac{\delta\delta^S(1-\pi_b)}{1-\delta\delta^S(1-\pi_b)} + \frac{\delta(\varphi - \bar{\varphi})\lambda(\delta^P, M_I/N_I^*)M_I/N_I^*}{1-\delta}\right] = (1-\rho)(\sigma - 1). \tag{25}$$

When communication is poor ($\varphi < \bar{\varphi}$) a higher chance of finding a match for a supplier $\lambda(\delta^P, M_I/N_I^*)M_I/N_I^*$ reduces the incentive for honest behavior and the payment to the supplier, T_I, must be correspondingly higher. The incentive does not depend on w^*. The resulting payment to the supplier, T_I, will be whichever is the highest of equation (24) and (25). I will denote this resulting function by $T_I = T(M_I/N_I^*)$.

I combine equations (22), (24) and (25) in $(T_I, M_I/N_I^*)$ space in Figure 5 below. As discussed above, the free entry condition is downward-sloping and the bargaining condition is upward-sloping. When communication is good the incentive constraint is downward sloping, whereas it is upward sloping if communication is bad.[24] The equilibrium T_I and M_I/N_I^* is where the free entry condition intersects with the upper envelope of the bargaining and incentive condition.

Consider a change in foreign wages and focus on the case where the intersection is between the incentive constraint and the free entry condition (illustrated in Figure 5).

[24] I have drawn the figure such that the free entry condition is steeper than the incentive constraint. Numerical simulations demonstrate that this is always true when Nash bargaining is symmetric. More generally, with generalized Nash bargaining, in particular when the weight on the producer approaches one, the incentive constraint might be steeper. Although, this would be an equilibrium, when this is true there always exists two additional equilibria: one where the free entry condition and the incentive condition intersect above the bargaining condition and one where the bargaining condition and the free entry condition intersect above the incentive condition. Then, this equilibrium is 'unstable' in the standard informal sense that if by mistake slightly more or slightly less than the equilibrium condition of M_I/N_I^*, entered the incentive condition would encourage further deviation until one of the two alternative 'stable' equilibria were met. Since issues of multiple equilibria are not the focus here, I restrict attention to the symmetric Nash bargaining. The unique equilibrium is the only substantial consequence of symmetric Nash bargaining.

An increase in foreign wages discourages the entry of foreign producers, N_I^* and increases the probability that a foreign producer finds a match. When communication is good this acts as a deterrent and reduces the required payment T_I. The opposite will happen when communication is poor. Finally, if the intersection is between the bargaining condition and the free entry condition, the lower entry of foreign suppliers will unambiguously increase their outside option and thereby their payment.

Analogous reasoning applies for the other three types of relationships. However, for domestic relationships there is no dependency on w^*. Further for simplicity I continue to assume perfect domestic contract enforcement such that the intersection is between the bargaining condition and the free entry condition.

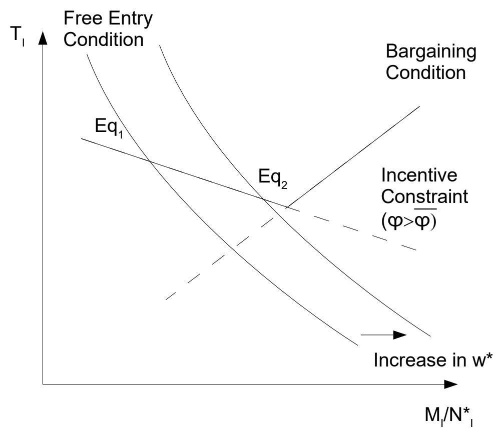


Figure 5: The *Free Entry Condition* describes a negative relationship between the payment to suppliers, T_I, and the relative number of producers, M_I/N_I^*. The downward sloping *Incentive Constraint*, reflects a higher relative number of producers, M_I/N_I^* means that a supplier will be matched more often, which — when communication is good ($\varphi > \bar{\varphi}$) — reduces the need to incentive via payment T_I. When $\varphi < \bar{\varphi}$ the Incentive Constraint is upward sloping. The upward sloping bargaining requires a higher payment to suppliers when there are relatively more producers. The intersection between the Free Entry Condition and the upper envelope of the Incentive Constraint and Bargaining condition determines the equilibrium $(T_I, M_I/N_I^*)$. An increase in foreign wages will reduce the entry of foreign producers and when the Incentive Constraint is downward-sloping reduce the required payment to the foreign suppliers.

I can combine these results into the following lemma

Lemma 1. *For given w^*, the equilibrium T_I and M_I/N_I^* are the solution to:*

$$w^* = (\sigma - 1)\frac{T_I - 1}{T_I}\frac{M_I}{N_I^*},$$

and $T(M/N)$ defined as whichever of the following two gives the highest T_I:

$$Bargaining: \ \frac{T_I}{T_I-1} = \sigma + (\sigma-1)\frac{1-\lambda_I M_I/N_I^*}{1-\lambda_I},$$

$$Incentive\,Constraint: \ T_I\left[\frac{\delta\delta^S(1-\pi_b)}{1-\delta\delta^S(1-\pi_b)} + \frac{\delta(\varphi-\bar{\varphi})\lambda_I M_I/N_I^*}{1-\delta}\right] = (1-\rho)(\sigma-1),$$

It holds that T_I is

i) increasing in w^* if the incentive condition is binding and communication is good $\varphi > \bar{\varphi}$.

ii) decreasing in w^* if the incentive condition is binding and communication is poor $\varphi < \bar{\varphi}$ or the bargaining condition is binding.

iii) the opposite results hold for T_I^*.

iv) T_D and T_D^* are found at the intersection of the bargaining condition and the free entry condition at $w^* = 1$ and are not a function of w^*.

Naturally, w^* cannot be taken as an exogenous variable and will take center stage in the analysis of trade policy below. Before that, however, I perform a few symmetric comparative statics so I can continue to consider $w^* = 1$. The labor market clearing condition (13) is extended to:

$$\lambda_D M_D q_D + \lambda_I^* M_I^* q_I^* + (1-\delta^S) f\left[M_D + N_D + M_I + N_I\right] = L, \tag{26}$$

where the last term on the left hand side the fixed cost required to replace the fraction $(1-\delta^S)$ of home firms that die every period. An analogous equation exists for foreign which, by the assumption of symmetry, also has a stock of labor of L.

An increase in contract enforcement, ρ, shifts the incentive condition downwards. Naturally, if the equilibrium is at the intersection between the free entry condition and the bargaining condition an increase in ρ has no impact on the equilibrium values of T_I and M_I/N_I^*, whereas if the equilibrium is at the intersection of incentive constraint and the free entry condition better enforcement allows for lower payment to the supplier: $dlogT_I/d\rho < 0$ which implies relatively less entry of suppliers, $dlog(M_I/N_I^*)/d\rho > 0$. The impact on per-period utility is (details in Appendix E.1):

$$sign\left[\frac{dU}{d\rho}\right] = sign\left[\left\{\left[M_I/N_I^* + 1\right]\epsilon_{\lambda_I} + 1\right\}\frac{dlog(M_I/N_I^*)}{d\rho} + \frac{dlogq_I}{d\rho}\right], \tag{27}$$

where $\epsilon_{\lambda_I} \equiv dlog\lambda_I/dlog(M_I/N_I^*)$ and $dlogq_I/d\rho > 0$. For a given M_I/N_I^* the fact that $T_I > 1$ means that production is too low and an increase in q_I improves efficiency. The increase in M_I/N_I^* has an ambiguous impact on utility. Symmetry in the matching function and equal fixed costs of production implies that for given q_I, $M_I/N_I^* = 1$ is optimal: at $M_I/N_I^* = 1$, $\epsilon_{\lambda_I} = -1/2$ and the term in the curly brackets is zero. For $M_I/N_I^* > 1$ the term is negative and a relative increase in M_I/N_I^* reduces utility. However, the latter term in expression (27) always dominates and $dU/d\rho > 0$ unambiguously. Similar reasoning demonstrates that when the incentive constraint is binding: $dU/d\pi_b < 0$ and $dU/d\delta > 0$: a higher break-up rate of relationships, π_b, reduces the incentive to cooperate in the current period, requires a higher payment to suppliers which reduces q_I and reduces efficiency. A higher probability of survival, δ, has the opposite effect.

6.1 Trade Policy through tariffs

I allow home government to impose a (gross) tariff of $\tau > 0$ on the import of goods from abroad, with τ^* the corresponding value for foreign import. Consequently prices of domestic varieties in home are set at $\frac{\sigma}{\sigma-1}T_D$ and prices of international varieties in home are $\frac{\sigma}{\sigma-1}w^*\tau T_I(M_I/N_I^*)$. Using the utility function (1), the relative consumption of domestic and foreign varieties must satisfy $Q_D/Q_I = (P_D/P_I)^{-\epsilon}$ which by substitution can be written as:

$$\frac{q_D}{q_I} = \frac{1-\nu}{\nu}\left[\frac{\lambda_D M_D}{\lambda_I M_I}\right]^{\frac{\epsilon-\sigma}{\sigma-1}}\left[\frac{\tau T_I w^*}{T_D}\right]^{\epsilon}. \tag{28}$$

With endogenous entry and new firms starting as unmatched the steady state will not be reached instantaneously. This makes optimal policy that changes the entry of firms a complicated dynamic problem. Since these dynamic considerations are not of importance to the central points of the paper, I will simplify matters and let the objective function of policy makers be the steady state utility. That, is in the following I impose the following assumption

Criterion. *No discounting of future periods:* $\delta^P \to 1$.

And the policy maker will therefore maximize the per-period utility in steady state:

$$U = \left(Q_D^{\frac{\epsilon-1}{\epsilon}} + (\nu/(1-\nu))^{\frac{1}{\epsilon}}\, Q_I^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}}. \tag{29}$$

Before proceeding, I first note that the globally welfare maximizing steady state allocation is given by:

Lemma. *Consider the problem of choosing mass of firms so as to maximize the sum of per-period utility home and abroad $U + U^*$. The solution entails that all firms produce:*

$$\hat{q} = \frac{2(1-\delta^S)f}{\lambda(1,1)}(\sigma - 1),$$

whereas total entry is:

$$M_D = N_D = M_D^* = N_D^* = \left[1 + \left(\frac{\nu}{1-\nu}\right)^{\frac{\epsilon-1}{\epsilon(\sigma-\epsilon)}}\right]^{-1} \frac{L}{2\sigma(1-\delta^S)f}$$

$$M_I = N_I = M_I^* = N_I^* = \left[1 + \left(\frac{1-\nu}{\nu}\right)^{\frac{\epsilon-1}{\epsilon(\sigma-\epsilon)}}\right]^{-1} \frac{L}{2\sigma(1-\delta^S)f}$$

Proof. K □

The symmetry of the matching function and the fixed costs of entry implies that the optimum is achieved where the number of a producers and suppliers of a particular type are equal. In particular home domestic matches must have $M_D = N_D$. The optimal production for each firm balances the fixed cost of production of creating a new firm with a love-of-variety gain from more varieties. As a consequence the optimal production is increasing in both fixed costs, f and the elasticity of substitution between varieties, σ. Furthermore, the higher is the fraction of periods a firm will be in operation the lower will the production be per period. The optimal production is independent of the relative weight on domestic varieties and ν only determines the relative number of domestic varieties.

The equilibrium cannot be efficient. To see this, suppose that the condition on equal entry of producers and suppliers is met: $M_D = N_D$. Then I can use the free entry condition of producers and suppliers, to find:

$$q_I = \frac{2f}{\lambda(1,1)}\left(\frac{T_I}{\sigma-1} + (T_I - 1)\right)^{-1} < \frac{2f}{\lambda(1,1)}(\sigma - 1) = \hat{q},$$

implying production would be too low or equivalently too much entry. This is akin to a “double-markup” feature, as the fact that two firms enter means that the price is set at the inefficiently high $T_I\sigma/(\sigma-1)$ and sales are inefficiently low. In general, however, production in the market equilibrium need not be lower than that of a the efficient allocation: For $T_I \to 1$, equation (21) shows that $q_I \to \infty$.

I'll let home and foreign choose tariffs simultaneously. The corresponding (symmetric) equilibrium reduces to a set of two identical first order conditions in home and foreign (see Appendix F)

$$\left[1-\tau^{-1}\right]\frac{dlog(M_I)}{d\tau}+\left\{\frac{\frac{\epsilon_{\lambda_I}}{\sigma-1}-\left(1+\epsilon_{T_I}\frac{T_I}{T_I-1}\right)}{1+\frac{\epsilon_{T_I}}{T_I-1}}\right\}\frac{dlog(w^*)}{d\tau}=0., \tag{30}$$

where $\epsilon_{T_I}\equiv dlog(T_I)/dlog(M_I/N_I^*)$ and $\Lambda>0$ is the determinant of a 2x2 system whose exact expression can be found in the appendix. A higher tariff will reduce the number of home international producers as well as demand for foreign labor ($dlog(M_I)/d\tau$, $dlogw^*/d\tau<0$). Reducing foreign wages will impact the domestic home representative agent for three reasons: First, the term $\frac{\epsilon_\lambda}{\sigma-1}/(1+\epsilon_{T_I}/(T_I-1))=\frac{1}{\sigma-1}dlog(\lambda)/dlogw^*<0$ captures that lower foreign wags encourages the entry of foreign suppliers and increases the probability of a match for a home international producer which benefits the home representative agent. The term $(1+\epsilon_{T_I}T_I/(T_I-1))$ reflects a terms-of-trade effect: It consists of the usual improvements in terms of trade from lower foreign wages, w^* (the "1"), but in addition features a change in the payment to foreign suppliers, T_I. If $\epsilon_T>0$ this is an additional benefit because lower M_I/N_I^* reduces payment to foreign suppliers, T_I, whereas if $\epsilon_T<0$ lower foreign wages will increase the payment to foreign suppliers. However, it can be demonstrated that $\left[\frac{\epsilon_{\lambda_I}}{\sigma-1}-\left(1+\epsilon_{T_I}\frac{T_I}{T_I-1}\right)\right]$ is always negative and lower foreign wages always benefit home. This must be weighted against the distortion of higher tariffs reducing the mass of home international producers and consequently an equilibrium must always feature $\tau=\tau^*>1$.

6.2 Increasing Returns to Scale in the Matching Function

Note, that in a symmetric equilibrium in which $w^*=1$ and the two countries impose the same trade policy, the equilibrium values of T_I and M_I/N_I^* are the same in the Nash equilibrium of trade policy and a setting with with no import tariffs. Higher tariffs only serve to reduce the number of producers and therefore active international products at home and in foreign, and the welfare gains from mutual trade liberalization comes from more varieties of foreign products. This depends crucially on the constant-returns-to-scale assumption embedded in λ. To see this, consider replacing equation (5) with a function $\tilde{\lambda}(1,M/N,M)$ where for given M/N $\partial\tilde{\lambda}/\partial M>0$ (say by replacing 3 with $\pi\mu M^a x/(1+x)$). I denote the (partial) elasticities as $\epsilon_M^{\tilde{\lambda}_I}$ and $\epsilon_{M/N}^{\tilde{\lambda}_I}$ for international matches and correspondingly for domestic matches. Let $\hat{\tau} = \tau = \tau^*$ denote the common tariff rate. In Appendix D I show that:

$$\left\{ U^{1/\epsilon} Q_I^{\frac{\epsilon-1}{\epsilon}} \frac{\epsilon - 1}{\epsilon} \right\}^{-1} \frac{dU}{dlog\hat{\tau}}$$

$$= \left\{ \begin{array}{c} \left[1 - \frac{1}{\tau}\right] \frac{\sigma}{\sigma-1} + \frac{\epsilon_M^{\tilde{\lambda}_I} - \epsilon_M^{\tilde{\lambda}_D}/\tau}{\sigma-1} \\ + \frac{1}{\sigma-1} \frac{1}{\tau} \frac{(T_D-1)(\sigma-1) + \epsilon_{M/N}^{\tilde{\lambda}_D}}{(T_D-1) + \epsilon_{M/N}^{T_D}} \epsilon_M^{T_D} - \frac{1}{\sigma-1} \frac{(T_I-1)(\sigma-1) + \epsilon_{M/N}^{\tilde{\lambda}_I}}{(T_I-1) + \epsilon_{M/N}^{T_I}} \epsilon_M^{T_I} \end{array} \right\} \times \frac{dlogM_I}{dlog\hat{\tau}}, \tag{31}$$

where symmetric trade liberalization increases domestic varieties such that $dM_I/d\hat{\tau} < 0$. The first term reflects the same effect as the first term in equation 30: A lower tariff encourages more entry of producers in international relationships (both home and abroad) which increases welfare. The second term is new and reflects an increase in matching efficiency from more firms in international relationships minus the corresponding decrease in efficiency from domestic relationships. With $\tau > 1$ international consumption is inefficiently low and if $\epsilon_M^{\tilde{\lambda}_I} = \epsilon_M^{\tilde{\lambda}_D}$ a reduction in tariffs increase overall welfare. The third term (which is always positive) reflects the fact that T_D decreases with lower M_D ($\epsilon_M^{T_D} > 0$) which reduces the distortion between number of domestic producers M_D and domestic production per firm, q_D. The fact that $sign(\epsilon_M^{T_I}) = sign(\bar{\varphi} - \varphi)$ (see Appendix D) implies that the fourth term can be both positive and negative. If communication is good ($\varphi > \bar{\varphi}$) an increase in the mass of producers, M_I — which increase the probability of match for the supplier — will reduce the incentive to deviate, lower T_I and thereby increase efficiency. In this case symmetric trade liberalization unambigiously increases welfare.

For the remainder of the paper, I restrict attention to constant-returns-to-scale matching functions.

6.3 Entry subsidies

Given the inefficient entry of producers and suppliers, a natural policy question is the taxation or subsidization of entry. In the following I allow for the subsidy of entry by introducing χ_M^D and χ_M^I as the subsidy (measured in units of labor) to home domestic and international producers with χ_N^D and x_N^I the corresponding values for home suppliers.

