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A Specific-Factors View on Outsourcing

by

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Abstract

A distinctive feature of the present wave of economic globalization is that the principle of world-wide arbitrage is increasingly applied to individual components of value added chains, rather than final goods. The result is a phenomenon called outsourcing, or international fragmentation. Economists have investigated this phenomenon with a focus on welfare and factor price effects, mainly using Heckscher-Ohlin-type trade models. Existing studies emphasize a positive welfare effect of international fragmentation, but reveal ambiguous effects on factor prices. This paper first reviews existing literature, identifying the crucial modeling differences that drive the differing results. It then presents an alternative view on international fragmentation based on the specific factors model, instead of the Heckscher-Ohlin model. The analysis explicitly deals with the cost of international fragmentation, emphasizing that there will typically be a fixed cost element, with important consequences for the welfare effect of outsourcing. Moreover, the paper highlights a crucial distinction between outsourcing that takes place in an environment where firms may entertain foreign direct investment, and international fragmentation without capital mobility where firms must rely on arms-length transactions. The results are as follows. a) With foreign direct investment, outsourcing which is driven by a low foreign wage unambiguously depresses the domestic wage rate. Outsourcing of a single fragment is sufficient to drive the domestic wage rate to the foreign level, adjusted for the cost of fragmentation. This holds irrespective of the factor intensity ranking of fragments. b) If outsourcing takes place without foreign direct investment, then the factor intensity ranking matters. Domestic labor loses if a labor intensive fragments moves "offshore", and vice versa. c) In both cases, international fragmentation may cause a welfare loss if the costs of fragmentation includes a fixed element.

JEL Code: F11, F13, F19

1 Introduction

From an economic point of view, the essence of globalization is the increasing dominance of world-wide arbitrage which, if perfect, implies that goods and factors cannot command different prices or returns at different locations for prolonged periods of time.[1] Arguably, there are at least two features that distinguish the second wave of economic globalization at the end of the 20th century from the first wave a hundred years ago. First, instead of ruling over a given set of well-defined production processes, the principle of international arbitrage is now applied to ever smaller slices of the value added chain. This gives rise to a new phenomenon called international fragmentation, or outsourcing. Empirical evidence for this is presented in Irwin (1996) and Feenstra (1998). And secondly, in a world where private activities are governed by world-wide arbitrage, the set of policy options which national governments may simultaneously, and independently, pursue is severely restricted. In a sense, the notion of arbitrage is extended to the realm of policy. The reason why this is of so much concern today lies with the simple fact that governments now want to do and achieve so much more than those in the first wave of globalization a hundred years ago. In this paper, I address the first of these features: international fragmentation.

Applying arbitrage to individual components (fragments) of the value added chain implies that firms in one country try to exploit international differences in factor prices or, more generally, prices of inputs that are not themselves tradable, by moving production of such components across the border ("offshore"), thereby attempting to reduce the unit-cost of the final product. Such outsourcing is favored, not only by a reduction of formal barriers to trade and foreign direct investment, but more importantly by a cut in the cost of linking individual value added fragments towards a steady supply of the final product to the buyer. Such costs are arguably higher for cross-border fragmentation than for domestic fragmentation. At the same time factor price differences are typically higher between countries than within. A crucial element of the recent improvement in information technology has been a marked reduction in the cost of cross-border service links between different components of the value added chain, thereby increasing the economic incentive for international fragmentation; see Harris (1993,2000) and Jones & Kierzkowski (2000a). While early instances of such outourcing have mainly involved neighboring economies, most notably the maquiladoras appearing in the mid 1990s at the US-Mexican border as a result of NAFTA, more recent instances reveal that for certain types of services distance has progressively lost importance. In some cases, even such far-away economies as India have become attractive outsourcing targets for US firms. In the European context, western European

[1] See Temin (1999) for an arbitrage-oriented account of globalization in recent economic history.

firms are likely to find eastern European countries as attractive low-cost targets for outsourcing.

