Offshoring along the production chain

Philipp Harms *Johannes Gutenberg University Mainz*
Oliver Lorz and Dieter Urban *RWTH Aachen University*

Abstract. In this paper, we analyze the offshoring decision of firms whose production process is characterized by a particular sequence of steps. International cost differences vary non-monotonically along the production chain, and moving unfinished goods across borders incurs transport costs. We show that, in such a setting, firms may refrain from offshoring even if relocating individual steps would be advantageous in terms of offshoring costs, or they may offshore (almost) the entire production chain to save transport costs. Small variations in model parameters may thus have a substantial impact on offshoring activities. JEL classification: D24, F10, F23

Délocalisation le long de la chaine de production. Dans ce mémoire, on analyse la décision de délocalisation des firmes dont le processus de production est caractérisé par une séquence particulière d'étapes. Les différences internationales de coûts varient de façon non-monotone le long de la chaine de production, et déplacer des produits au stade intermédiaire de production à travers des frontières implique des coûts de transport. On montre que, dans un tel cadre, les entreprises peuvent choisir de ne pas délocaliser même si la relocalisation de certaines étapes individuelles de production pourrait être avantageuse en termes de coûts, ou elles peuvent délocaliser (presque) la chaine de production dans son entier pour réduire les coûts de transport. De faibles variations dans les paramètres du modèle peuvent avoir un impact substantiel sur les activités de délocalisation.

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1. Introduction

Most production processes can be split up into several steps, some of which are possibly shifted abroad – that is, 'offshored' – to exploit international cost differences.[1] In this paper, we analyze the offshoring decision of firms whose production process is characterized by the following features. First, the entire process follows a strict, technologically determined *sequence* of production steps, and it is impossible to rearrange the order in which individual steps are performed. Second, international cost differences vary *non-monotonically* along the production chain. Third, every production step requires the *physical presence* of an intermediate good that embodies the contribution of all preceding steps, and transporting this good across borders is associated with a fixed transport cost.

There are various industries for which this description of the production process seems to be fairly accurate. One example at hand is the assembly of cars, which follows a given sequence of steps that can hardly be rearranged according to international cost differences. Moreover, cost differences vary non-monotonically along this sequence: car assembly involves capital-intensive, highly automatized production steps as well as some labour-intensive manual steps in between (see Dicken 2007). Most activities in the press shop, the body shop, and the paint shop, for example, are fully automatized, whereas workers perform parts of the paint shop (inspection, quality control, or hand polishing), or the wiring of the car. Finally, most production steps require the product, or at least a component of it, to be physically present. Spraying a car, for example, is impossible without having the car body in the factory.[2]

By focusing on a sequential production process with the above-mentioned characteristics, we deviate from the influential contributions by Kohler (2004) and Grossman and Rossi-Hansberg (2008). They order individual production steps according to international cost differences and thereby derive a unique threshold that determines which part of the production process is performed abroad and which part at home.[3] The technical restrictions considered in the current paper prevent such an ordering, which has important consequences for

1 There is by now a large literature on the 'second unbundling' Baldwin (2006), that is, the spatial fragmentation of the production process. A short and necessarily selective list of relevant contributions includes Jones and Kierzkowski (1990, 2001a, 2001b), Feenstra and Hanson (1996a, 1996b, 1997, 1999), Arndt (1997), Venables (1999), Glass and Saggi (2001), Jones (2000), Deardorff (2001a, b), and Egger and Egger (2007). By using the term offshoring instead of international outsourcing, we indicate that the geographical location of production is at the centre of our interest, while we abstract from the make-or-buy decision of firms.

2 Other examples of production processes that exhibit the features described above can be found in the textiles industry – one first needs to spin yarn before this yarn can be woven or knitted and finally the cloth can be tailored – or in the production of microchips, which begins with making silicon from quartz, purifying the silicon in a second step before wafers are produced; microchips are then built on these wafers and wafers are cut apart.

