Online appendix to "Input substitutability, trade costs and location"

More on trade costs τ

A crucial element here is that the trade costs in question indeed affect the costs of inputs multiplicatively, and this is all that is required for Lemma 1 to hold (so for example are of the iceberg sort, as proposed by Samuelson, 1954).[1] There are many trade costs that are of this type: ad-valorem tariffs (which are not iceberg costs), freight costs, insurance, exchange-rate conversion costs, contract enforcement costs and these constitute the bulk of Anderson and van Wincoop's (2004) estimates of trade barriers. These authors found in their sample that the size of trade costs was equivalent to a 170% ad-valorem tariff, including a 21% part in that estimate of just transport costs.

One can go, however, beyond a simple trade cost interpretation of τ. For example, international trade takes time and is risky; shipments of inputs may arrive at random times at a desired destination. Then, it would be natural for the final good producer to carry higher stocks of the input that travels farther. This introduces an additional cost, the more so the more the input is perishable. Therefore, the cost structures as discussed above in Inequality (3) may arise even without any explicit trade costs in place and would not be captured easily empirically. From the point of view of managers, the cost of coordinating the production of inputs up to a specification with subcontractors that are far away may be higher as well.

The fact that an input is more costly at a further destination may stem from the presence of asymmetric information problems that can be more acute with distance. As an example, consider a simple quality assurance problem where a final good producer requires one unit of an input from a subcontractor (there are many potential producers of this input). The subcontractor can produce a low or high quality product, which costs him then more to produce (as above, we shall assume flat marginal costs). Repeated provision of incentives offers a resolution to such a quality assurance problem (Klein and Leffler, 1981; Schapiro, 1983). The downstream firm offers then to trade with a subcontractor in the infinite future as long as the latter provides a high quality product, and pays a price ξ including a premium on top of the subcontractor's marginal cost w. If the subcontractor provides low quality, then the relationship is terminated. Assume for simplicity

[1] It may not matter that all trade costs are multiplicative. The result exhibited in Lemma 1 holds if there are small per unit shipping costs which are constant between locations in addition to the studied iceberg costs.

that the marginal cost of faulty good production is zero, while that of the high quality good w. The incentive compatibility condition is then

$$\frac{\xi - w}{1-\beta} \geq \xi\left(1-q\right) \tag{1}$$

where $\beta < 1$ is a discount factor used by the subcontractor to calculate the present discounted value of future profits, and q is the probability that the customer (the downstream firm) discovers a low quality good upon delivery. This implies that the incentive compatible price of an input guaranteeing the downstream firm a high quality product is $\xi \geq \frac{w}{q+(1-q)\beta}$. If the probability of detecting bad quality is higher for domestic (q) than foreign (q^*) subcontractors (so $0 < q^* < q < 1$), for example because monitoring domestic subcontractors is easier, this implies that foreign producers are going to obtain higher incentive rents. In the context of our model, for the case the Leontieff technology, this will imply $\psi_n = \frac{w_n}{q+(1-q)\beta} + \frac{w_s}{q^*+(1-q^*)\beta} < \frac{w_n}{q^*+(1-q^*)\beta} + \frac{w_s}{q+(1-q)\beta} = \psi_s$. Therefore, with such assumptions asymmetric information induces a cost that would be isomorphic to a trade cost of $\tau = \frac{q+(1-q)\beta}{q^*+(1-q^*)\beta} > 1$, and this can be generalized to technologies with any ρ. It is to note that the quality assurance problem and such costs would pertain to "differentiated" goods rather than "homogenous" goods. Indeed, Rauch (1999) defines homogenous goods as those traded on organized exchanges which is possible only when quality is easily and/or cheaply measurable. On how contract enforcement aspects of payments for international trade can imply multiplicative trade costs, see Schmidt-Eisenlohr (2012).

More general technologies

The inputs assumed in the paper were country-specific as each of the countries was unable to produce the other production input. More generally, one can deliver examples of families of technology distributions where the principal insight holds. The requirement is that the two countries involved in trade need to have technologies dissimilar enough. Consider for example a production technology of the final good $y = \left(\int_0^1 z\left(i\right)^\rho di\right)^{\frac{1}{\rho}}$ and two countries with a Pareto distribution of the inverse of productivities (effectively a Pareto distribution of prices) over a continuum of inputs with the shape parameter $\alpha > 0$ and the maximum productivity equal to 1. Suppose that the distribution is ordered so that good zero gets the highest productivity draw in the North and good one gets the highest productivity draw in the South. The North then has a distribution of prices with a cumulative distribution function of $1-\left(\frac{w_n}{x}\right)^{\alpha}$. The South, on the other hand, has the distribution of prices among the varieties that it offers on sale in the North of $\left(\frac{\tau w_s}{x}\right)^{\alpha}$. It has low productivity in inputs for which the North has a high productivity and vice versa. The maximum price of an input is then in the North $p_{\max,n} = ((w_n)^{\alpha} + (\tau w_s)^{\alpha})^{\frac{1}{\alpha}}$ whereas the minimum price of an input from the North is $p_{\min,nn} = w_n$ and that from the South is $p_{\min,sn} = \tau w_s$. The cost of production of the final good in the North is then $C_n = \left(\frac{\alpha}{\theta-\alpha}\left[((w_n)^{\alpha} + (\tau w_s)^{\alpha})^{\frac{\theta}{\alpha}} - \left(w_n^{\theta} + \tau^{\theta} w_s^{\theta}\right)\right]\right)^{\frac{1}{\theta}}$ where $\theta = -\frac{\rho}{1-\rho}$. If $\alpha < \frac{\theta}{2}$ after some basic algebra one can show that the North (the country with the higher wage) will have a lower cost of final good production no matter what the transport cost τ is. This means that countries need to be dissimilar in terms of technology and have a Ricardian productivity advantage over a set of goods that is large enough and/or the varieties have to be strongly complementary in the production process for the result to hold.

References

Anderson, James E. and Eric van Wincoop, 2004. "Trade costs." *Journal of Economic Literature* 42: 691–751.

Klein, Benjamin, and Keith B. Leffler, 1981. "The Role of Market Forces in Assuring Contractual Performance." *Journal of Political Economy* 89: 615-641.

Rauch, James E., 1999. "Networks Versus Markets in International Trade." *Journal of International Economics* 48: 7-35.

Samuelson, Paul A., 1954. "Transfer problem and the transport cost, II: Analysis of effects of trade impediments." *Economic Journal* 64: 264-89.

Schmidt-Eisenlohr, Tim, 2011. "Towards a Theory of Trade Finance." Oxford University, Department of Economics Working Paper 583.

Shapiro, Carl, 1983. "Premiums for High-Quality Products as Rents to Reputation." *Quarterly Journal of Economics*, 98: 659-680.