Hence, the entry condition for home international producers and suppliers is:

$$f - \chi_M^I = \frac{1}{1-\delta} \lambda_I \frac{1}{\sigma - 1} T_I q_I w^*, \tag{32}$$

$$f - \chi_N^I = \frac{1}{1-\delta} \lambda_I^* (M_I^*/N_I)(T_I^* - 1) q_I^*, \tag{33}$$

with analogous expressions for other firms. I abstract from tariffs. Before proceeding to the objective function of the home policy maker, I note the effect on foreign wages from changes in subsidies. To do that note, that substituting the free entry conditions of the domestic and foreign producers into the trade balance gives:

$$\left[f - \chi_M^I\right] M_I = \left[f - \chi_M^{I*}\right] w^* M_I^*. \tag{34}$$

Total discounted profits of a producer must equal $f - \chi_M^I$ and be proportional to per-period expected revenue of a producer. All else equal a disproportionate increase in home producers relative to foreign producers will increase demand for foreign labor and thereby increase foreign wages. Using this, one can show that (see Appendix H):

$$\frac{dlogw^*}{d\chi_M^I} = \frac{\frac{\sigma - \epsilon}{\sigma - 1}}{detA} \frac{(\epsilon - 1)}{(1 + \frac{1}{T-1}\epsilon_{T_I})} \left[\frac{1 + \epsilon_{\lambda_I}}{\sigma - 1} + \epsilon_{T_I} \frac{\left(\frac{\sigma}{\sigma - 1} - T_I\right)}{T_I - 1}\right] \frac{1}{f - \chi_M} > 0 \tag{35}$$

$$\frac{dlogw^*}{d\chi_N^I} = \frac{\frac{\sigma - \epsilon}{\sigma - 1}}{detA} \frac{(\epsilon - 1)}{(1 + \frac{1}{T_I - 1}\epsilon_{T_I})} \left(\frac{\epsilon_{\lambda_I}}{\sigma - 1} - \epsilon_{T_I}\right) \frac{1}{f - \chi_N} < 0, \tag{36}$$

where $detA/(\frac{\sigma-\epsilon}{\sigma-1}) \in (1, 2\sigma)$ is a (scaled) determinant of a two-by-two-system of equations. Consider first the expression in the parentheses in equation (35): There are two effects from an increase in the number of home producers on foreign wages: First, as captured by the term with $(1 + \epsilon_{\lambda_I})$, a higher number of home international producers the foreign labor. Second, as captured by the term with ϵ_{T_I} if a higher M_I/N_I^*increases T_I which further increases foreign wages (as $\sigma/(\sigma - 1) > T_I$). One can show that even if $\epsilon_{T_I} < 0$ the positive effect must always dominate and $dlogw^*/d\chi_M^I \geq 0$. Note that as $\epsilon \to 1$ the aggregator of the utility function is Cobb-Douglas and the spending on foreign varieties is constant, in which case $dlogw^*/d\chi_M^I \to 0$. Further, note that when $M_I/N_I^* \to \infty$, $1 + \epsilon_\lambda \to 0$ and $\epsilon_T \propto (1 + \epsilon_\lambda)$ such that $dlogw^*/d\chi_M^I \to 0$: Once the ratio of producers to suppliers is very high further subsidizing will have no impact on the mass of producers and therefore none on foreign wages.

Consider then equation (36) which gives the impact on foreign wages from subsidizing home international suppliers: More international suppliers will increase the number of matched foreign producers (with an elasticity of $-\epsilon_{\lambda_I}$) which increases demand for home labor and reduces relative foreign wages. For the second effect, suppose that having relatively more home suppliers (compared with foreign producers) increases payment to home suppliers ($\epsilon_{T_I} < 0$). A larger mass of home suppliers will drive up the necessary payment, T_I^* to home suppliers. The constant mark-up charged by foreign producers implies higher prices, lower demand and consequently less overall demand for home exports, pushing in the direction of higher foreign wages. Again, when $\epsilon \to 1$ there is no effect on wages from changes in subsidies, and $dlogw^*/d\chi_N^I$ approaches zero when the relative number of foreign producers compared with home suppliers is very low ($M_I^*/N_I \to 0$).

The objective of the domestic policymaker is:

$$max_{\chi_N^I,\chi_M^I,\chi_N^D,\chi_N^D} \left(Q_D^{\frac{\epsilon-1}{\epsilon}} + (\nu/(1-\nu))^{\frac{1}{\epsilon}} Q_I^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}},$$

where I focus on the case of $\nu \to 0$. It follows immediately from Lemma 6.1 that the domestic policy maker must set subsidies such that $M^D = N^D$. Further, at $\nu \to 0$, the domestic optimal is set independently of international considerations and $q_D = \frac{2f(1-\delta^S)}{\lambda(1,1)}(\sigma - 1)$.

The first order conditions for χ_M and χ_N become:

$$\frac{dU}{d\chi_z^I} \propto -\frac{dlogw^*}{d\chi_z^I} - \frac{\epsilon_{T_I}}{(1+\frac{1}{T_I-1}\epsilon_{T_I})}\left[\frac{2dlogw^*}{d\chi_z^I} + \frac{1}{f-\chi_z^I}\right] \tag{37}$$

$$+\left[\frac{(\epsilon_{\lambda_I}+1)}{\sigma-1} - \frac{(1-\delta^S)f}{\lambda_I q_I}\right]\frac{dlogM_I}{d\chi_z^I} - \frac{(1-\delta^S)f}{\lambda_I^* M_I^*/N_I q_I^*}\frac{dlogN_I}{d\chi_z^I} - \frac{\epsilon_{\lambda_I}}{\sigma-1}\frac{dlogN_I^*}{d\chi_z^I}$$

$$+\frac{T_I - T_D}{T_D}\left[\frac{\sigma}{\sigma-1}\frac{dlog\lambda_I M_I}{d\chi_z^I} + \frac{dlogq_I}{d\chi_z^I}\right] = 0,$$

where the first line constitutes simple terms-of-trade gains: A direct effect negative effect on domestic utility from higher foreign wages, as well as an effect on the payments to producers. Consider first an increase in χ_M^I. This will directly encourage entry of home foreign producers. If communication is good, $\varphi > \bar{\varphi}$ then this will encourage cooperation from foreign suppliers and the payment can be reduced ($\epsilon_{T_I} < 0$) implying a positive effect on utility. The additional term in wages comes from the fact that increases in foreign wages encourages the entry of home producers and suppliers with further reduces T and improves welfare. The exact expressions for the derivatives can be found in Appendix H.

The second line comes from direct changes to the number of firms: More home international producers will increase the number of varieties (with an elasticity of $0 < \epsilon_{\lambda_I} + 1 < 1$) but have an opportunity cost in terms of labor equivalent to $(1 - \delta^S) f / \lambda_I q_I$ (if $M_I = N_I^*$ and q_I is set at the optimal domestic level, q_D, this effect is zero). An increase in N_I increases the fixed costs of production without increasing the number of varieties and an increase in N_I^* increases ($0 < -\epsilon_{\lambda_I} < 1$) the number of varieties at home without increasing the fixed costs of production.

The third and final line only exists when $T_I > T_D$ and arises from the inefficiently low consumption of foreign varieties: Either an increase in active varieties $\lambda_I M_I$ or consumption thereof, q_I, increases utility.

Proposition 4. *Consider the first order conditions of equation. It holds that:*

i) There are more produces than suppliers in equilibrium $M_I/N_I^* \geq 1$

ii) The relative number of producers is decreasing in the efficiency of transmission of information, : $d(M_I/N_I^*)/d\varphi \leq 0$.

iii) There exists some $\hat{\delta}^S$ *for which all* δ^S *which* $\delta^S \leq \hat{\delta}^S$*:* $q_I > \hat{q}$

iv) For poor communication: $\varphi \leq \bar{\varphi}$ *it holds that:*

- $lim_{\epsilon \to \sigma}(M_I/N_I^*) = 1$ *and* $lim_{\epsilon \to \sigma} q_I = \hat{q}$

- $lim_{\epsilon \to 1}(M_I/N_I^*) = \infty$. *and* $lim_{\epsilon \to \sigma} q_I = \infty$. [25]

v) For good communications $\varphi > \bar{\varphi}$

- $lim_{\epsilon \to \sigma}(M_I/N_I^*) = 1$ *and* $lim_{\epsilon \to \sigma} q_I = \hat{q}$

- $0 < lim_{\epsilon \to 1}(M_I/N_I^*) < \infty$ *and* $lim_{\epsilon \to \sigma} q_I > \hat{q}$.

Proof. See Appendix G □

To see the intuition for this consider figure 6 which plots the points in (χ_M, χ_N) space where each one of the first order conditions of equation (37) are met. Define these as $\phi_N(\chi_M, \chi_N) = 0$ and $\phi_M(\chi_M, \chi_N) = 0$ for the first order condition of χ_N and χ_M, respectively.[26] It further plots as a stabled line the combination of χ_M, χ_N that gives $M_I/N_I^* = 1$, with points above the line having $M_I/N_I^* > 1$ and those below $M_I/N_I^* < 1$.

[25]Specifically, if $\varphi = \bar{\varphi}$then $lim_{\epsilon \to 1}(M_I/N_I) \propto (\epsilon - 1)^{-1/2}$ and if $\varphi < \bar{\varphi}$ then $lim_{\epsilon \to 1}(M_I/N_I) \propto (\epsilon - 1)^{-1}$ and for all $\varphi \leq \bar{\varphi}$, $lim_{\epsilon \to 1} q_I \propto (\epsilon - 1)^{-1}$.

[26]Though, related, this is strictly speaking not a best-response function as there are four decision variables, $\chi_M^I, \chi_N^I, \chi_M^{I*}, \chi_N^{I*}$. The symmetry allows me to plot it in a two-dimensional space.

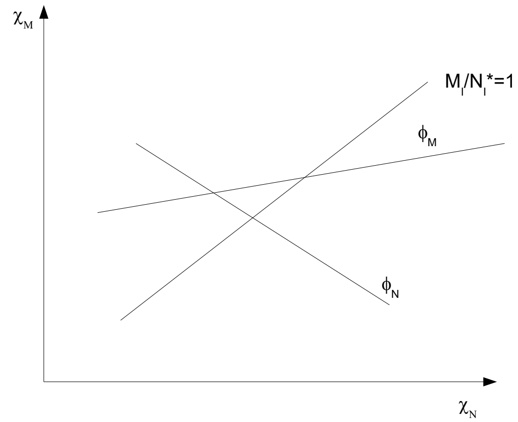


Figure 6: Equilibrium in entry subsidies, χ_M and χ_N. ϕ_M represents the optimal χ_M given χ_N and ϕ_N the optimal χ_N given χ_M. The line $M_I/N_I^* = 1$ represents the combination of χ_M and χ_N that would give $M_I/N_I^* = 1$. The intersection of ϕ_M and ϕ_N is always to the left of $M_I/N_I^* = 1$ and the equilibrium must feature $M_I/N_I^* > 1$.

The slope of ϕ_N is lower than ϕ_M, though they need not have the signs depicted here. Importantly, the intersection between the two is such that $M_I/N_I^* > 1$.

To see why, consider first the case where $\varphi = \bar{\varphi}$ such that $\epsilon_{T_I} = 0$ and T_I remains constant. Counter to the result in Proposition 4 suppose that $M_I/N_I^* = 1$ such that $\epsilon_{\lambda_I} = -1/2$. Then the first order conditions can be written as:

$$\phi_z = -\frac{dlogw^*}{d\chi_z^I} + \left[\frac{1/2}{\sigma-1} - \frac{(1-\delta^S)f}{\lambda_I q_I}\right]\left[\frac{dlogM_I}{d\chi_z^I} + \frac{dlogN_I}{d\chi_z^I}\right]$$

$$+\frac{1/2}{\sigma-1}\left[\frac{dlogN_I^*}{d\chi_z^I} - \frac{dlogN_I}{d\chi_z^I}\right] + \frac{T_I - T_D}{T_D}\left[\frac{\sigma}{\sigma-1}\frac{1}{2}\left(\frac{dlogM_I}{d\chi_z} + \frac{dlogN_I^*}{d\chi_z}\right) + \frac{dlogq_I}{d\chi_z}\right] = 0,$$

where I have used that $dlogM_I^*/d\chi_z = dlogN_I^*/d\chi_z$ and

$dlogq_I/d\chi_z = -1/2\left[dlogM_I/d\chi_z - dlogM_I^*/d\chi_z\right]$. The four terms capture four effects of changing the subsidies: The *terms-of-trade effect* captures the fact that an increase in the subsidy to producers increases demand for foreign products which raises their price and thereby reduces welfare. A subsidy to suppliers, however, increases demand for home products and increases home welfare. The second term captures the *increased-variety effect*. For $dlogM_I/d\chi_z$ it is the difference between an increase in variety from more active products and the higher fixed cost. For $dlogN_I/d\chi_z$ it captures an analogous effect for the supplier if N_I^* had gone up correspondingly with N_I. This term is the only that would survive in a domestic setting and illustrates where the result of efficient production in Lemma 6.1 comes from. One can demonstrate that:

$$\frac{dlogM_I}{d\chi_M} + \frac{dlogN_I}{d\chi_M} > \frac{dlogM_I}{d\chi_N} + \frac{dlogN_I}{d\chi_N},$$

for $\epsilon \in (1, \sigma)$. The reason is that whereas both a subsidy to producers and suppliers have a direct impact on the mass of firms, a subsidy to suppliers raises relative home wages and makes entry costs more expensive. If q_I is above the efficient level, an increase in subsidies will increase utility but more so for subsidies to producers.

The third term captures the fact that home suppliers do not increase one for one with foreign suppliers..

$$\frac{dlogN_I^*}{d\chi_N} - \frac{dlogN_I}{d\chi_N} = -\frac{dlogw^*}{d\chi_N} - \frac{1}{f - \chi_N} < 0,$$

$$\frac{dlogN_I^*}{d\chi_M} - \frac{dlogN_I}{d\chi_M} = -\frac{dlogw^*}{d\chi_M} > 0,$$

an increase in subsidies to suppliers always increases home suppliers more than foreign suppliers, whereas an increase in subsidies to producers increases the stock of foreign suppliers by more than domestic suppliers. One can show that this effect dominates the terms-of-trade effect and pulls in the direction of higher subsidies to producers. The fourth term comes from the fact that if $T_I > T_D$ imports are constrained and an increase in international varieties will improve welfare. Rewrite:

$$\left[\frac{\sigma}{\sigma-1}\frac{1}{2}\left(\frac{dlogM_I}{d\chi_N} + \frac{dlogN_I^*}{d\chi_N}\right) + \frac{dlogq_I}{d\chi_N}\right] = \frac{\sigma}{\sigma-1}\frac{dlogM_I}{d\chi_N} - \frac{2\sigma-1}{\sigma-1}\frac{1}{2}\left[\frac{dlogw^*}{d\chi_N}\right],$$

$$\left[\frac{\sigma}{\sigma-1}\frac{1}{2}\left(\frac{dlogM_I}{d\chi_M} + \frac{dlogN_I^*}{d\chi_M}\right) + \frac{dlogq_I}{d\chi_M}\right] = \frac{\sigma}{\sigma-1}\frac{dlogM_I}{d\chi_N} - \frac{2\sigma-1}{\sigma-1}\frac{1}{2}\left[\frac{dlogw^*}{d\chi_M} + \frac{1}{f-\chi_M}\right],$$

where the two terms in the first equation reflect the increase in variety from more domestic producers and that lower foreign wages ($dlogw^*/d\chi_N < 0$) implies higher quantity, q_I. The second equation is interpreted analogously, but reflecting that a direct transfer is paid. Using the exact expressions from Appendix H demonstrates that the positive effect from producer subsidy dominates.

In conclusion, when $q \geq \hat{q}$ the sum of the four terms are higher for home producers, and for any $\phi_N(\chi_M', \chi_N') = 0$ with $M_I/N_I^* = 1$ we must have $\phi_M(\chi_M', \chi_N') \geq 0$. Even when $q > \hat{q}$ one can show that this must hold and furthermore for any $\phi_M(\chi_M'', \chi_N'') = 0$ with $M_I/N_I^* = 1$ we must have $\phi_N(\chi_M'', \chi_N'') \leq 0$. Consequently we must have $M_I/N_I^* \geq 1$

in equilibrium and there are inefficiently many producers compared with suppliers. This happens in spite of the fact that encouraging the entry of producers increases foreign wages and therefore has a negative terms-of-trade effect. The reason is that whereas both fewer producers and suppliers saves on fixed cost of operation, f, fewer producers reduces the number of varieties to be enjoyed by the representative agent whereas fewer suppliers do not.

When $\varphi < \bar{\varphi}$ and therefore, $\epsilon_T > 0$ fewer suppliers imply a higher payment to home suppliers (all else equal). This further increases the incentive to reduce the number of suppliers as laid out in part i) of the proposition. However, when $\varphi > \bar{\varphi}$ fewer suppliers reduce the payment to home suppliers and discourage the reduction in number of suppliers (part ii). For the same reason the ratio M_I/N_I^* is decreasing in the efficiency of transmission, φ.

When entry is distorted in general fewer international matches exists which tends to drive up production per unit beyond the domestic production ($\hat{q}$). Hence, when international trade is relatively unconstrained such that T_I is close to T_D it is easy to find examples where production is higher than the domestic amount: $q_I > \hat{q}$. However, for sufficiently constrained international trade, say, for sufficiently low δ, the optimal strategy "over-compensated" by encouraging the entry of international producers and suppliers which drives down the production per unit below $q_I < \hat{q}$.