3 In Grossman and Rossi-Hansberg (2008), this results from the assumption that the sequence in which different tasks have to be performed is flexible such that they can be freely rearranged according to offshoring costs, while Kohler (2004) assumes that the relative cost disadvantage of the foreign location increases monotonically along the production process.

the resulting offshoring pattern. Most important, the decision to offshore an individual production step depends not only on production and offshoring costs for that particular step, but also on the location of preceding and subsequent steps. Facing a trade-off between selecting the cheapest location for an individual step and incurring additional transport costs, firms may tend to lump together several parts of the production chain in one country – even if this implies that some steps are not performed at the cheapest location. Moreover, minor parameter variations in our framework may result in shifts between different *offshoring regimes*. This contrasts with the models of Kohler (2004) and Grossman and Rossi-Hansberg (2008), where a minor variation of exogenous parameters leads to a smooth adjustment at the margin, that is, a small change in the number of tasks that are performed abroad. We obtain such a shift between industry-specific offshoring regimes even though we assume a CRS-technology. The existence of transport costs combined with the predetermined sequence of production steps is sufficient to lump together production steps. This causes an international bundling or unbundling of larger chunks of a production chain following marginal changes of transport, production, or offshoring costs.

Our setup is related to the work by Yi (2003) and Barba Navaretti and Venables (2004). Both papers also analyze the influence of transport costs on a fragmented production process and demonstrate that a rather modest reduction of such costs may substantially increase the volume of trade in intermediate inputs (Yi) and the extent of vertical FDI (Barba Navaretti and Venables). Unlike these researchers, we perform comparative static analyses with respect to various parameters that have an economic or technological interpretation, for example, the heterogeneity of production steps in terms of the domestic cost disadvantage, the depth of the production process, and so on.

We believe that, by placing a stronger emphasis on the technological features of industry-specific production processes, our approach offers an explanation for the question as to why different industries may have quite different fragmentation intensities even though factor cost differences and offshoring costs are not obviously different (see Geishecker and Görg 2008, OECD 2007).[4] Moreover, by arguing that, in equilibrium, some production steps may be performed in the domestic economy although a comparison of production cost would suggest they be located abroad, it rationalizes a discrepancy between estimates of the 'offshoring potential' for certain industrialized countries and the actual volume of offshoring activities. Despite large offshoring potential in terms of relative cost advantages for individual production steps, firms may choose to perform these steps at home, since they are firmly tied to adjacent steps. Our results are derived in a partial-equilibrium framework with exogenously given factor prices. Although we regard general equilibrium repercussions of offshoring decisions

4 Our work thus reflects the argument that 'offshoring is an industry-specific phenomenon, relating to the idiosyncratic way in which the value added process of certain industry may be sliced up, or fragmented, into different tasks' (Kohler 2008, 11).

on factor prices as being highly important – both from a theoretical and from an economic policy perspective – we have chosen to neglect them to keep the model analytically tractable.

The remainder of the paper is structured as follows: The following section describes the model, section 3 derives the offshoring pattern, and comparative statics are performed in section 4. Section 5 considers the case of increasing transport costs and section 6 concludes.

2. Model setup

Consider a competitive firm in some industry that produces a homogeneous good under constant returns to scale. Production consists of a continuum of individual steps that involve modifying an unfinished good. This process is of a Leontieff-type, that is, all steps have to be performed in order to finish the good, and it follows a predetermined sequence according to which the individual steps have to be performed one after the other. Each production step in this industry combines immobile production factors according to a constant returns to scale technology. We assume identical factor costs $c(w)$ at each production step, where w is the vector of factor prices. Factor prices are exogenously given, and for brevity we will omit the arguments of c in the following.

Each production step can be performed abroad ('*offshored*') to exploit factor cost differences. If step t is offshored, then production costs are raised by offshoring costs of the iceberg type; that is, foreign production costs are multiplied by the term $d(t) > 1$. This reflects the additional costs associated with performing step t in the foreign country (e.g., costs of communication between headquarter and production unit or supervision costs). Without loss of generality, we normalize unit factor costs abroad to $\bar{c} = 1$. The unit cost function of the offshored production step t is then given by $d(t)$.