Reflecting the general concern with wage effects of globalization and trade, international fragmentation has largely been addressed with a clear emphasis on its wage, or more generally factor price effects, and on welfare implications. The present paper sticks to this tradition. Unlike the previous literature, however, I shall rely on a specific factors model instead of a Heckscher-Ohlin model. This is motivated by two considerations. First, the Heckscher-Ohlin model is well known to yield weak results in higher dimensions. And secondly, its characteristic assumption that all factors are completely mobile as between sectors is of questional relevance from a policy perspective, where short run factor specificity is normally deemed important. Using a simple specific factors model, I shall employ the notion of effective (or imputed) prices for individual fragments of the value added chain, in order to analyze international fragmentation. The concept of effective prices was widely used in the theory of effective protection, but has not yet found its way into modern theory of fragmentation. I shall argue that it is a useful tool also for investigating the welfare and distributional consequences of international fragmentation in a unified way.

Relying on a simple specific factors model, the paper pursues two further innovations. First, it highlights the role that costs of international fragmentation play for the welfare consequences. The crucial point here is that maintaining a cross-border link for international fragmentation may entail a significant fixed cost element. It will be shown that this opens a possibility for outsourcing to reduce, rather than increase economic welfare in the home country. In addition, the paper highlights the role of international capital mobility for the factor price effect of fragmentation. Intuition tells us that it makes a big difference whether firms may couple outsourcing with foreign direct investment, or whether fragmentation must rely on arms-length transactions. I shall investigate this difference with special emphasis on factor prices and income distribution.

The paper is structured as follows. Section 2 takes a brief look at the literature, identifying the crucial assumptions and driving forces behind the different results, and putting the present approach into perspective. Section 3 introduces the basic framework, including the key concept of effective prices for fragments. The setting features a potentially fragmented technology, but section 3 first presents a benchmark case where outsourcing does not yet take place. The subsequent sections then assume a nearby low-wage country, and look at the incentives that domestic firms will face to move production of a fragment abroad, and at the domestic wage and welfare effects that arise if they do. Section 4 assumes that outsourcing takes place in an environment of mobile capital, so that domestic firms may undertake foreign direct investment. By way of contrast, section 5 turns to international fragmentation in a case where foreign direct investment is ruled out, either by policy or by more fundamental barriers to international capital

movements. Section 6 will close the paper with a summary.

2 A brief look at the literature

Interest in the phenomenon of outsourcing has arisen in the context of the so-called maquiladoras appearing at the US-Mexican border as a result of NAFTA. Against this background, Feenstra & Hanson (1996, 1997) present a stylized Heckscher-Ohlin-type model where outsourcing provides a key to understanding a conundrum which has often been pointed out in the recent wage debate: An increase in the skill-intensity of production in the face of an increase in the wage rate for high-skilled relative to low-skilled labor. This seems to defy the notion of cost-minimizing input substitution. According to Feenstra & Hanson, however, it is the result of outsourcing. More specifically, if fragments which are at the lower end in terms of skill-intensity in the US are moved to Mexico where, in turn, they are at the upper end of this scale, then the skill-intensity of production increases in both countries. As a consequence, demand for high-skilled labor is up in both countries, explaining why the increase in skill-intensity is coupled with a rise in the relative wage for skills. Thus, trade in the form of international fragmentation acts like a factor-biased technological change.[2]

There are two noteworthy features of the Feenstra-Hanson model which are crucial for this result: There is only one *final* good, and there are only two countries (US and Mexico), with prices endogenously adjusting to clear all goods markets, including intermediate goods (fragments). Arndt (1997, 1999) uses a more conventional Heckscher-Ohlin model with two goods and two factors to show that outsourcing may alleviate, rather than aggravate, the concern with falling US wages. If the labor-intensive import competing industry in the US moves some of its fragments to Mexico, this acts like a technological improvement on the remaining fragments of this industry. If prices of final goods are given from world commodity markets, then we have the well-known result that labor gains from a technological improvement in the labor intensive sector. Notice the difference to Feenstra-Hanson, not only in substance as regards the wage debate, but also in terms of the driving forces. Arndt emphasizes the sector-bias, while Feenstra

[2]This still leaves the question of why outsourcing occurs in the first place. In the model proposed by Feenstra & Hanson, the ultimate cause of outsourcing is foreign direct investment or, equivalently, a technological improvement in Mexico. But according to their story outsourcing still appears as a main culprit for recent wage movements in the US. Foreign direct investment will also be highlighted below, but there is an important difference. In the Feenstra-Hanson case, foreign direct investment is an exogenous cause of outsourcing which, as such, does not involve any further movement of capital. In the case considered below, foreign direct investment is an integral part of international fragmentation if capital is allowed to move. For completeness, one should also mention Feenstra & Hanson (1999) where outsourcing enters as a determinant of wages in an empirical exercise.