Finally, when $\epsilon \to 1$ and $\varphi = \bar{\varphi}$ changes in subsidies do not affect w^* and

$lim_{\epsilon\to 1} dlog N_I/d\chi_N = 1/(f - \chi_M)$ dominates in the first order condition for χ_N. Increasing home suppliers only has the negative impact of increasing fixed costs of operation and the equilibrium features $lim_{\epsilon\to 1} M_I/N_I^* = \infty$. When $\varphi > \bar{\varphi}$ and communications are good lowering the number of suppliers reduces the payment they receive which offsets the savings of lower operating costs and ensures that $lim_{\epsilon\to 1} M_I/N_I^* < \infty$ (see the details for the specific limits in the Appendix). The higher is ϵ the more sensitive demand is to changes in prices and in the limit of $\epsilon \to \sigma$ any deviation from $M_I/N_I^* = 1$, which shift consumption entirely towards domestic varieties, is undesirable.

7 Conclusion

Contract enforcement is generally weaker between international parties than between domestic parties. I construct a general equilibrium model of international trade in which a final good producer can renege on payment to a supplier after receiving an intermediate input. However, repeated interaction can serve as a substitute for formal court enforcement. The effectiveness of this mechanism depends on whether information of nonpayment is effectively transmitted to other potential suppliers, which allows for punishment through exclusion by multiple suppliers. The combined effect of weak contract enforcement and reputational concerns ability to overcome it can be captured by a single variable that restricts international trade. The model is flexible enough to allow for several extensions. In particular, I consider the role of banks as third parties and show that through size they can gain credibility and ensure more trade. The model replicates the most salient features of the industry for bank guarantees: it is highly concentrated; the providers of guarantees are predominantly local banks; banks engaged in long standing relationships confirm each other's guarantees; and the demand for such guarantees can increase during times of uncertainty. Further, the model demonstrates new sources of gains from manipulating tariffs and from trade liberalization.

This model is well suited to address other issues. Rose (2005) estimates a negative effect from sovereign defaults on trade flows and identifies the drying up of trade finance as a likely culprit. That notion could be formalized by introducing sovereign debt into the present model and letting the lenders to sovereigns also be the providers of trade finance. An alternative extension could focus on export credit agencies, which are important practical facilitators of international trade (about 12 per cent of world trade according to Gianturco, 2001). A likely explanation for their importance is government involvement on the exporters' side, which enables allows for a broader set of punishment in case of non-payment. Finally, the matching process is assumed here to be exogenous. An interesting path for future research would involve allowing firms to search actively for domestic or international partners as a function of contract enforcement effectiveness.

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Appendix

A Banks

A.1 Banks Crisis

Consider the model with a bank as described above and let the parameters be such that an equilibrium with bank guarantees can be supported (i.e. $\mathcal{P}$ is nonempty). Introduce a probability ϵ ($0 < \epsilon < 1$) every period that the bank dies (in which case the model reverts to the previous model without a bank). The equilibrium is then as in Proposition 3 but with $\delta (1 - \epsilon)$ replacing δ. Furthermore, the following statements hold.

Lemma 2. *(a) There exists an $0 < \bar{\epsilon} \leq 1$, such that for $\epsilon > \bar{\epsilon}$ no equilibrium with bank guarantees are possible and $\epsilon \leq \bar{\epsilon}$ allows for bank guarantees,*

(b) Equilibrium trade is discontinuous at $\epsilon = \bar{\epsilon}$. At this point, an increase in ϵ — or in the value α of relationship or a decrease in the probability of breakup, π_b — leads to a discontinuous drop in international trade and welfare.

The bank's fragility as a provider of guarantees naturally relates to how financial crises affect trade patterns, though it is in general not clear whether an overall increase in uncertainty will increase the demand for bank guarantees by making open account transactions riskier or reduce it through the reduced confidence in the bank. Auboin (2009) and Chor and Manova (2012) both argue that trade finance contraction had a negative impact on trade flows and Auboin and Meier-Ewert (2003) and Auboin (2007) further argue that low confidence in Asian banks constrained their ability to issue credible letters of credit, which constrained Asian imports during the Asian crisis. Levchenko, Lewis, and Tesar (2010) find that US exports who rely less on trade credit — and therefore presumably more on trade finance — were more affected by the crisis. Eaton, Kortum, Neiman and Romalis (2015)**?** find that the ratio of global trade to GDP declined by nearly 30 per cent during the 2008–2009 recession, but they account for most of this decline by compositional and demand effects. They, however, primarily focus on OECD countries, most of which are within Europe where issues of international contract enforcement are presumably lower than elsewhere.[27]

[27] Bernard, Redding, and Schott (2010) find that US exports to countries affected by the Asian crisis was much less affected for related parties (within multinationals) where issues of contract enforcement are presumably less of an issue. Amiti and Weinstein (2011) find a similar pattern for Japan in the 1990s.

A.2 Mutually Confirmed Letters of Credit

A great many of letters of credit are confirmed by an additional bank, which is usually located in the exporter's country. In the following section I incorporate that feature by allowing the two banks, B and B^*, to extend guarantees to one another instead of directly to the foreign suppliers. Thus, the particular stage game of Figure 2b is extended by adding a foreign bank such that, after the home bank makes an offer to the foreign bank of confirming all contracts of (q', T', F), the foreign bank can agree (or not) to confirm that offer before the producer makes an offer to the supplier. If banks mutually confirm each others' guarantee, then the net amount that needs to be transferred between the two countries — and hence the amount that could be defaulted on — can be considerably smaller.[28] In effect, mutually confirmed guarantees partially transform international obligations into domestic obligations, which are more easily enforced. To clarify the effects of a confirming bank, in this section I consider the following specific set of parameters.

Criterion. *The parameter set is such that the game with a bank (as described in Section 3.4) cannot achieve the first-best allocation:* $p^B > p_D$.

Also, I will perturb the game slightly so that although all exports from the home country to the foreign country are subject to imperfect international contract enforcement. Only a fraction n ($0 \leq n \leq 1$) of exports from foreign country to home country are subject to such imperfect contract enforcement. The remaining fraction, $1 - n$, can be perfectly enforced and are exogenously prevented from using bank guarantees. These two assumptions are imposed in order to make the problem interesting. The first guarantees that there is an inefficiency to be overcome. The second ensures that this inefficiency cannot be trivially overcome as symmetry in the two-county model implies that if banks guarantee all trade then the net outstanding between banks is always zero and so efficient trade can always be guaranteed. These considerations lead to the following proposition.

[28]In the law literature, this concept is referred to as "set-off" or "netting" (Wood, 1980; McKnight, 2008). Although the specific details vary across judicial systems, English law is clear on the matter: if a claim that is due is not honored, the debtor has the right of set-off; in the case of insolvency or bankruptcy, even contract clauses specifically prohibiting set-off will typically be ignored (Wood, 1980, 7.4). The situation under French law is less clear, but the parties usually specify in letters of credit, either international arbitration or that a dispute is to be heard in London (implying English law). This convention brings up another point: because conflicts are often heard in English courts, the expertise of these courts — as well as the relatively strong contract enforcement by English law — would be another argument favoring letters of credit.

Proposition 5. *Consider the game with two banks. A PBE with the first-best production (L/M) for all varieties and with $T^B = 1$, can be achieved if $n \geq \bar{n}$, where $\bar{n}$ is given by*

$$\frac{\delta}{1-\delta}\left((p_D - 1) - (p^O - 1)(p^O/p_D)^{-\sigma}\right) = (1-\phi)\,(1-\bar{n})\,. \tag{38}$$

The left-hand side of equation (38) is identical to the LHS of inequality (18) for the case of unconfirmed letters of credit, whereas the RHS is smaller to reflect that bilateral guaranteed trade implies a lower net outstanding. In fact, the higher is the fraction of home imports that require guarantees, the more balanced are the mutual outstanding obligations of the two banks and the greater are incentives *not* to deviate.[29]

The option of introducing an additional agent relates this paper to an emerging literature on central clearing partners (CCPs) for the trading of financial derivatives (Duffie and Zhu, 2010).

A.3 Banks as Providers of Credit

In addition, it is standard practice to couple the bank guarantee with extension of credit to the exporter (the supplier, in this model) before production takes place. This coupling can be captured naturally by a small perturbation of the present model. Consider an extension of the open account model in which the supplier must obtain credit before he can start producing. By taking out a loan before production of q, he establishes an obligation to the bank that provides the credit. At the same time, through a confirmed letter of credit the supplier obtains the bank's promise to provide the payment Tq once shipment has been made. Yet by coupling the two functions and having the bank provide both the guarantee and the original credit, the net outstanding between the two is only $(T-1)\,q$, which is equal to zero in the optimal PBE of open account. The assumption of perfect domestic contract enforcement implies that there are no costs to domestic liabilities but extending the model to incorporate issues of domestic contract enforcement would also allow for an efficiency gain when coupling the two, just as they often are in practice.

[29] In the theory of this section a bank's only role is to provide letters of credit. In practice, banks engage with each other in a number of ways besides letters of credit and often with outstanding amounts that are orders of magnitude higher than those associated with letters of credit (examples are derivatives and currency trading). In other words, the amount outstanding on letters of credit is dwarfed by a bank's total gross outstanding. In this case, the cost of reneging on a letter of credit is more than being cut off from the letter of credit market; it also includes the cost of being cut off from other international activities that are critical for the functioning of most modern banks.

B A large intermediary

I keep the search technology unchanged, so that the intermediary does not facilitate contact but does guarantee high-quality shipment to the producer. The setting in this case is completely analogous to that of the intermediary bank and I can demonstrate the following lemma.

Lemma 3. *Consider the prepayment model as previously described but now add an intermediary (in each country) that guarantees quality of the shipment. welfare-maximizing PBE has the unique allocation (q_D^I, q_I^I) as follows.*

Let $\mathcal{P} \subset R^+$ be the set of p for which

$$\frac{\delta}{1-\delta}\left[p - 1 - (p^P - 1)(p^P/p_D)^{-\sigma}\right] \geq (1-\rho)$$

holds, where an equilibrium an active intermediary will exist only if $\mathcal{P}$ is non-empty. Then (superscript I for intermediary) $p^I = min\{\mathcal{P}\}$, $q^I = L(p^I/P^I)^{-\sigma}$, with $p^I < p^P$, $q^I = L(p^I/P^I)^{-\sigma}$, $T^I = p^I$, and P^I is the ideal price index with non-financial intermediaries. In this case the following statements hold.

(i) p^I is increasing in the quality of communication (φ) and decreasing in probability of a relationship breaking up (π_b)

(ii) Welfare per worker is given by

$$v\left(p_D, p^I\right) = \left(\frac{M}{2}\right)^{\frac{1}{\sigma-1}} \frac{\left[\left(p_D\right)^{1-\sigma} + \left(p^I\right)^{1-\sigma}\right]^{\frac{\sigma}{\sigma-1}}}{p_D^{-\sigma} + \left(p^I\right)^{-\sigma}} > v\left(p_D, p^P\right).$$

Proof. Analogous to Appendix C. □

C Strategic substitutability and complementarity

Consider an equilibrium in which a fraction μ of contracts are done with open account and a fraction $(1-\mu)$ are done on pre-payment. When contracts are constrained, the incentive constraints are by definition:

$$\left[a\Pi_M^O + (\varphi - \bar{\varphi})b_M\left[\mu\Pi_M^O + (1-\mu)\Pi_M^P\right]\right] = (1-\phi)q^O,$$

$$\left[a\Pi_N^P + (\varphi - \bar{\varphi})b_N\left[\mu\Pi_N^O + (1-\mu)\Pi_N^P\right]\right] = (1-\rho)q^P.$$

where we write $a \equiv \delta\delta^S(1-\pi_b)/[1-\delta\delta^S(1-\pi_b)]$, $b_M = \delta\lambda/(1-\delta)$, $b_N \equiv \delta\lambda_I \cdot (M_I/N_I^*)/(1-\delta)$ for notational convenience. I first consider the case of $\varphi > \bar{\varphi}$ and then $\varphi \leq \bar{\varphi}$. I let π_M be the probability of a producer finding a match and π_N the probability that a supplier will.

Further, note that an IR constraint has to be binding for open account. It is no longer possible to have $\Pi_N^O = 0$ because the supplier would rather go back into the pool and search for somebody else. Instead I impose the constraint that:

$$V_N^O \geq V_N^H,$$

which will be binding. Using equation 6 as well as the definition of the outside option: $V_N^H = \pi_N \left[\mu V_N^O + (1-\mu)V_N^P\right] + \delta(1-\pi_N)V_N^H$ gives:

$$\Pi_N^O = (1-\delta)V_N^H = \frac{\pi(1-\mu)\Pi^P}{\{(1-\pi)\left[\mu - \delta(1-\pi_b)\delta^S\right] + (1-\mu)\}},$$

from which it follows that $\Pi_N^O \leq \Pi_N^P$ Further, $\partial\Pi_N^O/\partial\mu \geq 0$.

The case where $\varphi > \bar{\varphi}$

Step 1: There are parameter values for which $\Pi_M^O|_{\mu=0} < \Pi_M^P|_{\mu=0}$ and $\Pi_M^O|_{\mu=1} > \Pi_M^P|_{\mu=1}$ that is, when only open account contracts are used it is optimal to use open account and when only pre-payment is used it is optimal to use pre-payment. When this is the case there must also exist a value $0 < \bar{\mu} < 1$ for which $\Pi_M^P|_{\mu=\bar{\mu}} = \Pi_{\mu=\bar{\mu}}^O$ and producers are indifferent between using the two contracts.

Proof: Consider the case of $\pi_M \to 0$ and $\pi_N \to 1$ such that $b_M = 0$. This implies that open account prices are independent of other uses of contracts:

$$p^O|_{\mu=0} = p^O|_{\mu=1} = \frac{(1-\phi)}{\alpha} + 1,$$

such that

$$\Pi_M^O|_{\mu=0} = \Pi_M^O|_{\mu=1} = \frac{(1-\phi)}{\alpha}\left(\frac{1-\phi}{\alpha} + 1\right)^{-\sigma} P_I^\sigma Q_I.$$

And for pre-payment:

$$\left[a\Pi_N^P + (\varphi - \bar{\varphi})b_N\Pi_N^P\right] = (1-\rho)q^P \Leftrightarrow T|_{\mu=0} - 1 = \frac{1-\rho}{a + (\varphi - \bar{\varphi})b_N}$$

which gives profits for the producer of:

$$\Pi_M^P|_{\mu=0} = \frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}\left(\frac{(1-\rho)}{a+(\varphi-\bar{\varphi})b_N}+1\right)^{1-\sigma} P_I^\sigma Q_I,$$

such that the requirement for $\Pi_M^O|_{\mu=0} < \Pi_M^P|_{\mu=0}$ is:

$$\frac{(1-\phi)}{\alpha}\left(\frac{1-\phi}{\alpha}+1\right)^{-\sigma} < \frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}\left(\frac{(1-\rho)}{a+(\varphi-\bar{\varphi})b_N}+1\right)^{1-\sigma}.$$

And for $\mu = 1$ we have that the constraint for pre-payment is:

$$\left[a\Pi_N^P|_{\mu=1}\right] = (1-\rho)q^P|_{\mu=1} \Leftrightarrow T|_{\mu=1} - 1 = \frac{1-\rho}{a},$$

such that the equivalent condition becomes:

$$\frac{(1-\phi)}{a}\left(\frac{1-\phi}{a}+1\right)^{-\sigma} > \frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}\left(\frac{(1-\rho)}{a}+1\right)^{1-\sigma},$$

which can be met as $\varphi - \bar{\varphi} > 0$ and $\sigma > 1$ (but not if $\varphi < \bar{\varphi}$). An example is $\sigma = 4$, $\phi = 0.2$, $\delta = 0.5$, $\pi_b = 0.5$, $\pi_N = 1$, $\varphi = 1$ (which gives $a = 1/3$), $b_N = 1$. Since the condition is met strictly for these parameters it can also be met for $b_M > 0$.

Step 2: If $\Pi_M^O|_{\mu=0} > \Pi_M^P|_{\mu=0}$ then Π_M^O is preferable for all parameter values.

Proof: Suppose not, then there exists some parameter value $\mu = \hat{\mu}$ for which $\Pi_M^O|_{\mu=\hat{\mu}} < \Pi_M^P|_{\mu=\hat{\mu}}$, which implies that the two curves must have crossed in μ space with Π_M^P coming from below. This requires:

$$\frac{d\Pi_M^O}{d\mu}|_{\Pi_M^P=\Pi_M^O} < \frac{d\Pi_M^P}{d\mu}|_{\Pi_M^P=\Pi_M^O}.$$

Differentiate the condition for open account:

$$\left[a+(\varphi-\bar{\varphi})b_M\mu - \frac{(1-\phi)}{\frac{\sigma-1}{\sigma}p-1}\right]\frac{d\Pi_M^O}{d\mu}|_{\Pi_M^P=\Pi_M^O} = -(\varphi-\bar{\varphi})b_M(1-\mu)\frac{d\Pi_M^P}{d\mu}|_{\Pi_M^P=\Pi_M^O}. \quad (39)$$

We have:

$$\left[\left(a+(\varphi-\bar{\varphi})(1-\mu) - \frac{(1-\rho)}{q[(1-\sigma)+\sigma/T)}\right)\frac{d\Pi_N^P}{d\mu}\right] = -(\varphi-\bar{\varphi})b_N\left[\Pi_N^O - \Pi_N^P + \mu\frac{d\Pi_N^O}{d\mu}\right].$$

$\left(a+(\varphi-\bar{\varphi})(1-\mu)-\frac{(1-\rho)}{q[(1-\sigma)+\sigma/T)}\right) < 0$, otherwise this wouldn't be an optimal Π_N^P. Further, $\frac{d\Pi_N^O}{d\mu} \geq 0$. Hence, with $\Pi_N^O > \Pi_N^P$ we must have $d\Pi_N^P/d\mu|_{\Pi_M^P=\Pi_M^O} < 0$, that is more open accounts makes it less feasible to use pre-payment. Lower sales also implies that $d\Pi_M^P/d\mu|_{\Pi_M^P=\Pi_M^O} < 0$. Hence, from equation (39) we must have $d\Pi_M^O/d\mu|_{\Pi_M^P=\Pi_M^O} < 0$ as well. So for the two to cross we must have:

$$\frac{(1-\phi)}{\frac{\sigma-1}{\sigma}p-1} - a - (\varphi-\bar{\varphi})b_M\mu > (\varphi-\bar{\varphi})b_M(1-\mu) \Leftrightarrow$$

$$\frac{(1-\phi)}{\frac{\sigma-1}{\sigma}p-1} - a > (\varphi-\bar{\varphi})b_M,$$

meaning that if this holds for one μ it must hold for all. Hence, the two lines can at most cross once. So if they cross it must hold that $\Pi_M^O|_{\mu=1} < \Pi_M^P|_{\mu=1}$, implying: $\Pi_M^O|_{\mu=0} > \Pi_M^P|_{\mu=0} > \Pi_M^P|_{\mu=1} > \Pi_M^O|_{\mu=1}$. This requires that the highest profits $\Pi_M^O|_{\mu=0}$ that satisfy

$$\left[a\Pi_M^O|_{\mu=0} + (\varphi-\bar{\varphi})b_M\Pi_M^P|_{\mu=0}\right] \geq (1-\phi)q^O|_{\mu=0},$$

for $\Pi_M^P|_{\mu=0} < \Pi_M^O|_{\mu=0}$ must be higher than the highest profits $\Pi_M^O|_{\mu=1}$ that satisfy

$$\left[a\Pi_M^O|_{\mu=1} + (\varphi-\bar{\varphi})b_M\Pi_M^O|_{\mu=1}\right] \geq (1-\phi)q^O,$$

which cannot be because higher profits loosen the IC constraint. Hence, a contradiction.