In contrast to most of the existing literature, we assume that the firm's technology prescribes a strict order in which individual production steps have to be performed. Moreover, every production step requires the presence of the unfinished good produced at the preceding step. While transportation is assumed to be costless within national borders, any crossing of borders between two adjacent production steps is associated with constant costs T per unit of the good.[5] The variable T captures the costs arising not only from physical transportation, but also from the risk of delayed delivery. For the time being, we assume that the magnitude of T is independent of the stage of the production process. Later we will relax this assumption.

Our main deviation from the existing literature is to allow for offshoring costs to vary non-monotonically along the production chain. To see how predictions

5 We are assuming a stable relationship between the number of intermediate goods and the number of final goods, which does not change along the production process.

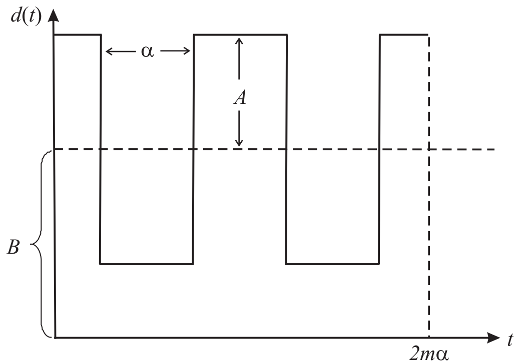

FIGURE 1 Offshoring costs

on offshoring patterns may radically differ, it is enough to give an example, where the offshoring costs $d(t)$ alternate symmetrically along the production chain. In particular, we consider a production process in which a segment with low offshoring costs per production step is followed by a segment of equal length with high offshoring costs, which is followed again by a segment with low offshoring costs and so on. The segments at the beginning and at the end of the production chain are characterized by high offshoring costs, and – for symmetry reasons – are assumed to be just half the length of the interior segments. Figure 1 depicts unit costs associated with different steps along this production chain.[6]

Our specification of the offshoring cost function provides us with a couple of parameters that have a straightforward and natural interpretation. First, the shift parameter B determines *average* offshoring costs; that is, if B is very high, the frictions associated with communication and supervision render offshoring relatively unattractive for the 'average' production step. Second, the term A of the cost function measures the deviation of high and low offshoring costs, respectively, from average offshoring costs. To ensure non-negative offshoring costs, we assume $B - A > 1$. The parameter α determines how frequently offshoring costs alternate around the average value of B along the production chain. If α is low, the production process is 'heterogeneous' with respect to offshoring costs. Conversely, if α is high, the sets of adjacent production steps that are characterized by lower or higher than average offshoring costs are large, making it advantageous ceteris paribus to perform comparatively large chunks of the production process at one location (at home or abroad). Finally, $2m\alpha$ determines the total length of

6 Choosing to fix factor costs while allowing the offshoring costs $d(t)$ to vary across production steps is inconsequential in our partial-equilibrium setup. We could as well have assumed fixed offshoring costs and allowed factor costs to vary along the production process – this variation being due to either changing input coefficients or a varying total factor productivity. Of course, when our model is extended to a general-equilibrium framework, such distinctions become important.

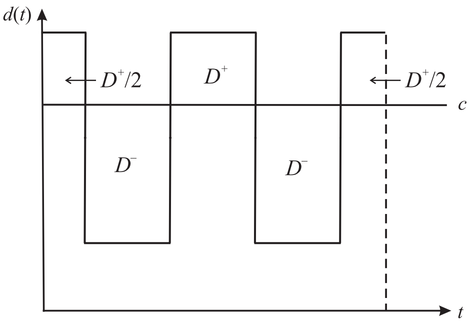

FIGURE 2 Cost savings from offshoring

the production chain ($m \in \mathbb{N}^+$), distinguishing production processes with a long production chain (high m) from those with only a short sequence (low m).

In addition to the transport cost T, we thus have four parameters to describe the technological environment of the offshoring decision. We later capture technological or institutional change by varying these parameters – by lowering average offshoring costs and the differences between these costs (lowering B and A, respectively), by allowing for greater heterogeneity in the production process (lowering α), or by changing the length of the production chain m.