& Hanson emphasize the factor-bias in technological change. In terms of theory, the two results are easily reconciled by referring to established results on the effect of technological change. As noted above, Feenstra & Hanson model a "world economy" consisting of the US and Mexico. Their model predicts that outsourcing acts like a simultaneous *factor biased* technological change in both countries. As Krugman (2000) has pointed out, this is like technical change in a *closed* economy. And it is well known that for a closed economy the factor-bias of this change determines its factor price effect. By way of contrast, if technical change takes place in a *small open economy* with given goods prices, it is the *sector-bias* that determines the factor price effect. And this is precisely what happens in the case considered by Arndt. But this still leaves the question of which of the two views is more relevant.

One expects that in Heckscher-Ohlin-type models the factor price effect is importantly determined by the factor intensity of the fragment which leaves the country when outsourcing takes place. In the Feenstra-Hanson model, the assumptions are such that the fragment moving from the US to Mexico is always the least skill-intensive one if viewed from the US, and the most skill-intensive if viewed from Mexico. This is ensured by assuming a single final good and a unique factor intensity ordering of all fragments, coupled with a lower relative wage of skilled labor in Mexico. However, allowing for more final goods generates more candidate fragments for outsourcing, and the outcome is less clear-cut. Following Arndt, consider two final goods and two factors (capital and labor), and assume a low-wage partner country as a target for outsourcing. While it is true that outsourcing always involves the most labor-intensive fragments, these may well be fragments of the industry which in the aggregate is relatively capital intensive. If that is the case, then invoking the logic indicated above implies that there is an equivalent technological improvement in a relatively capital intensive industry. The result is that the wage rate in the outsourcing country is depressed. But from the case considered by Arndt it becomes evident that the converse is no less plausible, unless further information is available, or more restrictive assumptions are made.

The ambiguity further increases if the Heckscher-Ohlin model is extended beyond the two-dimensional case. Deardorff (1998) argues that in the most general case of many goods and factors, fragmentation involves a well-defined tendency to enhance the possibility of factor price equalization. This means that fragmentation renders factor price equalization a possible equilibrium outcome for certain factor endowment distributions which would otherwise rule out an equilibrium with factor price equalization. The reason is that fragmentation increases the number of activities that may serve as carriers of factor price equalization. However, as shown by Deardorff (2000), this does not rule out that in certain very plausible instances fragmentation actually drives factor prices apart, rather than contributing to factor price equalization. Specifi-

cally, it is perfectly possible that the factor intensities of the fragments changing location are such that each country experiences an increase in demand for *its* relatively expensive factor. Note the difference to the Feenstra-Hanson result. There, outsourcing increases demand for skilled labor in both countries, being the relatively scarce and therefore expensive factor in Mexico, while abundant and *relatively* cheap in the US. The difference is explained by the above mentioned specific assumptions underlying the Feenstra-Hanson model, particularly the assumption of a single final good. This severely restricts the set of possible fragmentation patterns. Conversely, as the number of final goods increases beyond the number of factors, it seems almost impossible to pin down the factor price effects of international fragmentation, unless additional assumptions are made. This general impression is reinforced by the work of Jones & Kierzkowski (2000a, 2000b) who show that fragmentation may be beneficial or harmful to (low-skilled) workers, depending on a complex interplay between the factor endowment position and output pattern of a country, and the factor intensities prevailing in the different fragments.

It seems to me that the literature on fragmentation once more reveals that the Heckscher-Ohlin model tends to yield week results on factor price effects in higher dimensions. Much less ambiguity is, of course, present regarding the welfare effects of fragmentation. Here, the general impression one obtains from the literature is that, barring distortions, international fragmentation is but a further instance of beneficial division of labor. However, we shall see below that fixed costs of coordination and networking may imply that international fragmentation causes a welfare loss. As regards the ambiguity of factor price effects, in my view two reactions are possible. One may either look at it as a fascinating world offering a rich variety of sometimes rather surprising results, or one may lament the lack of unambiguous and policy relevant results. For those inclined to take the latter view, the specific-factors model may seem an attractive alternative route to take for a fruitful analysis of fragmentation. Pioneered by Jones (1971), the specific factors model has repeatedly shown its potential to remove ambiguity, while at the same time adding relevance to the results. Somewhat surprisingly, it has so far not played a prominent role in the fragmentation literature. Jones & Kierzkowski (2000b) offer a few indications to the effect that the specific factors setting tends to yield more "normal-sounding results" where outsourcing into low-wage countries tends to depress domestic wages. In the following, I shall offer a detailed account of these results.