Step 3: step 2: If $\Pi_M^O|_{\mu=1} < \Pi_M^P|_{\mu=1}$ then Π_M^P is preferable for all parameter values.

Proof follows the same outline as for Step 2 and is omitted.

The case where $\varphi < \bar{\varphi}$

Step 1: There are parameter values for which $\Pi_M^O|_{\mu=0} > \Pi_M^P|_{\mu=0}$ and $\Pi_M^O|_{\mu=1} < \Pi_M^P|_{\mu=1}$ that is, when only open account contracts are used it is optimal to use pre-payment and when only pre-payment is used it is optimal to use open account. When this is the case there must also exist a value $0 < \bar{\mu} < 1$ for which $\Pi_M^P|_{\mu=\bar{\mu}} = \Pi_{\mu=\bar{\mu}}^O$ and producers are indifferent between using the two contracts. This is the only equilibrium.

Proof. Again, consider the case of $b_M = 0$ and note that the inequality from the case of $\varphi > \bar{\varphi}$ are now flipped. Hence, we must require:

$$\frac{(1-\phi)}{\alpha}\left(\frac{1-\phi}{\alpha}+1\right)^{-\sigma} > \frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}\left(\frac{(1-\rho)}{a+(\varphi-\bar{\varphi})b_N}+1\right)^{1-\sigma}.$$

$$\frac{(1-\phi)}{a}\left(\frac{1-\phi}{a}+1\right)^{-\sigma} < \frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}\left(\frac{(1-\rho)}{a}+1\right)^{1-\sigma}.$$

Which since $\varphi < \bar{\varphi}$ can now be met for $b_N > 0$ (change $\rho = 0.8$ and $\varphi = 0.2$ in the numerical example above).

Step 2: There can be at most one intersection of the Π_M^P and Π_M^O curves.

Proof: For there to be one intersection there must have exists an intersection where:

$$\frac{d\Pi_M^O}{d\mu}|_{\Pi_M^P=\Pi_M^O} < \frac{d\Pi_M^P}{d\mu}|_{\Pi_M^P=\Pi_M^O}.$$

but then following steps analogous to Step 3 above, there is only one intersection.

Combining these leads to the following Proposition.

D Increasing Returns to Scale in Matching Function

The probability of being matched by a domestic producer is $\tilde{\lambda}_D$ which is a function of M_D/N_D and M_D with elasticities $\epsilon_{M/N}^{\lambda_D}$ and $\epsilon_M^{\lambda_D}$, respectively. The corresponding $\tilde{\lambda}_I$ gives the probability of a home foreign producer of matching and takes M_I/N_I and M_I as arguments. Let tariffs be denoted by the common variable $\hat{\tau} = \tau = \tau^*$. Due to symmetry I can disregard the distinction between domestic and foreign variables. Continue to let T_I be given by the equations in the text, but now as a function of M_I/N_I and M_I with elasticities $\epsilon_{M/N}^{T_I}$ and $\epsilon_M^{T_I}$, respectively and corresponding expressions for T_D. Using symmetry the labor market clearing condition can be written as:

$$\lambda_D M_D q_D + \lambda_I M_I q_I + (1-\delta^S) f\left[M_D + N_D + M_I + N_I\right] = L. \tag{40}$$

Use the free entry conditions (using that $w^* = 1$):

$$f = \frac{1}{1-\delta}\lambda_M \frac{1}{\sigma-1} T_I q_I \tag{41}$$

$$f = \frac{1}{1-\delta}\lambda_M M/N(T_I - 1)q_I. \tag{42}$$

And differentiate to get:

$$dlog(M_I/N_I) = -\frac{\epsilon_M^{T_I}}{(T_I - 1) + \epsilon_{M/N}^{T_I}} dlogM_I \tag{43}$$

$$-dlogq_I = \frac{\left[\epsilon_M^{\lambda_I} + \epsilon_M^{T_I}\right](T_I - 1) + \left[\epsilon_M^{\lambda_I}\right]\epsilon_{M/N}^{T_I} - \left[\epsilon_{M/N}^{\lambda_I}\right]\epsilon_M^{T_I}}{(T_I - 1) + \epsilon_{M/N}^{T_I}} dlogM_I. \tag{44}$$

I use these along with equations (41)-(42) to differentiate the labor clearing condition (40):

$$\frac{\lambda_D M_D}{\lambda_I M_I}\frac{q_D}{q_I} T_D dlogM_D + T_I dlogM_I = 0.$$

And use (with $w^* = 1$):

$$\frac{q_D}{q_I} = \frac{1-\nu}{\nu}\left[\frac{\lambda_D M_D}{\lambda_I M_I}\right]^{\frac{\epsilon-\sigma}{\sigma-1}}\left[\frac{T_I}{T_D}\tau\right]^{\epsilon} \tag{45}$$

to get

$$\left[\frac{1-\nu}{\nu}\right]^{\frac{\epsilon-1}{\epsilon}}\left[\frac{\lambda_D N_D^M}{\lambda_I N_I^M}\right]^{\frac{\epsilon-1}{\sigma-1}}\left[\frac{\tau T_I}{T_D}\right]^{\epsilon-1} dlogM_D + \frac{1}{\tau} dlogM_I = 0. \tag{46}$$

Then differentiate the utility function to get:

$$dU$$

$$= U^{1/\epsilon} Q_I^{\frac{\epsilon-1}{\epsilon}} \frac{\epsilon-1}{\epsilon}\left\{\left[\frac{(\lambda_D M_D)^{\frac{\sigma}{\sigma-1}}}{(\lambda_I M_I)^{\frac{\sigma}{\sigma-1}}}\frac{q_D}{q_I}\right]^{\frac{\epsilon-1}{\epsilon}}\left[\frac{\sigma}{\sigma-1} dlog\lambda_D M_D + dlogq_D\right] + \left[\frac{\sigma}{\sigma-1} dlog\lambda_I M_I + dlogq_I\right]\right\},$$

where I replace with equations (43) to (46) to get:

$$\left\{U^{1/\epsilon} Q_I^{\frac{\epsilon-1}{\epsilon}} \frac{\epsilon-1}{\epsilon}\right\}^{-1} dU$$

$$= \left[\frac{1-\nu}{\nu}\right]^{\frac{\epsilon-1}{\epsilon}}\left[\frac{\lambda_D M_D}{\lambda_I M_I}\right]^{\frac{\epsilon-1}{\sigma-1}}\left[\frac{T_I}{T_D}\tau\right]^{\epsilon-1}$$

$$\times\left[\frac{\sigma}{\sigma-1} + \frac{1}{\sigma-1}\left(\frac{(T_D - 1)\left(\epsilon_M^{\lambda_D} - (\sigma-1)\epsilon_M^{T_D}\right) + \epsilon_{M/N}^{T_D}\epsilon_M^{\lambda_D} - \epsilon_{M/N}^{\lambda_D}\epsilon_M^{T_D}}{(T_D - 1) + \epsilon_{M/N}^{T_D}}\right)\right] dlogM_D$$

$$+\left[\frac{\sigma}{\sigma-1}+\frac{1}{\sigma-1}\left(\frac{(T_I-1)\left(\epsilon_M^{\lambda_I}-(\sigma-1)\epsilon_M^{T_I}\right)+\epsilon_{M/N}^{T_I}\epsilon_M^{\lambda_I}-\epsilon_{M/N}^{\lambda_I}\epsilon_M^{T_I}}{(T_I-1)+\epsilon_{M/N}^{T_I}}\right)\right]dlogM_I$$

$$=-\frac{1}{\tau}\left[\frac{\sigma}{\sigma-1}+\frac{1}{\sigma-1}\left(\frac{(T_D-1)\left(\epsilon_M^{\lambda_D}-(\sigma-1)\epsilon_M^{T_D}\right)+\epsilon_{M/N}^{T_D}\epsilon_M^{\lambda_D}-\epsilon_{M/N}^{\lambda_D}\epsilon_M^{T_D}}{(T_D-1)+\epsilon_{M/N}^{T_D}}\right)\right]dlogM_I$$

$$+\left[\frac{\sigma}{\sigma-1}+\frac{1}{\sigma-1}\left(\frac{(T_I-1)\left(\epsilon_M^{\lambda_I}-(\sigma-1)\epsilon_M^{T_I}\right)+\epsilon_{M/N}^{T_I}\epsilon_M^{\lambda_I}-\epsilon_{M/N}^{\lambda_I}\epsilon_M^{T_I}}{(T_I-1)+\epsilon_{M/N}^{T_I}}\right)\right]dlogM_I,$$

such that:

$$\left\{U^{1/\epsilon}Q_I^{\frac{\epsilon-1}{\epsilon}}\frac{\epsilon-1}{\epsilon}\right\}^{-1}\frac{dU}{dlog\hat{\tau}}$$

$$=\left\{\begin{array}{c}\left[1-\frac{1}{\tau}\right]\frac{\sigma}{\sigma-1}+\frac{\epsilon_M^{\lambda_I}-\epsilon_M^{\lambda_D}/\tau}{\sigma-1}\\ +\frac{1}{\sigma-1}\frac{1}{\tau}\frac{(T_D-1)(\sigma-1)+\epsilon_{M/N}^{\lambda_D}}{(T_D-1)+\epsilon_{M/N}^{T_D}}\epsilon_M^{T_D}-\frac{1}{\sigma-1}\frac{(T_I-1)(\sigma-1)+\epsilon_{M/N}^{\lambda_I}}{(T_I-1)+\epsilon_{M/N}^{T_I}}\epsilon_M^{T_I}\end{array}\right\}\frac{dlogM_I}{dlog\hat{\tau}},$$

which is equation (31) in the main text. Differentiating equation (45) gives $dlogM_I/d\hat{\tau}<0$.

The elasticity $\epsilon_M^{T_D}$ can be found by differentiating

$$\frac{T_D}{T_D-1}=\sigma+(\sigma-1)\frac{1-\lambda_D M_D/N_D}{1-\lambda_D}, \tag{47}$$

to get:

$$sign(\epsilon_M^{T_D})=sign\left[(M/N-1)\frac{\partial\lambda_I}{\partial M}\right].$$

Since the solution to equation (47) and

$$1=(\sigma-1)\frac{T_D-1}{T_D}\frac{M_D}{N_D},$$

requires $M_D/N_D>1$, it must be the case that $\epsilon_M^{T_D}>0$. One can show that $\left[(T_D-1)(\sigma-1)+\epsilon_{M/N}^{\lambda_D}\right]\left[(T_D-1)+\epsilon_{M/N}^{T_D}\right]^{-1}>0$.

Further, with T_I given by:

$$\frac{T_I}{\sigma-1}\left[\frac{\delta(1-\pi_b)}{1-\delta(1-\pi_b)}+\frac{\delta(\varphi-\bar{\varphi})\lambda_I M_I/N_I}{1-\delta}\right]=(1-\rho),$$

it must be true that $sign(\epsilon_M^{T_I})=sign(\bar{\varphi}-\varphi)$. Finally, one can show that

$$\left[(T_I-1)(\sigma-1)+\epsilon^{\lambda_I}_{M/N}\right]\left[(T_I-1)+\epsilon^{T_I}_{M/N}\right]^{-1}>0.$$

E Endogenous Entry

E.1 Changes in bargaining equilibrium

Consider an increase in contract enforcement ρ. As w^* remains 1 from symmetry and M_D/N_D remains constant, I can rewrite the home labor market clearing condition as

$$\lambda_D M_D q_D+\lambda_I M_I q_I+(1-\delta^S)f\left[M_D+N_D+M_I+N_I\right]=L.$$

Differentiate and use free entry conditions to get:

$$\frac{\lambda_D M_D q_D}{\lambda_I M_I q_I}\frac{\sigma}{\sigma-1}T_D\frac{dlog(M_D)}{d\rho}+\frac{\sigma}{\sigma-1}T_I\frac{dlog(M_I)}{d\rho}+\frac{dlog(\lambda_I q_I)}{d\rho}-(T_I-1)\frac{dlog(M_I/N_I)}{d\rho}=0,$$

Use equation (1) to write:

$$\frac{q_D}{q_I}=\frac{1-\nu}{\nu}\left[\frac{\lambda_D M_D}{\lambda_I M_I}\right]^{\frac{\epsilon-\sigma}{\sigma-1}}\left[\frac{T_I}{T_D}\right]^{\epsilon},$$

to get:

$$\frac{1-\nu}{\nu}\left[\frac{\lambda_D M_D}{\lambda_I M_I}\right]^{\frac{\epsilon-1}{\sigma-1}}\left[\frac{T_I}{T_D}\right]^{\epsilon}\frac{\sigma}{\sigma-1}T_D\frac{dlog(M_D)}{d\rho}+\frac{\sigma}{\sigma-1}T_I\frac{dlog(M_I)}{d\rho}+\frac{dlog(\lambda_I q_I)}{d\rho}-(T_I-1)\frac{dlog(M_I/N_I)}{d\rho}=0$$

Use this after differentiating the utility function to get:

$$\frac{dU}{d\rho}\propto\left\{\left[M_I/N_I^*+1\right]\frac{dlog(\lambda_I)}{dlog(M_I/N_I^*)}+1\right\}\frac{dlog(M_I/N_I^*)}{d\rho}+\frac{dlogq_I}{d\rho}, \tag{48}$$

which is equation (27) in the main text.

Differentiate the free entry conditions of the international producers and suppliers and substitute for $dlogT_I/d\rho$:

$$\left\{\epsilon_{\lambda_I}-(T-1)\right\}dlog(M_I/N_I)+dlogq_I=0.$$

Substitute in equation (48) to get:

$$\frac{dU}{d\rho} \propto \{M_I/N_I\epsilon_{\lambda_I} + T_I\} \frac{dlog(M_I/N_I)}{d\rho}.$$

To see that $dU/d\rho > 0$ consider two cases:

a) $M_I/N_I \leq 1$. Note that $-1 < \epsilon_{\lambda_I} < 0$ and $T_I > 1$, hence, for all $M_I/N_I < 1$, $dU/d\rho > 0$.

b) $M_I/N_I > 1$. For all $M_I/N_I > 1$, $-1/2 < \epsilon_{\lambda_I} < 0$, so sufficient condition for $dU/d\rho < 0$ is:

$$-\frac{1}{2}[M_I/N_I] + T_I < 0.$$

This is clearly most easily met for high M_I/N_I and low T_I. The intersection between the incentive constraint and the free entry condition must always feature a lower M_I/N_I and higher T_I than the intersection between the bargaining condition and the free entry condition. Hence, consider the intersection between the bargaining condition and the free entry condition, which are, respectively:

$$\frac{T_I}{T_I - 1} = \sigma + (\sigma - 1)\frac{1 - \lambda_I M_I/N_I}{1 - \lambda_I},$$

$$1 = (\sigma - 1)\frac{T_I - 1}{T_I}\frac{M_I}{N_I}.$$

The intersection has the highest M_I/N_I and lowest T_I at $\sigma \to \infty$, which gives:

$$lim_{\sigma\to\infty}\frac{M_I}{N_I} = lim_{\sigma\to\infty}\left[1 + \frac{1 - \lambda_I M_I/N_I}{1 - \lambda_I}\right],$$

and implies:

$$lim_{\sigma\to\infty}T_I = 1$$

$$lim_{\sigma\to\infty}M_I/N_I = 2,$$

which implies that for all finite σ:

$$-\frac{1}{2}[M_I/N_I] + T_I > 0$$

and hence $dU/d\rho > 0$ is unambiguously positive.

The incentive constraint:

$$\frac{T_I}{\sigma-1}\left[\frac{\delta\delta^S(1-\pi_b)}{1-\delta\delta^S(1-\pi_b)}+\frac{\delta(\varphi-\bar{\varphi})\lambda_I M_I/N_I}{1-\delta}\right]=(1-\rho).$$

Differentiating shows that LHS is decreasing in π_b implying $dT_I/d\pi_b > 0$.