Finally, we assume that the finished product is sold in the home market of the producer. This assumption implies that firms have to ship their final input back home (at a cost T) even if they choose to perform all production steps abroad. We regard such a setting to be plausible, since, for most goods, final consumption takes place in industrialized countries, while the largest factor cost savings are found in developing countries or emerging market economies. Accordingly, the last ‘production’ steps would be the good’s packaging and labelling and its sale to domestic consumers.[7]

3. The offshoring decision

Given our specification of the offshoring cost curve, we may now characterize the offshoring decision. This is done in figure 2. To make the model interesting, we consider only the case $B - A < c < B + A$; that is, the home country has a cost advantage for production steps with high offshoring costs and the foreign country for production steps with low offshoring costs.

Figure 2 depicts the case of $m = 2$. For all steps in the interval $[0; \alpha/2]$, production costs abroad (including offshoring costs) exceed domestic production costs. For all steps between $\alpha/2$ and $3\alpha/2$, producing abroad is cheaper than

7 Instead of imposing that the finished good is sold on the domestic market, we could also think of some domestic location advantage for the final production steps.

producing at home even if offshoring costs are taken into account. In the interval $[3\alpha/2, 5\alpha/2]$, domestic production dominates foreign production and so on.

If there were no transport costs, the firm would obviously exploit all cost differences and produce abroad whenever $d(t) < c$. However, once the costs of shipping intermediate goods back and forth are strictly positive, the size of cost savings matters as well. We denote the total cost savings that result from offshoring a sequence with low offshoring costs by D^-, and the cost advantage of producing a similar sequence with high offshoring costs at home by D^+. Our assumptions concerning the shape of the offshoring cost function yield

$$D^- = \alpha\,[c - (B - A)] \qquad \text{and} \qquad D^+ = \alpha\,[B + A - c]\ . \tag{1}$$

Increasing the term A, that is, the deviation from average offshoring costs, obviously increases D^- and D^+. Moreover, D^- declines, whereas D^+ increases in the average offshoring costs B. Higher average offshoring costs – reflected by an upward shift of the $d(t)$-curve – render offshoring less advantageous compared with domestic production. A higher factor cost advantage of the foreign country – reflected by a higher value of c – has the opposite effect. Finally, we see from (1) that both D^- and D^+ increase in α. Recall that a higher value of α reflects lower heterogeneity of adjacent production steps in terms of relative offshoring costs. Technically, raising α ceteris paribus raises the frequency of the $d(t)$-function and diminishes cost savings associated with offshoring a sequence of production steps.

From (1) we obtain

$$D^- - D^+ = 2\alpha\,[c - B]\,. \tag{2}$$

This equation compares cost savings from offshoring production segments for which the foreign country has a cost advantage with cost savings from leaving other segments with $d(t) > c$ at home. The cost difference $D^- - D^+$ is positive if and only if factor costs at home c exceed average offhoring costs B. For this case we can say that the foreign country has a *total cost advantage* in producing the good we consider. The expression in (2) also demonstrates that the absolute value of cost savings increases in α: if the foreign country offers a cost advantage for longer segments of the production process, this raises the relative benefits of offshoring these segments.

Note, finally, that owing to our symmetry assumption, the cost advantage from producing the first or the last production sequence at home is given by $D^+/2$.

We can now turn to the firm's offshoring decision. Obviously, the last sequence of the production chain always takes place at home because, first, it is cheaper to produce these steps at home and, second, the final good needs to be present at home to be sold on the domestic market. With respect to the other production steps, we can distinguish the following *production regimes*: domestic production,

production abroad, and fragmented production. As the name implies, in the *domestic production regime*, the firm stays at home over the entire production chain. *Production abroad* is characterized by the whole sequence of production steps – except for the final segment – being done in the foreign country. In the *fragmented production regime*, all segments of the production chain with low offshoring costs are offshored, whereas the other segments are performed at home. Since the offshoring cost function is symmetric, firms offshore all segments with $c > d(t)$ if it is worthwhile offshoring one of them. By the same type of argument, we can exclude offshoring patterns other than these three.[8]

Production abroad causes the transport cost T only once: when the intermediate good is shipped back to the home country. Fragmented production instead involves sending the intermediate good forth and back between domestic and foreign production sites. Hence, the unfinished good crosses the border $2m$ times in the production process.