3 The point of reference: equilibrium without outsourcing

I first present an equilibrium for a small open economy where by assumption there is no outsourcing. This will serve as a point of reference for investigating the implication of international fragmentation. More specifically, subsequent sections will introduce a neighboring country as a

candidate for outsourcing, and the consequence of outsourcing will be investigated by comparing the "outsourcing-equilibrium" with the "no-outsourcing-equilibrium" characterized in this section.

I shall use a largely standard version of the specific factors model, in order to achieve a maximum applicability of familiar tools of analysis. Suppose, then, that there is a perfectly competitive economy facing given prices for two final goods. It produces these goods in amounts Q^1 and Q^2 with constant returns to scale technologies, using sector specific physical capital and labor which moves freely between sectors. The economy has a given and constant endowment with both types of capital, K^1 and K^2, as well as labor L. Let the relative price of good 1 be p. I assume that technology in sector 1 is amenable to fragmentation while good 2 is always produced in an integrated way. Thus, production of good 1 is subject to a production function of the form

$$Q^1 = Q^1\left[F_1^1\left(K_1^1, L_1^1\right), F_2^1\left(K_2^1, L_2^1\right)\right], \tag{1}$$

where F_1^1 and F_2^1 are the amounts of two fragments entering production of the final good. $Q^1[\cdot]$ may be interpreted as representing the fragmentation technology, where $F_1^1(\cdot)$ and $F_2^1(\cdot)$ represent the two components (fragments) of the value added chain. It is important that this technology by assumption does not account for any costs that arise if fragmentation crosses international borders. These will be introduced below. Good 2 is produced according to a standard production function $Q^2\left(K^2, L^2\right)$. All of these functions are assumed to be homogenous of degree 1. There is a given stock of capital in sector 2. Moreover, we assume that capital in sector 1 may move across fragments. Hence, the remaining resource constraints for this economy are $K_1^1 + K_2^1 = K^1$, and $L_1^1 + L_2^1 + L^2 = L$.

Profit maximizing firms will ensure that the following conditions are satisfied in equilibrium:

$$pQ_1^1F_{1L}^1 = pQ_2^1F_{2L}^1 = Q_L^2 = w, \quad \text{and} \tag{2}$$

$$Q_1^1F_{1K}^1 = Q_2^1F_{2K}^1 = r^1, \tag{3}$$

where Q_1^1 is the marginal productivity of fragment 1 in final assembly of good 1 (analogously for Q_2^1), while F_{1K}^1 is the marginal productivity of capital in producing fragment 1 (analogously for fragment 2 and labor), and Q_L^2 is the marginal productivity of labor in sector 2. w denotes the equilibrium wage rate, while r^1 is the capital rental in sector 1. Condition 2 states that the marginal value productivities of labor are equal in all possible employments, i.e., the two fragments in sector 1, and sector 2. Equation 3 requires equal marginal productivity of capital in both fragments of sector 1. The rental for capital in sector 2 is simply determined by its marginal productivity. A good 2 is our numéraire, we have $r^2 = Q_K^2$.

Given linear homogeneity, output of good 1 may be written as

$$Q^1 = Q_1^1 \left(F_{1K}^1 K_1^1 + F_{1L}^1 L_1^1\right) + Q_2^1 \left(F_{2K}^1 K_2^1 + F_{2L}^1 L_2^1\right). \tag{4}$$

In value terms, we may write

$$pQ^1 = pQ_1^1 F_1^1 + pQ_2^1 F_2^1, \quad \text{or} \tag{5}$$

$$pQ^1 = \tilde{p}_1 F_1^1 + \tilde{p}_2 F_2^1, \tag{6}$$

where $\tilde{p}_1$ and $\tilde{p}_2$ are the *imputed*, or *effective prices* of fragments 1 and 2, respectively. With these effective prices for the two fragments, final assembly in industry 1 takes place at zero profits, as required by the assumption of perfect competition. Given the first order conditions 2 and 3, we have, for $i = 1, 2$,

$$\tilde{p}_i F_i^1 = wL_i^1 + r^1 K_i^1, \tag{7}$$

which simply states that the imputed value of fragment i in equilibrium equals the opportunity cost of producing this fragment. Notice that the imputed value per unit of fragment 1, $\tilde{p}_1$, depends on a specific input quantity of fragment 2, and vice versa. I shall henceforth also refer to $\tilde{p}_i F_i^1$ as the *derived* value of fragment i. In what follows, the initial equilibrium values of all variables will be indicated by a superscript *.