Differentiating shows that LHS is increasing in δ implying $dT_I/d\delta < 0$

F Tariff Policy

The equilibrium is described by:

The utility maximization condition of home (equation 28) is given by:

$$\frac{q_D}{q_I}=\frac{1-\nu}{\nu}\left[\frac{\lambda_D M_D}{\lambda_I M_I}\right]^{\frac{\epsilon-\sigma}{\sigma-1}}\left[\frac{\tau T_I w^*}{T_D}\right]^{\epsilon}, \tag{49}$$

with a corresponding equation for foreign:

$$\frac{q_D^*}{q_I^*}=\left[\frac{\lambda_D^* M_D^*}{\lambda_I^* M_I^*}\right]^{\frac{\epsilon-\sigma}{\sigma-1}}\left[\frac{\tau^* T_I^*}{T_D^* w^*}\right]^{\epsilon}, \tag{50}$$

The labor market clearing condition in home (equation 26)

$$\lambda_D q_D M_D+\lambda_I^* q_I^* M_I^*+(1-\delta)f\left[M_D+N_D+M_I+N_I\right]=L,$$

with a corresponding equation for foreign.

The entry condition for home domestic and international producers:

$$\frac{\lambda_D}{1-\delta}\frac{T_D}{\sigma-1}q_D=f,\ \frac{\lambda_I}{1-\delta}\frac{T_I w^*}{\sigma-1}q_I=f,$$

And for the suppliers they are:

$$\frac{\lambda_D}{1-\delta}\frac{M_D}{N_D}(T_D-1)q_D=f,\ \frac{\lambda_I^*}{1-\delta}\frac{M_I^*}{N_I}(T_I^*-1)q_I^*=f,$$

with corresponding equations in foreign. And finally, a balance of trade condition requiring:

$$T_I w^*\lambda_I M_I q_I=T_I^*\lambda_I^* M_I^* q_I^*.$$

These equations determine the whole equilibrium as a function of τ and τ^*.

Substituting equation (49) into the first order condition gives:

$$\left[\frac{q_D}{q_I}\right]^{\frac{\epsilon-1}{\epsilon-\sigma}}\left(\frac{\nu}{1-\nu}\right)^{\frac{(\sigma-1)}{(\epsilon-\sigma)}}\frac{\sigma}{\sigma-1}\frac{dlog(M_D)}{d\tau}+\left(\left[\frac{\tau T_I}{T_D}\right]^{-\epsilon}\right)^{-\frac{\sigma(\epsilon-1)}{(\epsilon-\sigma)\epsilon}}\left[\frac{\sigma}{\sigma-1}\frac{dlog(\lambda_I M_I q_I)}{d\tau}-\frac{1}{\sigma-1}\frac{dlog(q_I)}{d\tau}\right]=0. \tag{51}$$

Note, that by using the free entry conditions and the trade balance I can write

$$\frac{dlog(M_I)}{d\tau}=\frac{dlog(M_I^*)}{d\tau}+\frac{dlog(w^*)}{d\tau}. \tag{52}$$

$$\left(1+\frac{\epsilon_T}{T_I-1}\right)\left[\frac{dlogM_I}{d\tau}-\frac{dlogN_I^*}{d\tau}\right]=\frac{dlogw^*}{d\tau} \tag{53}$$

$$-\left\{\frac{\epsilon_{\lambda_I}+1+\epsilon_{T_I}\frac{T_I}{T_I-1}}{1+\frac{\epsilon_{T_I}}{T_I-1}}\right\}\frac{dlogw^*}{d\tau}=\frac{dlogq_I}{d\tau}, \tag{54}$$

where $\epsilon_{\lambda_I}\equiv dlog(\lambda_I)/dlog(M_I/N_I^*)$ and $\epsilon_{T_I}\equiv dlog(T_I)/dlogw^*$. Symmetric expressions exist for $[dlogM_I^*/d\tau - dlogN_I/d\tau]$ and $dlogq_I/d\tau$. Using these expressions in the first order condition (51) along with $dlog(\lambda_I q_I)/d\tau = -dlogw^*/d\tau - \epsilon_{T_I}[dlogM_I - dlogN_I^*]$ gives:

$$\left[\frac{q_D}{q_I}\right]^{\frac{\epsilon-1}{\epsilon-\sigma}}\left(\frac{\nu}{1-\nu}\right)^{\frac{(\sigma-1)}{(\epsilon-\sigma)}}\frac{\sigma}{\sigma-1}\frac{dlog(M_D)}{d\tau} \tag{55}$$

$$+\left(\left[\frac{\tau T_I}{T_D}\right]^{-\epsilon}\right)^{-\frac{\sigma(\epsilon-1)}{(\epsilon-\sigma)\epsilon}}\left[\frac{\sigma}{\sigma-1}\left[\frac{dlog(M_I)}{d\tau}\right]+\frac{1}{\sigma-1}\left\{\frac{\epsilon_{\lambda_I}-(\sigma-1)\left(1+\epsilon_{T_I}\frac{T_I}{T_I-1}\right)}{1+\frac{\epsilon_{T_I}}{T_I-1}}\right\}\frac{dlogw^*}{d\tau}\right]=0.$$

Differentiating the labor market clearing condition gives:

$$\frac{\lambda_D q_D M_D}{\lambda_I^* q_I^* M_I^*}\frac{dlog(N_D^M)}{d\tau}+\frac{dlog(\lambda_I^* q_I^* M_I^*)}{d\tau}+\frac{(1-\delta)f}{\lambda_I^* q_I^* M_I^*}\left[(M_D+N_D)\frac{dlog(M_D)}{d\tau}+M_I\frac{dlog(M_I)}{d\tau}+N_I\frac{dlog(N_I)}{d\tau}\right]=$$

where I have used that the free entry conditions of domestic producers are independent of foreign wages and therefore τ. As a consequence, q_D,λ_D and M_D/N_D remain constant.

Use equation (49), the fact that the equilibrium is symmetric as well as the free entry conditions to find:

$$\left\{1+\frac{\delta f}{\lambda_D q_D}+\frac{\delta f N_D/M_D}{\lambda_D q_D}\right\}\left[\frac{q_D}{q_I}\right]^{\frac{\epsilon-1}{\epsilon-\sigma}}\left(\frac{\nu}{1-\nu}\left[\frac{\tau T_I}{T_D}\right]^{-\epsilon}\right)^{\frac{\sigma-1}{\epsilon-\sigma}}\frac{dlog(M_D)}{d\tau}+\frac{dlog(\lambda_I^* q_I^* M_I^*)}{d\tau}$$

$$+\frac{\delta f}{\lambda_I q_I M_I}\left[M_I\frac{dlog(M_I)}{d\tau}+N_I\frac{dlog(N_I)}{d\tau}\right]=0.$$

Use the free entry condition and equations (52) to (54) as well as the trade balance (34) to find:

$$\left\{1+\frac{\delta f}{\lambda_D q_D}+\frac{\delta f N_D/M_D}{\lambda_D q_D}\right\}\left[\frac{q_D}{q_I}\right]^{\frac{\epsilon-1}{\epsilon-\sigma}}\left(\frac{\nu}{1-\nu}\left[\frac{\tau T_I}{T_D}\right]^{-\epsilon}\right)^{\frac{\sigma-1}{\epsilon-\sigma}}\frac{dlog(M_D)}{d\tau}-\frac{\epsilon_{T_I}}{\left(1+\frac{\epsilon_{T_I}}{T_I-1}\right)}\frac{dlogw^*}{d\tau}-\frac{dlogw^*}{d\tau}$$

$$+\left[1+\frac{(1-\delta)f}{\lambda_I q_I M_I}+\frac{(1-\delta)f}{\lambda_I q_I M_I/N_I}\right]dlog(M_I)+\frac{2\epsilon_{T_I}}{1+\frac{\epsilon_{T_I}}{T_I-1}}\frac{dlogw^*}{d\tau}+\frac{dlogw^*}{d\tau}$$

$$+\frac{\delta f}{\lambda_I q_I M_I/N_I}\left[\frac{1}{\left(1+\frac{\epsilon_{T_I}}{T_I-1}\right)}-1\right]\frac{dlogw^*}{d\tau}=0,$$

where the free entry condition of the home international suppliers ensures that the terms with $dlogw^*/d\tau$ cancel:

$$\left\{1+\frac{\delta f}{\lambda_D q_D}+\frac{\delta f N_D/M_D}{\lambda_D q_D}\right\}\left[\frac{q_D}{q_I}\right]^{\frac{\epsilon-1}{\epsilon-\sigma}}\left(\frac{\nu}{1-\nu}\left[\frac{\tau T_I}{T_D}\right]^{-\epsilon}\right)^{\frac{\sigma-1}{\epsilon-\sigma}}\frac{dlog(M_D)}{d\tau}$$

$$+\left[1+\frac{(1-\delta)f}{\lambda_I q_I M_I}+\frac{(1-\delta)f}{\lambda_I q_I M_I/N_I}\right]\frac{dlog(M_I)}{d\tau}=0.$$

Which I then insert into the first order condition (55) to find:

$$\left[1-\frac{1+\frac{\delta f}{\lambda_I^* q_I^*}+\frac{\delta f N_I^N}{\lambda_I^* q_I^* N_I^{M*}}}{1+\frac{\delta f}{\lambda_D q_D}+\frac{\delta f N_D^N/N_D^M}{\lambda_D q_D}}\frac{\sigma}{\sigma-1}\left[\frac{\tau T_I}{T_D}\right]^{-1}\right]\frac{dlog(N_I^M)}{d\tau}+\left\{\frac{\frac{\epsilon_{\lambda_I}}{\sigma-1}-\left(1+\epsilon_{T_I}\frac{T_I}{T_I-1}\right)}{1+\frac{\epsilon_{T_I}}{T_I-1}}\right\}\frac{dlog(w^*)}{d\tau}=0.$$

I use the free entry conditions in equilibrium to find:

$$\frac{1+\frac{\delta f}{\lambda_I^* q_I^*}+\frac{\delta f N_I^N}{\lambda_I^* q_I^* N_I^{M*}}}{1+\frac{\delta f}{\lambda_D q_D}+\frac{\delta f N_D^N/N_D^M}{\lambda_D q_D}}\left[\frac{\tau T_I}{T_D}\right]^{-1}=\frac{\frac{T_I}{\sigma-1}+T_I}{\frac{T_D}{\sigma-1}+T_D}\left[\frac{\tau T_I}{T_D}\right]^{-1}=\tau^{-1},$$

such that the first order condition reduces to:

$$\left[1-\tau^{-1}\right]\frac{dlog(M_I)}{d\tau}+\left\{\frac{\frac{\epsilon_{\lambda_I}}{\sigma-1}-\left(1+\epsilon_{T_I}\frac{T_I}{T_I-1}\right)}{1+\frac{\epsilon_{T_I}}{T_I-1}}\right\}\frac{dlog(w^*)}{d\tau}=0.$$

To find $dlog(w^*)/d\tau$ and $dlog(M_I)/d\tau$ note that total-differentiating equation (49) gives:

$$-dlogq_I =$$

$$\frac{\epsilon-\sigma}{\sigma-1}\left[dlogM_D-\epsilon_{\lambda_I}\left[dlogM_I-dlogN_I^*\right]-dlogM_I\right]+\epsilon\left[dlog\tau+dlogw^*+\epsilon_{T_I}\left[dlogM_I-dlogN_I^*\right]\right]$$

$$-dlogq_I^*=\frac{\epsilon-\sigma}{\sigma-1}\left[dlogM_D^*-\epsilon_{\lambda_I}\left[dlogM_I^*-dlogN_I\right]-dlogM_I^*\right]+\epsilon\left[-dlogw^*+\epsilon_{T_I}\left[dlogM_I^*-dlogN_I\right]\right].$$

Substitute for all but M_I and M_I^* further using that $M_D dlog(M_D)+M_I dlog(M_I)=0$ from the labor market clearing condition:

$$\left\{\frac{\epsilon_{\lambda_I}+1+\epsilon_{T_I}\frac{T_I}{T_I-1}}{1+\frac{\epsilon_{T_I}}{T_I-1}}\right\}\left[dlogM_I-dlogM_I^*\right]=$$

$$\frac{\epsilon-\sigma}{\sigma-1}\left[-\frac{M_I}{M_D}dlogM_I-\frac{\epsilon_{\lambda_I}}{\left(1+\frac{\epsilon_T}{T_I-1}\right)}\left[dlogM_I-dlogM_I^*\right]-dlogM_I\right]$$

$$+\epsilon\left[dlog\tau+\frac{1+\frac{T}{T-1}\epsilon_{T_I}}{\left(1+\frac{\epsilon_T}{T_I-1}\right)}\left[dlogM_I-dlogM_I^*\right]\right]$$

$$-\left\{\frac{\epsilon_{\lambda_I}+1+\epsilon_{T_I}\frac{T_I}{T_I-1}}{1+\frac{\epsilon_{T_I}}{T_I-1}}\right\}\left[dlogM_I-dlogM_I^*\right]=$$

$$\frac{\epsilon-\sigma}{\sigma-1}\left[-\frac{M_I}{M_D}dlogM_I+\frac{\epsilon_{\lambda_I}}{\left(1+\frac{\epsilon_T}{T_I-1}\right)}\left[dlogM_I-dlogM_I^*\right]-dlogM_I^*\right]$$

$$-\epsilon\left[\frac{1+\frac{T}{T-1}\epsilon_{T_I}}{\left(1+\frac{\epsilon_T}{T_I-1}\right)}\left[dlogM_I-dlogM_I^*\right]\right].$$

which is a system of two equations with two unknowns and can be written as:

$$\begin{bmatrix} c_1 & c_2 \\ c_2 & c_1 \end{bmatrix}\begin{bmatrix} dlogM_I \\ dlogM_I^* \end{bmatrix}=\begin{bmatrix} \epsilon dlog\tau \\ 0 \end{bmatrix},$$

where

$$c_1 = \frac{\epsilon_{\lambda_I} - (\epsilon - 1)\left(1 + \epsilon_{T_I}\frac{T_I}{T_I - 1}\right)}{1 + \frac{\epsilon_{T_I}}{T_I - 1}} - \frac{\sigma - \epsilon}{\sigma - 1}\left[\frac{M_I}{M_D} + \frac{\epsilon_{\lambda_I} + 1 + \epsilon_{T_I}\frac{T_I}{T_I - 1} + 1 + \frac{\epsilon_{T_I}}{T_I - 1}}{1 + \frac{\epsilon_{T_I}}{T_I - 1}}\right],$$

$$c_2 = -c_1 + \frac{\epsilon - \sigma}{\sigma - 1}\left[1 + \frac{M_I}{M_D}\right]$$

.

$$a_{12} = -a_{11} + \frac{\epsilon - \sigma}{\sigma - 1}$$

such that:

$$\frac{dlogM_I}{dlog\tau} = \frac{\epsilon c_1}{c_1^2 - c_2^2}$$

$$\frac{dlogw^*}{dlog\tau} = \frac{dlog(M_I)}{d\tau} - \frac{dlog(M_I^*)}{d\tau} = -\frac{\sigma - \epsilon}{\sigma - 1}\frac{\epsilon\left(1 + \frac{M_I}{M_D}\right)}{c_1^2 - c_2^2}$$

G Subsidies to fixed costs of entry

Proof of Proposition 4.

The home government maximizes per-period utility: :

$$max_{x_M^I, \chi_N^I, \chi_M^D, \chi_N^D} \left([\lambda_D M_D]^{\frac{\sigma}{\sigma-1}} q_D\right)^{\frac{\epsilon-1}{\epsilon}} + \left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}} \left([\lambda_I M_I]^{\frac{\sigma}{\sigma-1}} q_I\right)^{\frac{\epsilon-1}{\epsilon}}, \tag{56}$$

subject to the trade balance and labor market clearing conditions, respectively:

$$T_I w^* \lambda_I M_I q_I = T_I^* \lambda_I^* M_I^* q_I^*. \tag{57}$$

$$\lambda_D M_D q_D + \lambda_I^* M_I^* q_I^* + (1 - \delta^S) f\left[M_D + N_D + M_I + N_I\right] = L, \tag{58}$$

the relative consumption of domestic and international varieties: :

$$\frac{q_D}{q_I} = \frac{1-\nu}{\nu}\left[\frac{\lambda_D M_D}{\lambda_I M_I}\right]^{\frac{\epsilon-\sigma}{\sigma-1}}\left[\frac{T_I}{T_D} w^*\right]^{\epsilon} \tag{59}$$

$$\frac{q_D^*}{q_I^*} = \frac{1-\nu}{\nu}\left[\frac{\lambda_D^* M_D^*}{\lambda_I^* M_I^*}\right]^{\frac{\epsilon-\sigma}{\sigma-1}}\left[\frac{T_I^*}{T_D^*}/w^*\right]^{\epsilon} \tag{60}$$

and subsidies for entry of the four types of firms.

$$f-\chi_M^D=\frac{\lambda_D}{1-\delta}\frac{T_D}{\sigma-1}q_D,\;\; f-\chi_N^D=\frac{\lambda_D}{1-\delta}\frac{M_D}{N_D}(T_D-1)q_D \tag{61}$$

$$f-\chi_M^I=\frac{1}{1-\delta}\lambda_I\frac{1}{\sigma-1}T_Iq_Iw^*,\;\; f-\chi_N^I=\frac{1}{1-\delta}\lambda_I^*(M_I^*/N_I)(T_I^*-1)q_I^*, \tag{62}$$

with analogous expressions for foreign.

Step 1. Subsidies to domestic firms ensures: $M_D=N_D$ **and** $q_D=\frac{2f(1-\delta^S)}{\lambda((\delta^S)^2,1)}(\sigma-1)$**.**

Proof: Construct the Lagrangian of 56 subject to 58, and (61) and note that the Lagrangian constants on the two constraints of (61) must be binding. The first order conditions wrt $dlogM_D$ and $dlogN_D$ then require::

$$\frac{d(\lambda_D M_D)}{dlogM_D}=\frac{d(\lambda_D M_D)}{dlogN_D},$$

and as $dlog\lambda_D/dlogM_D=-dlog\lambda_D/dlogN_D$ this requires $dlog\lambda_D/dlogM_D=-1/2$ which is only met at $M_D=N_D$. Using this it is trivial to show that:

$$q_D=\frac{2f(1-\delta^S)}{\lambda_D}(\sigma-1), \tag{63}$$

with $\lambda_D\equiv\lambda((\delta^S)^2,1)$ is optimal. Symmetry ensures an analogous expression for foreign's home production. We can take q_D and q_D^* as given and solve the problem just for χ_M^I and χ_N^I.