To determine the optimal offshoring pattern for a firm under consideration, we simply have to compare costs under the three different regimes. If the firm produces domestically, total costs C^d to supply one unit of the good are $C^d = 2m\alpha c$. Cost savings from production abroad compared with those from domestic production are given by $C^d - C^a = m\left(D^- - D^+\right) + D^+/2 - T$. These cost savings increase in D^- and decline in D^+ and in the transport costs T. By setting $C^d = C^a$ and using the expressions in (1), we can determine a critical level of transport costs $T^{a,d}$ for which the cost advantage of production abroad compared with producing domestically vanishes completely:

$$T^{a,d} \equiv \frac{\alpha}{2}(4m-1)(c-B) + \frac{\alpha A}{2} \ . \tag{3}$$

Cost savings from fragmented production compared with those from domestic production $C^d - C^f$ can be obtained as $C^d - C^f = mD^- - 2mT$. This difference is positive as long as transport costs are below a critical value $T^{f,d}$, which is given by

$$T^{f,d} \equiv \frac{\alpha}{2}(c-B) + \frac{\alpha A}{2} \ . \tag{4}$$

Finally, the cost advantage from fragmented production compared with production abroad is given by the condition $C^a - C^f = (2m-1)\left(D^+/2 - T\right)$.

8 To check for robustness of our results, we also have considered versions of our model in which the offshoring cost function is shifted horizontally. In such a setting, the model may produce additional regimes with offshoring intervals differing from fragmented production as it is defined here. The basic insights of our model, however, remain: a regime with fragmented production exists for low enough transport costs, whereas for higher transport costs the firm may offshore longer segments of the production chain.

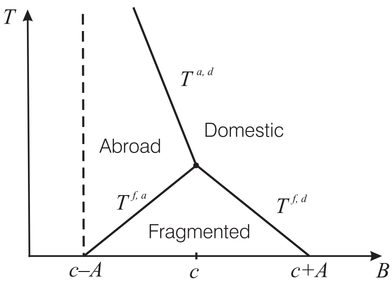

FIGURE 3 Offshoring regimes

Fragmented production saves costs compared with production abroad as long as transport costs are below a critical value $T^{f,a}$, given by

$$T^{f,a} \equiv \frac{\alpha}{2}(B-c) + \frac{\alpha A}{2}\ . \tag{5}$$

Figure 3 depicts the threshold values for transportation costs as a function of average offshoring costs B. While $T^{a,d}$ and $T^{f,d}$ are decreasing in B, $T^{f,a}$ is increasing. To keep firms indifferent between domestic production and production abroad / fragmented production, a smaller cost advantage of the foreign country, as reflected by a higher value of B, has to be compensated by lower transport costs. The $T^{a,d}$-line is steeper than the $T^{f,d}$-line, because any increase in B has a greater impact on total costs if firms consider performing all production steps abroad and because this increase has to be compensated by a stronger decline in transport costs for firms to stay indifferent between the two regimes. Conversely, the $T^{f,a}$-line is increasing in B: With a dwindling foreign cost advantage, that is, a larger value of B, fragmented production becomes more attractive relative to production abroad, unless higher transport costs reduce the incentive to frequently shift the intermediate good across borders. Note, finally, that the three lines intersect in the point $(c, \alpha A/2)$: if average offshoring costs equal domestic production costs $(B = c)$, transport costs of $\alpha A/2$ simply eat up the cost savings from producing in different countries and thus keep firms indifferent between the three regimes.