The supply-side equilibrium of this economy is depicted in figure 1 which uses the familiar diagram due to Neary (1978). The assumption here is that, fragmentability notwithstanding, both components of the value added in industry 1 are carried out domestically. International fragmentation will be considered in the following section. The schedule M_L^1 gives the marginal value productivity of labor in sector 1 assuming that the first order condition $pQ_1^1 F_{1L}^1 = pQ_2^1 F_{2L}^1$, as well as equation 3 are fulfilled.[3] If both fragments are produced domestically, this is the labor demand schedule of industry 1. For each total labor input in industry 1, the first order conditions determine a unique allocation of this labor (as well as the given capital stock K^1) to the two fragments. The schedules M_{1L}^1 relates fragment-1-allocation to the wage rate. It is a marginal value productivity schedule for fragment 1, assuming that firms in industry 1 always choose a profit maximizing total employment, and a profit maximizing allocation of the capital stock. The horizontal difference between M_L^1 and M_{1L}^1 then gives the corresponding fragment-2-employment. The equilibrium wage rate is w^*, with fragment-1-employment of labor equal to

[3] One might be tempted to think of industry 1 as a notional 2-good-2-factor economy, treating the two fragments as notional commodities. According to the Rypbczyinski theorem, such an economy should be able to absorb an increase in labor supply at unchanged marginal productivities by a suitable reallocation of factors. However, this analogy is misleading, because in general the two fragments do not have constant imputed prices.

L_1^{1*}, and fragment-2-employment is $L_2^{1*} = L^{1*} - L_1^{1*}$. Sector-2-employment is $L^{2*} = L - L^{1*}$. Corresponding to M_{1L}^1, M_{2L}^1 gives the marginal productivity schedule for fragment 2, with origin at L_1^{1*}. It is simply the horizontal difference between M_L^1 and M_{1L}^1, with its vertex moved from point A to point B.[4] The schedules $\bar{M}_{1L}^1$ and $\bar{M}_{2L}^1$ give marginal productivities of labor in the two fragments, assuming capital inputs in both fragments as well as labor input in the other fragment, respectively, are kept at their equilibrium quantities, instead of adjusting them in accordance with the first order conditions. For obvious reasons, these schedules are steeper than the ones where the first order conditions are met.

We can now measure equilibrium output value in industry 1, pQ^{1*}, as the area $\mathrm{AC}L^{1*}O^1$.[5] Labor income in industry 1 is equal to $L^{1*}w^*$, while capital income is measured by the triangle ACE or, equivalently, by triangle ADE plus triangle BCD. Turning to the individual fragments, we measure $\tilde{p}_1 F_1^{1*}$ and $\tilde{p}_2 F_2^{1*}$, respectively, by areas $\mathrm{AD}L_1^{1*}O^1$ and $\mathrm{BC}L^{1*}L_1^{1*}$. Notice, however, that these are *derived* values. Neither of them exists independent of the other; see above. Armed with this figure, we can now turn to outsourcing.

4 Outsourcing with foreign direct investment

To consider outourcing, we need further assumptions. We interpret the domestic economy as the US, or a western European economy, which is now confronted with a low wage neighboring country, say Mexico or an eastern European country. To keep matters as simple as possible, I abstain from modeling this foreign country explicitly. Its wage rate is denoted by $w^f < w^*$.

To have a meaningful case of outsourcing, we must assume conditions which preclude that industry 1 leaves the high wage country altogether, and which restrict industry 1 firms to outsourcing of a subset of value added components when attempting to exploit low foreign wages. We thus assume that firms in the low wage country have no access to the technology of producing final good 1, while home firms nonetheless face perfect competition for good 1 on world markets. And secondly, the domestic economy offers a country-specific advantage to industry 1, say a specific form of infrastructure, which can only be exploited by producing fragment 1 domestically, and then "assembling" the final good, drawing on fragment 2 which may, or may not, be produced abroad. If it is, then there is international fragmentation or, from our country's point of view, outsourcing.