Step 2. The first order conditions of the maximization problem.

The utility maximization problem is reduced to:

$$max_{x_M^I,\chi_N^I}\left([\lambda_D M_D]^{\frac{\sigma}{\sigma-1}}q_D\right)^{\frac{\epsilon-1}{\epsilon}}+\left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}}\left([\lambda_I M_I]^{\frac{\sigma}{\sigma-1}}q_I\right)^{\frac{\epsilon-1}{\epsilon}}, \tag{64}$$

with q_D and λ_D (but not M_D) constant. Differentiating wrt χ_z^I, $z=N,M.$ and using symmetry and equation 59 to write:

$$\frac{dU}{d\chi_z^I}\propto\left[\frac{1-\nu}{\nu}\right]\left[\frac{\lambda_D M_D}{\lambda_I M_I}\right]^{\frac{\epsilon-1}{\sigma-1}}\left[\frac{T_I}{T_D}\right]^{\epsilon-1}\frac{\sigma}{\sigma-1}\frac{dlogM_D}{d\chi_z^I}+\left[\frac{\sigma}{\sigma-1}\frac{dlog\lambda_I M_I q_I}{d\chi_z^I}-\frac{1}{\sigma-1}\frac{dlogq_I}{d\chi_z^I}\right]=0.$$

Substitute $dlogM_D/d\chi_z^I$ from equation (58) and $dlog(\lambda_I^* M_I^* q_I^*)/d\chi_z^I$ from equation

(57) and use that:

$$dlogM_I - dlogN_I^* - [dlogM_I^* - dlogN_I] = \frac{1}{(1+\frac{1}{T-1}\epsilon_T)}\left[2dlogw^* + \frac{d\chi_M}{f-\chi_M} + \frac{d\chi_N}{f-\chi_N}\right]$$

to get:

$$\begin{aligned}
&\frac{dU}{d\chi_z^I} \propto \phi_z(\chi_N^I, \chi_M^I) \\
&-\frac{dlogw^*}{d\chi_z^I} - \frac{\epsilon_T}{(1+\frac{1}{T-1}\epsilon_T)}\left[\frac{2dlogw^*}{d\chi_z^I} + \frac{1}{f-\chi_z^I}\right] \\
&+\left[\frac{(\epsilon_\lambda+1)}{\sigma-1} - \frac{(1-\delta^S)f}{\lambda_I q_I}\right]\frac{dlogM_I}{d\chi_z^I} - \frac{(1-\delta^S)f}{\lambda_I^* M_I^*/N_I q_I^*}\frac{dlogN_I}{d\chi_z^I} - \frac{\epsilon_\lambda}{\sigma-1}\frac{dlogN_I^*}{d\chi_z^I} \\
&+\frac{T_I - T_D}{T_D}\left[\frac{\sigma}{\sigma-1}\frac{dlog\lambda_I M_I}{d\chi_z^I} + \frac{dlogq_I}{d\chi_z^I}\right] = 0,
\end{aligned} \tag{65}$$

which is equation 37 in the main text.

Step 3. The derivatives wrt χ_N and χ_M.

See Online Appendix H. These expressions will be used below.

Step 5. Show that for $\varphi = \bar{\varphi}$: $lim_{\epsilon\to 1}(M_I/N_I)^{-1} = \kappa_1(\epsilon-1)^{1/2}$ and $lim_{\epsilon\to 1}q_I^{-1} = \kappa_2(\epsilon-1)$ with κ_1, κ_2 positive and finite.

First note that:

$$\epsilon_T = -\frac{\delta(\varphi-\bar{\varphi})\lambda_I M_I/N_I}{(1-\delta)(1-\rho)(\sigma-1)}T_I(1+\epsilon_\lambda), \tag{66}$$

which gives $\epsilon_T = 0$ for $\varphi = \bar{\varphi}$. Differentiate the system of equations for λ, x and π (equations (3)-(5)) to find:

$$\frac{dlog\lambda_I}{dlog(M_I/N_I)} = \frac{1-\delta}{1-\delta(1-\pi)}\frac{1}{x+1}\left[\frac{-(M_I/N_I)^{-1} - \delta\lambda_I\frac{dlog\lambda_I}{dlog(M_I/N_I)}}{(M_I/N_I)^{-1} - \lambda_I\delta} - \frac{\lambda_I\delta}{1-\lambda_I\delta}\frac{dlog\lambda_I}{dlog(M_I/N_I)}\right],$$

and $limx_{M_I/N_I\to\infty} = lim\pi_{M_I/N_I\to\infty} = lim_{M_I/N_I\to\infty}\lambda_I = 0$. Using the same equations it can be shown that:

$$lim_{M_I/N_I\to\infty}\lambda_I = \frac{\mu(M_I/N_I)^{-1}}{1-\delta(1-\mu)(1-\pi_b)},$$

$$lim_{M_I/N_I\to\infty}[\epsilon_\lambda + 1] = \frac{\delta\mu(M_I/N_I)^{-1}}{1-\delta(1-\mu)(1-\pi_b)}.$$

such that $lim_{M_I/N_I\to\infty}dlog\lambda_I/dlog(M_I/N_I) = -1$ and $lim_{M_I/N_I\to\infty}dlog(\epsilon_\lambda+1)/dlog(M_I/N_I) = -1$.

Use this in the first order condition 65 along with the expression from appendix H (in particular their limits as $(\epsilon - 1) \rightarrow 0$) to get:

$$lim_{\epsilon\rightarrow 1}\phi_M = \left[\frac{T_I}{T_D}\frac{\sigma}{\sigma-1} - 1\right](\epsilon_\lambda + 1) - \frac{(1-\delta^S)f}{\lambda_I q_I} = 0. \tag{67}$$

$$lim_{\epsilon\rightarrow 1}\phi_N = 2\frac{(\epsilon-1)}{\sigma-1}\frac{1}{f-\chi_N} - \frac{(1-\delta^S)f}{\lambda_I M_I/N_I q_I}\frac{1}{f-\chi_N} = 0, \tag{68}$$

where, in the second equation, I have used:

$$lim_{\epsilon\rightarrow 1}\left(-\frac{dlogw^*}{d\chi_z} + \frac{dlogN_I^*}{d\chi_N^I}\right) = lim_{\epsilon\rightarrow 1}2(\epsilon-1)(\gamma-1)\frac{1}{f-\chi_N} = 2\frac{(\epsilon-1)}{\sigma-1}\frac{1}{f-\chi_N}.$$

As $lim_{\epsilon\rightarrow 1}(\epsilon_\lambda+1) \propto lim_{\epsilon\rightarrow 1}(M/N)^{-1} = \kappa_1(\epsilon-1)^{1/2}$ and $lim_{\epsilon\rightarrow 1}\frac{1}{\lambda_I q_I} \propto lim_{\epsilon\rightarrow 1}(M/N)/q_I = \kappa_1\kappa_2(\epsilon-1)^{1/2}$ and $\left[\frac{T_I}{T_D}\frac{\sigma}{\sigma-1} - 1\right]$ is asymptotically a positive constant, equation (67) presents an equation with κ_1, κ_2. Since $0 < lim_{\epsilon\rightarrow 1}\lambda_I(M_I/N_I) < 1$ equation 68 presents an additional condition. It is clear that the solution requires $\kappa_1, \kappa_2 > 0$.

Step 6. Show that for $\varphi > \bar{\varphi}$: $1 < lim_{\epsilon\rightarrow 1}(M/N) < \infty$ and $lim_{\epsilon\rightarrow 1}q < \infty$

From equation 66 we have that $\epsilon_T < 0$. For $\epsilon \rightarrow 1$ and asymptotically constant M/N and q we can write:.

$$\frac{dU}{d\chi_z^I} \propto \phi_z(\chi_N^I, \chi_M^I)$$

$$lim_{\epsilon\rightarrow 1}\phi_M = -\frac{\epsilon_T}{(1+\frac{1}{T-1}\epsilon_T)}\left[\frac{1}{f-\chi_M^I}\right] + \left[\left[\frac{T_I}{T_D}\frac{\sigma}{\sigma-1} - 1\right](\epsilon_\lambda+1) - \frac{(1-\delta^S)f}{\lambda_I q_I}\right]\frac{1}{f-\chi_M^I} - \frac{\epsilon_\lambda}{\sigma-1}\frac{\frac{1}{T-1}\epsilon_T}{(1+\frac{1}{T-1}\epsilon_T)}\frac{1}{f-\chi_M} = 0,$$

$$lim_{\epsilon\rightarrow 1}\phi_N = -\frac{\epsilon_T}{(1+\frac{1}{T-1}\epsilon_T)}\left[\frac{1}{f-\chi_M^I}\right] - \frac{(1-\delta^S)f}{\lambda_I M_I/N_I q_I}\frac{1}{f-\chi_M^I} = 0,$$

Substituting

$$-\frac{\epsilon_T}{(1+\frac{1}{T-1}\epsilon_T)}\left[\frac{M}{N} - 1\right] = -\frac{\epsilon_\lambda}{\sigma-1}\frac{\frac{1}{T-1}\epsilon_T}{(1+\frac{1}{T-1}\epsilon_T)} + \left[\frac{T_I}{T_D}\frac{\sigma}{\sigma-1} - 1\right](\epsilon_\lambda+1),$$

which, as $\epsilon_T < 0$ requires $lim_{\epsilon\rightarrow\infty}M/N > 1$.

Step 7. Show that for $\varphi < \bar{\varphi}$ such that $\epsilon_T > 0$: $lim_{\epsilon\rightarrow 1}(M/N) = \kappa_1(1-\epsilon)^{-1}$ and $lim_{\epsilon\rightarrow 1}q_I = \kappa_2(1-\epsilon)^{-1}$ with $0 < \kappa_1, \kappa_2 < \infty$

This gives:

$$lim_{\epsilon\to 1}\phi_M = \left\{-\epsilon_T + \left[\frac{(\epsilon_\lambda+1)}{\sigma-1} - \frac{(1-\delta^S)f}{\lambda_I q_I}\right] + \frac{1}{T-1}\epsilon_T\right\}\frac{1}{f-\chi_M^I} = 0$$

$$lim_{\epsilon\to 1}\phi_N = \left\{-\epsilon_T - \frac{(1-\delta^S)f}{\lambda_I^* M_I^*/N_I q_I^*} + \left[\frac{\sigma}{\sigma-1}\right]\frac{(\epsilon-1)}{\sigma-1}\right\}\frac{1}{f-\chi_N^I} = 0,$$

where $lim\epsilon_T \propto (M/N)^{-1} = \kappa_1(1-\epsilon)^1$ and there always exists a κ_1 low enough to ensure that the second equation is binding for positive M/N and q. κ_2 follows from first equation.

Step 8. Show that $lim_{\epsilon\to\sigma}(M/N) = 1$ **and** $lim_{\epsilon\to\sigma} = \hat{q}$**.**

Consider the first order conditions at $M/N = 1$ for $\epsilon \to \sigma$ and use that:

$$lim_{\epsilon\to\sigma}(\sigma-\epsilon)\frac{dlogN_I^*}{d\chi_z} = (\sigma-\epsilon)lim_{\epsilon\to\sigma}\frac{dlogM_I}{d\chi_z} => 0$$

$$lim_{\epsilon\to\sigma}(\sigma-\epsilon)\frac{dlogM_I^*}{d\chi_z} = (\sigma-\epsilon)lim_{\epsilon\to\sigma}\frac{dlogM_I}{d\chi_z} > 0,$$

for $z = M, N$. Hence:

$$lim_{\epsilon\to\sigma}(\sigma-\epsilon)\frac{dlog\lambda_I M_I}{d\chi_z^I}|_{M_I/N_I=1} = lim_{\epsilon\to\sigma}1/2(\sigma-\epsilon)\left[\frac{dlogM_I}{d\chi_z^I} - \frac{dlogN_I^*}{d\chi_z^I}\right] = 0$$

$$lim_{\epsilon\to\sigma}(\sigma-\epsilon)\frac{dlogq_I}{d\chi_z^I} = lim_{\epsilon\to\sigma}(\sigma-\epsilon)\left[-\frac{(\epsilon_\lambda+1+\frac{T}{T-1}\epsilon_T)}{(1+\frac{1}{T-1}\epsilon_T)}\left[\frac{dlogM_I}{d\chi_z} - \frac{dlogM_I^*}{d\chi_z}\right]\right] = 0$$

$$lim_{\epsilon\to\sigma}(\sigma-\epsilon)\frac{dlogw^*}{d\chi_N} = lim_{\epsilon\to\sigma}(\sigma-\epsilon)\left[dlogM_I - dlogM_I^* - \frac{d\chi_M}{f-\chi_M}\right] = 0,$$

which enables me to write:

$$lim_{\epsilon\to\sigma}(\sigma-\epsilon)\phi_M = (\sigma-\epsilon)\left[\frac{1/2}{\sigma-1}\right]\left[\frac{dlogM_I}{d\chi_M^I} + \frac{dlogN_I^*}{d\chi_M^I}\right] - (\sigma-\epsilon)\frac{(1-\delta^S)f}{\lambda_I^* q_I^*}\left[\frac{dlogN_I}{d\chi_M^I} + \frac{dlogM_I}{d\chi_M^I}\right] = 0 \Leftrightarrow$$

and

$$lim_{\epsilon\to\sigma}\phi_N(\sigma-\epsilon) = (\sigma-\epsilon)\left[\frac{1/2}{\sigma-1}\right]\left[\frac{dlogM_I}{d\chi_N^I} + \frac{dlogN_I^*}{d\chi_N^I}\right] - (\sigma-\epsilon)\frac{(1-\delta^S)f}{\lambda_I^* q_I^*}\left[\frac{dlogN_I}{d\chi_N^I} + \frac{dlogM_I}{d\chi_N^I}\right] = 0.$$

And since:

$$lim_{\epsilon\to\sigma}(\sigma-\epsilon)\frac{dlogN_I}{d\chi_z} = (\sigma-\epsilon)lim_{\epsilon\to\sigma}\frac{dlogM_I}{d\chi_z} => 0,$$

both first order conditions reduce to:

$$\left[\frac{1/2}{\sigma - 1}\right] - \frac{(1-\delta^S)f}{\lambda_I q_I} = 0,$$

which reduces to the definition of $\hat{q}$.

Step 9. For $d(M_I/N_I)/d\varphi \leq 0$

Note that rewriting first order conditions $(f - \chi_z)\phi_z$ they do not depend directly on χ_z. We can therefore equivalently write them as depending on q_I and M_I/N_I and write the corresponding two-dimensional vector as:

$$\phi(M_I/N_I, q_I; \varphi) = 0,$$

and differentiate the system to get a linear system from which $d(M_I/N_I)/d\varphi$ can be derived along the lines of appendix H. Tedious derivations demonstrate that

$$d(M_I/N_I)/d\varphi \leq 0.$$

H Appendix System of equations

Differentiate the two equations for relative consumption (60) and (59)

$$-dlogq_I = \left[\frac{\sigma-\epsilon}{\sigma-1}\epsilon_\lambda + \epsilon\epsilon_T\right](dlogM_I - dlogN_I^*) + \frac{\sigma-\epsilon}{\sigma-1}dlogM_I - \frac{\sigma-\epsilon}{\sigma-1}dlogM_D + \epsilon dlogw^*, \tag{69}$$

$$-dlogq_I^* = \left[\frac{\sigma-\epsilon}{\sigma-1}\epsilon_\lambda + \epsilon\epsilon_T\right](dlogM_I^* - dlogN_I) + \frac{\sigma-\epsilon}{\sigma-1}dlogM_I^* - \frac{\sigma-\epsilon}{\sigma-1}dlogM_D^* - \epsilon dlogw^*. \tag{70}$$

Differentiate the labor market clearing condition:

$$\left(\frac{\nu}{1-\nu}\right)^{\frac{\sigma-1}{\epsilon-\sigma}}\left[\frac{q_D}{q_I}\right]^{\frac{\epsilon-1}{\epsilon-\sigma}}\left[\frac{T_I}{T_D}\right]^{-\sigma\frac{\epsilon-1}{\epsilon-\sigma}}\frac{\sigma}{\sigma-1}\frac{T_D}{T_I}dlog(N_D^M) + \frac{\sigma}{\sigma-1}dlog(N_I^M)$$

$$+\frac{1}{T_I}dlog(\lambda_I q_I) - \frac{(T_I-1)}{T_I}dlog(N_I^M/N_I^N) = 0,$$

with q_D, q_I, T_I, T_D all positive but finite $\nu \to 0$ implies $dlogN_D^M \to 0$ and $dlogN_D^{M*} \to 0$.