The threshold values as depicted in figure 3 allow us to distinguish three regions that represent combinations of transport costs (T) and average offshoring costs (B) for which a certain regime (production abroad, fragmented production, domestic production) is preferable. Generally, production abroad is chosen if the foreign country has a total cost advantage ($B < c$), and if transport costs are small enough to be compensated by the foreign cost advantage but too high to warrant fragmented production. Fragmented production, in turn, is preferable for very low transport costs, and firms may choose this mode even if the foreign country has a total cost disadvantage, that is, if $B > c$. Finally, domestic production is chosen for combinations of high offshoring costs and high transport costs.

4. Comparative static analysis

We can use figure 3 to explore as to how changes in model parameters influence the firms' offshoring choices. A general improvement of communication and information technologies shifts the $d(t)$-curve downward. Apparently, this decline of average offshoring costs B makes production abroad more attractive compared with its alternatives. A possible regime switch involves fragmented production if transport costs are low, while it is reflected by an immediate jump from the domestic production regime to production abroad if T is high. To analyze the impact of a decline in transport costs, we start from a situation in which T is sufficiently high to prevent any offshoring. If the foreign country has a total cost advantage, that is, if $c > B$, a reduction of T first results in a shift to the production abroad regime before, as T decreases further, the fragmented production regime is chosen. Conversely, if average offshoring costs are high ($c < B$), the firm refrains from the production abroad regime even for moderate values of T and choses fragmented production for only very small values of T.

These results reveal that offshoring activities may change in a non-continuous way if transport costs pass certain thresholds. Moreover, a hump-shaped pattern of offshoring activities may emerge. As transport costs decline, there is first a large increase in offshoring activities as the sector moves from domestic production to production abroad. At a further reduction of transport costs the offshoring volume declines again, switching to the fragmented production regime. Note that for these results we do not assume network effects or agglomeration economies.

With respect to the influence of the other parameters, we note that raising A shifts the dividing lines in figure 3 upward, thus expanding the parameter space in which fragmented production takes place. This is intuitive: if the production process is characterized by sharp cost differences between individual steps, it becomes more profitable to switch between locations even if transport costs are relatively high and/or the foreign country's cost advantage $c - B$ is low. Raising the heterogeneity of adjacent production steps in terms of cost savings, that is, lowering α, has the opposite effect, as the dividing lines in figure 3 become flatter, narrowing the parameter space for which fragmented production is profitable. Again, this is not surprising: Frequent changes between locations are desirable only if cost savings at any location warrant the associated transport costs, and a declining value of α lowers these cost savings. The length of the production chain m influences only the border $T^{a,d}$ between the production abroad regime and domestic production. The longer the production chain, the more attractive production abroad becomes, since the transport costs associated with repatriating the unfinished good become less important relative to potential cost savings.

5. Extension: increasing transport costs

So far, we have taken transport costs to be the same no matter at which production stage transport takes places. In contrast to this assumption, one may very well argue that transport costs change along the production process. For example, if a good becomes more valuable as production progresses, the costs to transport the unfinished intermediate good across borders are likely to increase as well. To account for this possibility, we now discuss an extension of our baseline model in which transport costs are no longer constant but increase according to $T(t) = T_0 + \tau t$, where T_0 denotes the initial transport costs at production stage 0 and τ are marginal transport costs.[9]

We focus on the case in which the foreign country has a total cost advantage for producing the good, that is, $c > B$, which implies that $D^- > D^+$. Moreover, we assume that transport costs are not too strongly increasing over the production process; that is, $\tau < c - (B - A)$. This assumption implies that the marginal cost savings from producing an additional step at the cheaper location exceed the marginal increases in transport costs. Otherwise, a firm would always fare better by not producing abroad.