Total-differentiate (62) and the corresponding expressions for foreign as well as the trade balance to find the derivatives of w^*, q_I, q_I^*, N_I and N_I^* as function of $dlogM_I$ and $dlogM_I^*$ as well as $d\chi_N^I$ and $d\chi_M^I$

$$dlogM_I - dlogN_I^* = \frac{1}{(1+\frac{1}{T-1}\epsilon_T)}\left[dlogM_I - dlogM_I^*\right], \tag{71}$$

$$dlogM_I^* - dlogN_I = -\frac{1}{\left(1+\frac{1}{T-1}\epsilon_T\right)}\left[dlogM_I - dlogM_I^* + \frac{d\chi_N}{f-\chi_N} - \frac{d\chi_M}{f-\chi_M}\right],$$

$$dlogw^* = dlogM_I - dlogM_I^* - \frac{d\chi_M}{f-\chi_M}.$$

$$dlogq_I = -\frac{(\epsilon_\lambda + 1 + \frac{T}{T-1}\epsilon_T)}{(1+\frac{1}{T-1}\epsilon_T)}\left[dlogM_I - dlogM_I^*\right]$$

$$dlogq_I^* = -\frac{d\chi_N}{f-\chi_N} + \frac{\left(\epsilon_\lambda + 1 + \epsilon_T\frac{T}{T-1}\right)}{\left(1+\frac{1}{T-1}\epsilon_T\right)}\left[dlogM_I - dlogM_I^* + \frac{d\chi_N}{f-\chi_N} - \frac{d\chi_M}{f-\chi_M}\right],$$

which we then substitute into equations (69) and (70) to get:

$$\frac{(\epsilon_\lambda + 1 + \frac{T}{T-1}\epsilon_T)}{(1+\frac{1}{T-1}\epsilon_T)}\left[dlogM_I - dlogM_I^*\right] = \tag{72}$$

$$\frac{\left[\frac{\sigma-\epsilon}{\sigma-1}\epsilon_\lambda + \epsilon\epsilon_T\right]}{(1+\frac{1}{T-1}\epsilon_T)}\left[dlogM_I - dlogM_I^*\right] + \frac{\sigma-\epsilon}{\sigma-1}dlogM_I + \epsilon\left[dlogM_I - dlogM_I^* - \frac{d\chi_M}{f-\chi_M}\right],$$

$$\frac{d\chi_N}{f-\chi_N} - \frac{\left(\epsilon_\lambda + 1 + \epsilon_T\frac{T}{T-1}\right)}{\left(1+\frac{1}{T-1}\epsilon_T\right)}\left[dlogM_I - dlogM_I^* + \frac{d\chi_N}{f-\chi_N} - \frac{d\chi_M}{f-\chi_M}\right] = \tag{73}$$

$$-\left[\frac{\sigma-\epsilon}{\sigma-1}\epsilon_\lambda + \epsilon\epsilon_T\right]\frac{1}{\left(1+\frac{1}{T-1}\epsilon_T\right)}\left[dlogM_I - dlogM_I^* + \frac{d\chi_N}{f-\chi_N} - \frac{d\chi_M}{f-\chi_M}\right] + \frac{\sigma-\epsilon}{\sigma-1}dlogM_I^*$$
$$-\epsilon\left[dlogM_I - dlogM_I^* - \frac{d\chi_M}{f-\chi_M}\right],$$

such that the system can be written as:

$$\begin{bmatrix} a_1 & a_2 \\ a_2 & a_1 \end{bmatrix}\begin{bmatrix} dlogM_I \\ dlogM_I^* \end{bmatrix} = \begin{bmatrix} b_{11} & 0 \\ b_{21} & b_{22} \end{bmatrix}\begin{bmatrix} \frac{1}{f-\chi_M} \\ \frac{1}{f-\chi_N} \end{bmatrix},$$

with:

$$a_1 = -a_2 - \frac{\sigma-\epsilon}{\sigma-1},$$

where:

$$a_2 = \frac{\left(\frac{T\epsilon_T}{T-1}+1\right)(\epsilon-1) - \frac{\epsilon-1}{\sigma-1}\epsilon_\lambda}{(1+\frac{1}{T-1}\epsilon_T)}$$

$$b_{11} = -\epsilon$$

$$b_{21} = a_2$$

$$b_{22} = -a_2 + \epsilon - 1.$$

This immediately gives the derivatives of the system:

$$\frac{dlogM_I}{d\chi_M} = \frac{b_{11}a_1 - b_{21}a_2}{detA}$$

$$\frac{dlogM_I^*}{detA} = \frac{a_1b_{21} - a_2b_{11}}{detA}$$

$$\frac{dlogM_I}{d\chi_N} = -\frac{b_{22}a_2}{detA}$$

$$\frac{dlogM_I^*}{d\chi_N} = \frac{a_1b_{22}}{detA}$$

$$\frac{dlogM_I}{d\chi_M^I} = \frac{b_{11}a_1 - b_{21}a_2}{det(A)}\frac{1}{f-\chi_M^I} = \frac{1}{f-\chi_M} - \frac{(a_1+\epsilon)\,a_1}{detA}\frac{1}{f-\chi_M}$$

$$\frac{dlogM_I}{d\chi_N^I} = \frac{(1-\epsilon+a_2)\,a_2}{detA}\frac{1}{f-\chi_N}$$

$$\frac{dlogM_I^*}{d\chi_M} = \frac{a_1b_{21} - a_2b_{11}}{detA} = \frac{-(\frac{1-\epsilon}{\sigma-1}(1+\epsilon_\lambda))}{detA}a_2\frac{1}{f-\chi_M}$$

$$\frac{dlogM_I^*}{d\chi_N} = -\frac{a_1(1-\epsilon+a_2)}{detA}\frac{1}{f-\chi_N}$$

$$\frac{dlogw^*}{d\chi_M^I} = \frac{dlogM_I}{d\chi_M} - \frac{dlogM_I^*}{d\chi_M} - \frac{1}{f-\chi_M} = \left(\frac{\sigma-\epsilon}{\sigma-1}\right)\frac{a_1+\epsilon}{detA}\frac{1}{f-\chi_M}$$

$$\frac{dlogw^*}{d\chi_N^I} = \frac{dlogM_I}{d\chi_N} - \frac{dlogM_I^*}{d\chi_N} = b_{22}\frac{\frac{\sigma-\epsilon}{\sigma-1}}{detA}\frac{1}{f-\chi_N} = (\epsilon-1)\left(\frac{-(\epsilon_T)}{(1+\frac{1}{T-1}\epsilon_T)}\right)\frac{\frac{\sigma-\epsilon}{\sigma-1}}{detA}\frac{1}{f-\chi_N}$$

$$\frac{dlogw^*}{d\chi_N^I} = \frac{dlogM_I}{d\chi_N} - \frac{dlogM_I^*}{d\chi_N} = -\left(\frac{\sigma-\epsilon}{\sigma-1}\right)\frac{(1-\epsilon+a_2)}{detA}\frac{1}{f-\chi_N}$$

$$\frac{dlogN_I^*}{d\chi_M^I} = \frac{\frac{1}{T-1}\epsilon_T}{(1+\frac{1}{T-1}\epsilon_T)}\frac{1}{f-\chi_M} + \frac{a_1+\epsilon}{detA}\frac{1}{f-\chi_M}\frac{1}{1+\frac{1}{T-1}\epsilon_T}\left\{a_2 - \frac{1}{T-1}\epsilon_T a_1\right\}$$

$$\frac{dlogN_I^*}{d\chi_N^I} = \frac{dlogM_I}{d\chi_N} - \frac{dlogw^*}{d\chi_N} = -a_1\left[\frac{(1-\epsilon+a_2)}{detA}\frac{1}{f-\chi_N}\right],$$

$$\frac{dlogN_I}{d\chi_M} = \frac{dlogM_I^*}{d\chi_M} + \frac{1}{\left(1+\frac{1}{T-1}\epsilon_T\right)}\left[\frac{dlogM_I}{d\chi_M} - \frac{dlogM_I^*}{d\chi_M} - \frac{1}{f-\chi_M}\right]$$

$$\frac{dlogN_I}{d\chi_N^I} = \frac{dlogM_I^*}{d\chi_N^I} + \frac{1}{\left(1+\frac{1}{T-1}\epsilon_T\right)}\left[\frac{dlogM_I}{d\chi_N^I} - \frac{dlogM_I^*}{d\chi_N^I} + \frac{1}{f-\chi_N}\right]$$

$$\frac{dlogq_I}{d\chi_N^I} = -\frac{(\epsilon_\lambda + 1 + \frac{T}{T-1}\epsilon_T)}{(1+\frac{1}{T-1}\epsilon_T)}\left[\frac{dlogM_I}{d\chi_N^I} - \frac{dlogM_I^*}{d\chi_N^I}\right]$$

$$\frac{dlogq_I}{d\chi_M^I} = -\frac{(\epsilon_\lambda + 1 + \frac{T}{T-1}\epsilon_T)}{(1+\frac{1}{T-1}\epsilon_T)}\left[\frac{dlogM_I}{d\chi_M^I} - \frac{dlogM_I^*}{d\chi_M^I}\right]$$

$$\frac{dlogq_I^*}{d\chi_M^I} = \frac{\left(\epsilon_\lambda + 1 + \epsilon_T\frac{T}{T-1}\right)}{\left(1+\frac{1}{T-1}\epsilon_T\right)}\left[\frac{dlogM_I}{d\chi_M^I} - \frac{dlogM_I^*}{d\chi_M^I} - \frac{1}{f-\chi_M}\right]$$

$$dlogq_I^* = \left[\frac{(\epsilon_\lambda+\epsilon_T)}{\left(1+\frac{1}{T-1}\epsilon_T\right)}\right]\frac{1}{f-\chi_N} + \frac{\left(\epsilon_\lambda + 1 + \epsilon_T\frac{T}{T-1}\right)}{\left(1+\frac{1}{T-1}\epsilon_T\right)}\left[\frac{dlogM_I}{d\chi_N} - \frac{dlogM_I^*}{d\chi_N}\right],$$

where

$$detA = \left(a_2 + \frac{\sigma-\epsilon}{\sigma-1}\right)^2 - a_2 = \left(\frac{\sigma-\epsilon}{\sigma-1}\right)^2 + 2\frac{\sigma-\epsilon}{\sigma-1}a_2.$$

Online Appendix

I Perfect Bayesian Equilibrium - For Online Publication

Here i formally define the game and the strategies of Assumption 3.4.

I.1 Definition of Game

All players are either always in domestic or always in international relationships and players in domestic relationships always set monopoly prices $p_D = \sigma/(\sigma-1)$. In the following, I can therefore focus on a game just with the players who engage in international relationships. To facilitate exposition, I will let $\bar{\mathcal{M}}_I^T = \bar{\mathcal{M}}_I \cup \bar{\mathcal{M}}_I^*$ denote the total set (home and foreign) of final good producers who can match internationally and let $\bar{\mathcal{N}}_I^T = \bar{\mathcal{N}}_I \cup \bar{\mathcal{N}}_I^*$, the corresponding set of intermediate input suppliers with $\bar{\mathcal{M}}_{I,t}^T \subseteq \bar{\mathcal{M}}_I^T$ and $\bar{\mathcal{N}}_{I,t}^T \subseteq \bar{\mathcal{N}}_I^T$ the sets of such players active in period t.

The extensive form of the game is
$\Gamma = \left\langle \bar{\mathcal{M}_I}^T \cup \bar{\mathcal{N}_I}^T \cup c, H, P, f_c, (\mathcal{I}_i)_{i\in\bar{\mathcal{M}_I}^T} \cup (\mathcal{I}_j)_{j\in\bar{\mathcal{N}_I}^T}, (\gtrsim_i)_{i\in\bar{\mathcal{M}_I}^T} \cup (\gtrsim_j)_{j\in\bar{\mathcal{N}_I}^T} \right\rangle$, where H is the set of possible histories (as described below), and $h \in H$ is one such history. The correspondence $P(h) \subset \bar{\mathcal{M}_I}^T \cup \bar{\mathcal{N}_I}^T \cup c$ assigns a set of players to move at history h, where c denotes chance, and $f_c(\cdot|h)$ is the associated probability distribution that determines the "actions" of chance (as described below). $\mathcal{I}_i$ and $\mathcal{I}_j$ are information partitions of final good producers ($i \in \bar{\mathcal{M}_I}^T$) and intermediate input suppliers, ($j \in \bar{\mathcal{N}_I}^T$), respectively, and finally perfect diversification means that all players are risk-neutral and inherit the common discount factor δ of the representative agent. I initially define the set of possible histories.

The set of histories

Let a_t be the actions (including those of chance) of period $t \in \mathbf{Z}$. Using this, I define:

$h(t^0) = (..., a_{t-2}, a_{t-1})$ is a history at the unset of every stage game, where $P(h(t^0)) = c$, and chance decides on the sets of active players and matches as described in the main text. $\bar{\mathcal{M}}_{I,t}^T$ is the set of active final good producers and $g_t : \bar{\mathcal{M}}_{I,t}^T \to \bar{\mathcal{N}}_{I,t}^T$ is the mapping of specific links such that $g_t(i)$ is the partner of i at time t. This gives

$h(t^1) = h(t^0) \cup \{(\bar{\mathcal{M}}_{I,t}^T, g_t)\}$, at which point $P(h(t^1)) = \bar{\mathcal{M}}_{I,t}^T$ and each final good producer, $i \in \bar{\mathcal{M}}_{I,t}^T$, offers a contract $b_{i,t}^{contract} = (q_{i,t}, T_{i,t}) \in \mathbf{R}^+ \times \mathbf{R}$ to $g_t(i)$. This leads to:

$h(t^2) = h(t^1) \cup \{(q_{i,t}, T_{i,t})_{i\in\bar{\mathcal{M}}_{I,t}^T}\}$, at which point the intermediate input suppliers ($P(h(t^2)) = \bar{\mathcal{N}}_{I,t}^T$) decide whether to accept or not $b_{g_t(i)}^{acceptance} \in \{accept, noaccept\}$, and thereby ship $q_{i,t}$ or not. This leads to:

$h(t^3) = h(t^2) \cup \{(b_{g_t(i),t}^{acceptance})_{i\in\bar{\mathcal{M}}_{I,t}^T}\}$, at which point $P(h(t^3)) = \bar{\mathcal{M}}_{I,t}^T$, and the final good producers decide whether to pay or not: $b_{i,t}^{payment} \in \{pay, nopay\}$ if $b_{g_t(i),t}^{acceptance} = accept$. If $b_{g_t(i),t}^{acceptance} = noaccept$, then $b_{i,t}^{payment} = \emptyset$. This leads to:

$h(t^4) = h(t^3) \cup \{(b_{i,t}^{payment})_{i\in\bar{\mathcal{M}}_{I,t}^T}\}$, at which point both players simultaneously decide whether to continue ($P(h(t^4)) = \bar{\mathcal{M}}_{I,t}^T \cap \bar{\mathcal{N}}_{I,t}^T$), $m_{i,t}^M, m_{g_t(i),t}^N \in \{continue, nocontinue\}$. This leads to:

$h(t^5) = h(t^4) \cup \{(m_{i,t}^M, m_{g_t(i),t}^N)_{i\in\bar{\mathcal{M}}_{I,t}^T}\}$, at which point chance, $(P(h(t^5)) = c)$, chooses

$(C_{i,t}, L_{i,t})_{i \in \bar{\mathcal{M}}_{I,t}^{T}}$, where $C_{i,t} \in \{continue, discontinue\}$ and $L_{i,t} \in \{tell, notell\}$. All draws are independent and for each i there is a probability $1 - \pi_b$ of $C_{i,t} = \{continue\}$ and a probability φ of $L_{i,t} = \{tell\}$. If, for a given pair, $(i, g_t(i))$ $(m_{i,t}^{M}, m_{g_t(i),t}^{M}) = (continue, continue)$ and $C_{i,t} = continue$, then the pair will be a part of next period's matches: $i \in \bar{\mathcal{N}}_{I,t+1}^{T}$ and $j = g_t(i) = g_{t+1}(i)$. If not both will go back to the pools of unmatched players. I will denote by

$a_{i,t} = \{(i, g_t(i)), (q_{i,t}, T_{i,t}), (b_{g_t(i),t}^{acceptance}), (b_{i,t}^{payment}), \left(m_{i,t}^{M}, m_{g_t(i),t}^{N}\right), (C_{i,t}, L_{i,t})\}$ the outcome of the particular stage game, such that $a_t = (a_{i,t})_{i \in \bar{\mathcal{M}}_{I,t}^{T}}$ is total set of actions in period t. Let $H(t^s)$, $s = 0, 1, 2, 3, 4, 5$ denote the set of possible histories of type s, and let $H(t) = \bigcup_{s=0}^{5} H(t^s)$ denote the possible set of histories at stage t.

Information sets

For each $i \in \mathcal{M}_I^T$ I construct a partition $\mathcal{I}_i$ of $\{h \in H : P(h) = i\}$ such that $I_i(h) \in \mathcal{I}_i$ and if for two histories h', h'', with $h'' \in I_i(h')$ then i cannot distinguish between the two. I impose the following restriction: Consider two histories $h', h'' \in \{h \in H : P(h) = i\}$ and denote by "$'$" all elements of h'. If for all $s < t$ and $\iota \in \bar{\mathcal{M}}_I^T$: a) $C'_{\iota,s} \in h' \Leftrightarrow C'_{\iota,s} \in h''$ and b) For all $C_{\iota,s} = tell$ or $\iota = i$ then $a'_{\iota,s} \in h' \Leftrightarrow a'_{\iota,s} \in h''$. Then $h'' \in I_i(h')$. If not then $h'' \notin I_i(h')$. I construct the analogous partition, $\mathcal{I}_j$ for all $j \in \bar{\mathcal{N}}_I^T$. Hence, players are informed of the particular stage games of which they were a part or where nature played "tell".

Strategies

I misuse notation slightly, by defining, $b_{i,t}^{contract} : \mathcal{I}_i \to \mathbf{R}^{+} \times \mathbf{R}$ as the strategy function of final good producer i when offering contract, $b_{j,t}^{acceptance} : \mathcal{I}_j \to \{accept, noaccept\}$ as the response function of the intermediate input supplier, $b_{i,t}^{payment} : \mathcal{I}_i \to \{pay, nopay\}$ if $b_{g_t(i),t}^{acceptance} = \{accept\}$ and $b_{i,t}^{payment} = \{\emptyset\}$ if $b_{g_t(i),t}^{acceptance} = \{noaccept\}$ as the pay function of the final good producer, and finally $m_{i,t}^{M} : \mathcal{I}_i \to \{continue, nocontinue\}$ $m_{j,t}^{N} : \mathcal{I}_j \to \{continue, nocontinue\}$ for the decision of whether to continue. The strategy for final good players is denoted $\sigma_i^M, i \in \bar{\mathcal{M}}_I^T$ and for intermediate input suppliers $\sigma_j^N \in \bar{\mathcal{N}}_I^T$ with $\sigma = \{(\sigma_i^M)_{i \in \bar{\mathcal{M}}_I^T}, (\sigma_j^M)_{j \in \bar{\mathcal{N}}_I^T}\}$.