Given our assumptions, firms have no incentive to relocate production at points other than $\alpha/2, 3\alpha/2, 5\alpha/2$, and so on. At a given stage t' of the production process, where $t' \in \{\alpha/2, 5\alpha/2, \ldots, 2\alpha m - 3\alpha/2\}$, the firm benefits from offshoring the sequence of production steps on the interval $[t', t' + \alpha]$ to the *foreign* economy if

$$D^- > 2T_0 + \tau(2t' + \alpha)\,. \tag{6}$$

Conversely, a firm that produces abroad at stage t'', where $t'' \in \{3\alpha/2, 7\alpha/2, \ldots, 2\alpha m - 5\alpha/2\}$, benefits from performing the sequence $[t'', t'' + \alpha]$ in the *domestic* economy if

$$D^+ > 2T_0 + \tau(2t'' + \alpha)\,. \tag{7}$$

If these two inequalities are satisfied for all t' and t'', then we obtain fragmented production over the entire production chain, as in the baseline model.

The novel feature associated with increasing transport costs is that fragmented production may take place at early stages of the production process, while later stages are performed entirely in one economy, where firms deliberately forgo lower production costs in order to save transport costs. Figure 4 illustrates this for the special case of $D^- > 2T_0 + 2\tau\,(2m - 1)\,\alpha$ and $2T_0 + 2\tau\,(2m - 4)\,\alpha < D^+ < 2T_0 + 2\tau\,(2m - 2)\,\alpha$. For this parameter constellation, the firm produces the entire segment $[2\alpha m - 7\alpha/2, 2\alpha m - \alpha/2]$ in the foreign country, accepting the higher costs incurred on the interval $[2\alpha m - 5\alpha/2, 2\alpha m - 3\alpha/2]$. Hence, production abroad dominates the later part of the production process. Conversely, the

9 The linear specification is chosen for simplicity.

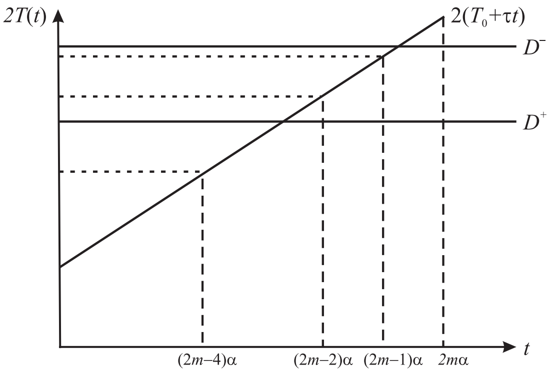

FIGURE 4 Increasing transport costs

earlier stages are characterized by fragmented production, where firms fully exploit international cost differences. Obviously, an increase in T_0 or τ may reduce the share of fragmented production, enlarging the final segment with production abroad.

6. Summary and concluding remarks

This paper has introduced a new approach to analyzing firms' offshoring decisions. Most existing models assume that individual production steps can be arranged according to their offshoring costs or that these costs vary monotonically along the production process. By contrast, we have focused on the plausible case that the sequence of production steps cannot be varied at will. Moreover, we have allowed for the possibility that cost differentials between domestic and foreign production are neither monotonically increasing nor monotonically decreasing along the process. Combined with the plausible assumption that shifting intermediate goods between different locations is costly, this may lead to a clustering of individual production steps, such that the decision to produce a single step at home or abroad depends on the location of preceding or subsequent steps. In our framework, this results in three different regimes of international production, and we have shown that the borders between these regimes depend in a non-trivial way on costs of transportation and on offshoring costs. Thus, the influence of globalization – defined as improved international communication and reduced barriers to international trade – on the offshoring pattern is far from straightforward. On the one hand, firms may be reluctant to offshore certain production steps, although, considered in isolation, these steps could be performed at far lower cost abroad. On the other hand, minor changes in the costs of offshoring or technological innovations affecting the structure of the production process may result in the relocation of considerable parts of the production chain all at once.

With regard to further advances in theory, the next logical step is to embed our offshoring model into a general equilibrium framework of international trade. We may then be able to obtain new insights into the relationship between the conditions for offshoring and factor rewards. Moreover, it should be possible to empirically test the implications of our approach. Our model suggests that one needs to take into account that various industries differ with respect to the 'sequentiality' and potential modularization of their production chains, the size and relevance of transport costs, as well as the costs of relocating individual production steps. In our view, a firm grasp of these technological constraints holds the key for a better understanding of the extent and evolution of offshoring.

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