Beliefs

A belief system $\mu_i^M(I_i)(h)$ assigns probabilities to each history $h \in I_i$ for each information element and analogously for μ_j^N with $\mu = \{(\mu_i^M)_{i \in \bar{\mathcal{M}}_I^T}, (\mu_j^N)_{j \in \bar{\mathcal{N}}_I^T}\}$.

Having defined the game, strategies and beliefs I define the perfect Bayesian equilibrium

Perfect Bayesian equilibrium

A perfect Bayesian equilibrium is an assessment (σ, μ) where i) for every i and every h in which player i plays $\sigma_i^M(h)$ is a best response to $(\sigma_{-i}^M, \sigma_j^N)$ given μ and analogously for every j. ii) Whenever possible (on the equilibrium path) Bayes' rule is used for the beliefs.

Characteristics of the unique PBE allocation

When a new match has been made there are two possible histories: either neither has deviated from the history so far in which case the main text shows that the producer offers $T = 1$ with a q resulting from a price of $max\{1 + (1-\phi)/\alpha, \sigma/(\sigma-1)\}$. The supplier will adhere to this and this constitutes an equilibrium.

The welfare maximizing PBE

Consider a potential candidate assessment (σ', μ') with production by each international match of q which has suppliers always accepting the offers of producers and producers always paying $T_{i,t}$. Consider first strategies on path. If a producer i pays he gets:

$$V_{i,t}(\sigma', \mu') = (p(q) - T_{i,t})\, q + \delta[(1-\pi_b)\delta^S V_{i,t+1}(\sigma', \mu') + (1-(1-\pi_b)\delta^S) V_{i,t+1}^H(\sigma', \mu'),$$

whereas if he doesn't he gets:

$$(p(q) - \phi T_{i,t})\, q + \delta[(1-\varphi)\, \hat{V}_{i,g_t(i),t+1}(\sigma', \mu') + \varphi V_{i,t+1}^D(\sigma', \mu')],$$

where $\hat{V}_{i,g_t(i),t+1}$ is the value to producer i of having cheated but only her present partner $(g_t(i))$ knowing and no other potential partner will believe a deviation has happened. Maximal incentives requires partner $g_t(i)$ breaking the match and all players $V_{i,t+1}^D = 0$, but if $C_{i,t} = notell$ only $g_t(i)$ will know of the deviation. As the discounted value of ever meeting this supplier again is zero and no other supplier's moves can be made contingent on actions in this period, $\hat{V}_{i,g_t(i),t+1}(\sigma', \mu')$ can be no lower than $V_{i,t+1}^H$. The only requirement on supplier's incentives is willingness to participate so $T_{i,t} = 1$ in all periods ensures highest incentives for producers. This result in (dropping i and t as equilibrium actions are identical for all):

$$V_i(\sigma', \mu') = \frac{(p(q_I) - 1)\, q + \delta(1-(1-\pi_b)\delta^S) V_i^H(\sigma', \mu')}{1 - \delta(1-\pi_b)}$$

$$> (p(q) - \phi)\, q + \delta(1-(1-\pi_b)\delta^S)\,(1-\varphi)\, V_i^H(\sigma', \mu').$$

From the main text I have $V^H(\sigma', \mu') = \pi_M(p(q_I) - 1)q/[(1-\delta)(1 - \delta\delta^S(1 - \pi_b - \pi_M))$, which results in the constraint

$$\alpha(p(q) - 1)q \geq (1 - \phi)q,$$

from Proposition 1.

It is thus established that no PBE can have higher welfare. It remains to be established that this can be supported as a PBE. Consider first the case in which the constraint does not allow for first best (the alternative case follows straightforwardly). Hence, there is a unique $p^O = 1 + (1-\phi)/\alpha$ charged by international relationships. Consider the following candidate assessment (σ, μ). Define H^* as the set of histories where no deviations have taken place $H^*_{i,j}$ $(H^*_{i,j} \supset H^*)$ as the set of histories where neither producer i nor producer j have deviated and $\hat{H}^*_{i,j}(t)$ as the set of histories where supplier j does not have positive information that there were deviation in any particular stage game $a_{i,s}$, $s < t$ that producer i participated in (i.e. the only particular stage games, $a_{i,s'}$ in which there could have been deviations had $j \neq g_{s'}(i)$ and $C_{i,s'} = notell$).

$$b^{contract}_{i,t}\left(I_i\left(h\left(t^1\right)\right)\right) = \begin{cases} (q^O, 1) & \text{if } h\left(t^1\right) \in \hat{H}^*_{i,j}(t) \\ (0,0) & \text{else} \end{cases},$$

$$b^{shipment}_{j,t}\left(I_j\left(h\left(t^2\right)\right)\right) = \begin{cases} accept & \text{if } h\left(t^2\right) \in \hat{H}^*_{i,j}(t) \\ noaccept & \text{else} \end{cases},$$

$$b^{payment}_{i,t}\left(I_i\left(h\left(t^3\right)\right)\right) = \begin{cases} pay & \text{if } h\left(t^3\right) \in \hat{H}^*_{i,j}(t) \\ nopay & \text{else} \end{cases},$$

$$m^M_{i,t}\left(I_i\left(h\left(t^4\right)\right)\right) = \begin{cases} continue & \text{if } h\left(t^4\right) \in \hat{H}^*_{i,j}(t) \\ nocontinue & \text{else} \end{cases},$$

$$m^N_{j,t}\left(I_j\left(h\left(t^4\right)\right)\right) = \begin{cases} continue & \text{if } h\left(t^4\right) \in \hat{H}^*_{i,j}(t) \\ nocontinue & \text{else} \end{cases},$$

The requirement of a PBE is that Bayes' rule is used on-equilibrium path, that is

$$\mu^M_i(H^*)(h)\, and\, \mu^N_j(H^*),\ i \in \bar{\mathcal{M}}^T_I, j \in \bar{\mathcal{N}}^T_I,$$

adheres to Bayes' rule based on the specification of the matching function. Since, the exact matches do not matter the exact nature of the distribution is not essential. In addition to this I add:

$$\mu_j^N(\hat{H}_{i,j}^*)(h) = 0,\ for\, h \notin H_{i,j}^*,$$

that is regardless of what other off-path behavior has been observed, for a match (i, j) player j will believe i has not previously deviated regardless unless he is observed to have done so. We place no additional requirements on μ^M and μ^N (except that they are proper probability distributions).

As in the text, let V denote the value function for a matched final good producer who does not deviate, V^H is the value function for an unmatched final good producer who has not deviated, and V^D that of an unmatched final good producer who is publicly known to have deviated. By the one-deviation principle we can examine simple deviations for each note. It is trivially clear that $b_{i,t}^{contract}$ is optimal. On path, adhering to the contract for $h_i(t^1) \in H_{i,j}^*(t)$ gives V, whereas deviating gives $0 + \delta\left(\phi V^D + (1-\phi)V^H\right) < V$. Off-path, regardless of what contract is offered, the partnership will break up and both will go back to the pool. Hence $(0, 0)$ is optimal. For $b_{j,t}^{shipment}$, when $h_i(t^2) \in H_{i,j}^*(t)$ both will return 0 and accepting is optimal. For $h_i(t^2) \notin H_{i,j}^*(t)$ any contract (q', T') will return $-q'$ in expectation and not accepting is optimal. For $b_{i,t}^{pay}$ it follows from the discussion above that *pay* is optimal when $h_i(t^3) \in H_{i,j}^*(t)$. When $h_i(t^3) \notin H_{i,j}^*(t)$, there are two possibilities: If it is public knowledge that i has participated in a particular stage game with deviation, then there is no need for paying and *nopay* is optimal. If this is not public knowledge, it will be with probability φ regardless of what the producer does, and *nopay* is optimal. Finally, on-path *continue* is optimal for both parties, and off-path both are optimal as well.

The Economic Outcome

With the solution for the optimal PBE in hand, it follows that the price of goods sold by international relationships is $p^O = max\{1 + (1-\phi)/\alpha, \sigma/(\sigma-1)\}$, such that relative demand immediately follows: $q^O/q_D^O = (p^O/p_D)^{-\sigma}$. With symmetric labor market clearing condition I get 14) from Proposition 1. The rest of the proposition follows directly from differentiation.

J Appendix B

Proof of part (iii)-(v) of Proposition 1

Part (iii) follows directly from the definition of p^O and differentiating $v(p^O, p_D)$ with respect to parameters.

For part (iv) differentiate equation (14) wrt N:

$$v(p^O, p_D) = \frac{\left\{ [\lambda_D M_D]^{\frac{\epsilon-1}{\sigma-1}} + \frac{\nu}{1-\nu} [\lambda_I M_I]^{\frac{\epsilon-1}{\sigma-1}} \left[p^O/p_D\right]^{1-\epsilon} \right\}^{\frac{\epsilon}{\epsilon-1}}}{[\lambda_D M_D]^{\frac{\epsilon-1}{\sigma-1}} + \frac{\nu}{1-\nu} [\lambda_I M_I]^{\frac{\epsilon-1}{\sigma-1}} [p^O/p_D]^{-\epsilon}}$$

$$dlogv = \frac{\frac{\nu}{1-\nu} [\lambda_I M_I]^{\frac{\epsilon-1}{\sigma-1}} \left[p^O/p_D\right]^{-\epsilon}}{[\lambda_D M_D]^{\frac{\epsilon-1}{\sigma-1}} + \frac{\nu}{1-\nu} [\lambda_I M_I]^{\frac{\epsilon-1}{\sigma-1}} [p^O/p_D]^{-\epsilon}} \times$$

$$\left[\begin{array}{c} \frac{\epsilon}{\epsilon-1} \left[p^O/p_D\right] \frac{[\lambda_D M_D]^{\frac{\epsilon-1}{\sigma-1}} + \frac{\nu}{1-\nu} [\lambda_I M_I]^{\frac{\epsilon-1}{\sigma-1}} \left[p^O/p_D\right]^{-\epsilon}}{[\lambda_D M_D]^{\frac{\epsilon-1}{\sigma-1}} + \frac{\nu}{1-\nu} [\lambda_I M_I]^{\frac{\epsilon-1}{\sigma-1}} [p^O/p_D]^{1-\epsilon}} \left[-\frac{\epsilon-1}{\sigma-1} \epsilon_{\lambda_I} dlogN_I - (\epsilon-1) dlogp^O \right] \\ + \frac{\epsilon-1}{\sigma-1} \epsilon_{\lambda_I} dlogN_I + \epsilon dlogp^O \end{array} \right],$$

from which it follows that $\partial logv/\partial dlogN_I > 0$ and $\partial logv/\partial logp^O < 0$. Since $\partial p^O/\partial N_I < 0$ for $\varphi > \bar{\varphi}$ it follows that $dv/dN_I > 0$. For the second part of (v) consider:

$$\frac{dp^O}{dlogN_I} = \frac{dp^O}{d\alpha} \frac{d\alpha}{dlogN_I} = -\frac{1-\phi}{\alpha^2} \frac{\delta}{1-\delta} \epsilon_{\lambda_I} \lambda_I (\varphi - \bar{\varphi}).$$

As $lim_{M_I/N_I \to \infty} \lambda_I = 0$ it follows that the partial effect of N_I must dominate and: $lim_{M_I/N_I \to \infty} \frac{dlogv}{dlogN_I} > 0$. Conversely, consider $M_I/N_I \to 0$ which has $lim_{M_I/N_I \to 0} \lambda_I = 1$. Then it is clear that there exists an ϵ' where for any $\epsilon < \epsilon'$: $dlogv/dlogN_I < 0$.

Analogous derivations show the result for (iv).

K Proof of Lemma

It is clear that the symmetric setting requires symmetry in solution. Use this to write the problem as:

$$max_{M_D, N_D, M_I, N_I, q_I, q_D} \left(\left([\lambda_D M_D]^{\frac{\sigma}{\sigma-1}} q_D \right)^{\frac{\epsilon-1}{\epsilon}} + \left(\frac{\nu}{1-\nu} \right)^{\frac{1}{\epsilon}} \left([\lambda_I M_I]^{\frac{\sigma}{\sigma-1}} q_I \right)^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}}$$

subject to:

$$\lambda_D M_D q_D + \lambda_I M_I q_I + (1-\delta^S) f \left[M_D + N_D + M_I + N_I \right] = L.$$

Write this as a Lagrange problem and note that the first order conditions of $logM_D$ and $logN_D$ are:

$logM_D$:

$$\left(\left([\lambda_D M_D]^{\frac{\sigma}{\sigma-1}}q_D\right)^{\frac{\epsilon-1}{\epsilon}}+\left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}}\left([\lambda_I M_I]^{\frac{\sigma}{\sigma-1}}q_I\right)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{1}{\epsilon-1}}\left([\lambda_D M_D]^{\frac{\sigma}{\sigma-1}}q_D\right)^{\frac{\epsilon-1}{\epsilon}}\left[\frac{\sigma}{\sigma-1}(\epsilon_{\lambda_D}+1)\right]$$

$$-\kappa\left[\lambda_D M_D q_D(\epsilon_{\lambda_D}+1)+(1-\delta^S)f\right]=0,$$

$logN_D$:

$$\left(\left([\lambda_D M_D]^{\frac{\sigma}{\sigma-1}}q_D\right)^{\frac{\epsilon-1}{\epsilon}}+\left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}}\left([\lambda_I M_I]^{\frac{\sigma}{\sigma-1}}q_I\right)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{1}{\epsilon-1}}\left([\lambda_D M_D]^{\frac{\sigma}{\sigma-1}}q_D\right)^{\frac{\epsilon-1}{\epsilon}}\left[\frac{\sigma}{\sigma-1}(-\epsilon_{\lambda_D})\right]$$

$$-\kappa\left[\lambda_D M_D q_D(-\epsilon_{\lambda_D})+(1-\delta^S)f\right]=0,$$

which requires $\epsilon_{\lambda_D}=-1/2$ and consequently $M_D=N_D$ and analogously $M_I=N_I$. The problem can therefore be rewritten as:

$$max_{M_D,M_I,q_I,q_D}\left(\left([\lambda(1,1)M_D]^{\frac{\sigma}{\sigma-1}}q_D\right)^{\frac{\epsilon-1}{\epsilon}}+\left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}}\left([\lambda(1,1)M_I]^{\frac{\sigma}{\sigma-1}}q_I\right)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}}$$

$$-\kappa\left\{\lambda(1,1)M_D q_D+\lambda(1,1)M_I q_I+(1-\delta^S)f\left[2M_D+2M_I\right]-L\right\}$$

with first order conditions:

$logM_D$:

$$\left(\left([\lambda(1,1)M_D]^{\frac{\sigma}{\sigma-1}}q_D\right)^{\frac{\epsilon-1}{\epsilon}}+\left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}}\left([\lambda(1,1)M_I]^{\frac{\sigma}{\sigma-1}}q_I\right)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{1}{\epsilon-1}}\left([\lambda(1,1)M_D]^{\frac{\sigma}{\sigma-1}}q_D\right)^{\frac{\epsilon-1}{\epsilon}}\frac{\sigma}{\sigma-1}$$

$$-\kappa\left[\lambda(1,1)M_D q_D+(1-\delta^S)2fM_D\right]=0$$

$logq_D$:

$$\left(\left([\lambda(1,1)M_D]^{\frac{\sigma}{\sigma-1}}q_D\right)^{\frac{\epsilon-1}{\epsilon}}+\left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}}\left([\lambda(1,1)M_I]^{\frac{\sigma}{\sigma-1}}q_I\right)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{1}{\epsilon-1}}\left([\lambda(1,1)M_D]^{\frac{\sigma}{\sigma-1}}q_D\right)^{\frac{\epsilon-1}{\epsilon}}$$

$$-\kappa\left[\lambda(1,1)M_D q_D\right]=0$$

$logM_I$:

$$\left(\left(\left[\lambda(1,1)M_D\right]^{\frac{\sigma}{\sigma-1}} q_D\right)^{\frac{\epsilon-1}{\epsilon}} + \left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}} \left(\left[\lambda(1,1)M_I\right]^{\frac{\sigma}{\sigma-1}} q_I\right)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{1}{\epsilon-1}} \left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}} \left(\left[\lambda(1,1)M_I\right]^{\frac{\sigma}{\sigma-1}} q_I\right)^{\frac{\epsilon-1}{\epsilon}} \frac{\sigma}{\sigma -}$$

$$-\kappa\left[\lambda(1,1)M_I q_I + (1-\delta^S)2fM_I\right] = 0$$

$logq_I$:

$$\left(\left(\left[\lambda(1,1)M_D\right]^{\frac{\sigma}{\sigma-1}} q_D\right)^{\frac{\epsilon-1}{\epsilon}} + \left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}} \left(\left[\lambda(1,1)M_I\right]^{\frac{\sigma}{\sigma-1}} q_I\right)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{1}{\epsilon-1}} \left(\frac{\nu}{1-\nu}\right)^{\frac{1}{\epsilon}} \left(\left[\lambda(1,1)M_I\right]^{\frac{\sigma}{\sigma-1}} q_I\right)^{\frac{\epsilon-1}{\epsilon}}$$

$$-\kappa\left[\lambda(1,1)M_I q_I\right] = 0,$$

combine $logM_D$ and $logq_D$ to find:

$$q_D = \frac{(1-\delta^S)2f}{\lambda(1,1)}(\sigma-1),$$

where the same holds for q_I. Finally, combine $logq_D$ and $logq_I$ to get

$$\left[\frac{\nu}{1-\nu}\right]^{\frac{\epsilon-1}{\epsilon(\sigma-\epsilon)}} M_D = M_I,$$

and insert in labor market clearing condition to get:

$$\left[1 + \left[\frac{\nu}{1-\nu}\right]^{\frac{\epsilon-1}{\epsilon(\sigma-\epsilon)}}\right] M_D = \frac{L}{2f\sigma(1-\delta^S)},$$

which completes the proof.