[4] We assume, for simplicity, that employment in both fragments starts at the same initial wage rate. In general, however, points A and B need not be at the same vertical difference from the origin.

[5] It may alternatively be measured as the area under $\bar{M}_{1L}^1$ and to the left of L_1^{1*}, or as the area under $\bar{M}_{2L}^1$ between L_1^{1*} and L^{1*}.

Outsourcing requires running an international, or global, production network. More specifically, components of the value added process which are carried out in separate locations with different jurisdictions need to be linked towards a steady supply of the product to the buyer. This gives rise to a cost element which is absent in non-fragmented production, or if fragmentation is strictly national, and which is therefore not yet captured by the fragmentation technology $Q^1[\cdot]$. In practice, this cost may depend on how closely related the different fragments are in terms of ownership structure. Specifically, it is likely to depend on whether or not outsourcing is coupled with foreign direct investment. In either case, maintaining a transport and communication network which facilitates international fragmentation is likely to entail a significant *fixed* cost element. Without going into any further detail, I therefore assume that firms incur a fixed cost of Z, given in terms of foreign labor, if they secure fragment 2 of their value added from production abroad. This may be interpreted as a direct labor input within the foreign production unit, or as the labor-equivalent of the price that the supplier of a global communications network charges for network use.[6] In the following, I will assume the former. In addition, there is a variable element to the cost of international fragmentation which we model as a "surcharge-equivalent" ζ on the foreign wage rate.[7]

All of these assumptions will underlie both this and the next section. In this section, as opposed to the next, we additionally assume that domestic firms may move their industry-specific capital K^1 abroad in any amount they deem desirable when attempting to exploit the low wage through outsourcing.[8] Moreover, we assume that there is some internalization advantage which renders outsourcing coupled with foreign direct investment more attractive than relying on arms-length transactions.[9]

4.1 The "outsourcing equilibrium"

Drawing on foreign labor to work with their own capital allows domestic firms to obtain the initial imputed value of fragment 2, $\tilde{p}_2^* F_2^{1*}$, at an opportunity cost which differs from $w^* L_2^{1*} + r^{1*} K_2^{1*}$ (see

[6] For more details, see Harris (2000).

[7] In line with the familiar notion of "iceberg-cost" of trade or transportation, this implies that for an input of one effective unit of labor in production of fragment 2 abroad, firms have to hire $1+\zeta$ units of foreign labor. Thus, the cost of cross-border service links may also involve some form of Harrod-neutral productivity disadvantage of foreign labor.

[8] For ease of modeling, we I shall express fragmentation costs in terms of F_2^1 (instead of foreign labor), when dealing with outsourcing in the case of immobile capital; see below.

[9] The term foreign direct investment is a bit misleading in that our setting does not involve any capital *formation*. What we have in mind, instead, is cross-border movement of *existing* capital. I stick to the term foreign direct investment because it is commonly used to indicate *internal*, instead of *arms-length*, transactions.

equation 7). Specifically, given the above assumption on the cost of international fragmentation, the cost-advantage of securing F_2^{1*} via outsourcing is equal to $\left[w^* - (1+\zeta)\, w^f\right] L_2^{1*} - Zw^f$. Thus, moving all of fragment-2-production F_2^{1*} offshore, relying on foreign direct investment of K_2^{1*}, yields a positive cost-advantage if the relative wage difference is sufficiently large, i.e., if and only if

$$w^* \Big/ w^f - 1 > \zeta + Z \Big/ L_2^{1*} \,. \tag{8}$$

If this condition is satisfied, the initial equilibrium is disturbed, since firms face an incentive to change the production location of fragment 2. In figure 2, we draw Zw^f as the shaded rectangle DCIF , and inequality 8 is satisfied if the line $w^f\,(1+\zeta)$ is below this Zw^f-rectangle. To avoid clutter, the M_{2L}^1-line has not been reproduced in this figure. Quite clearly, exogenous reductions in Z and/or ζ may take the economy from a "no-outsourcing-equilibrium", where 8 is violated, to a new equilibrium where fragmentability makes a difference in that outsourcing takes place. Let us take this as our globalization scenario.

How does this new equilibrium look like? The first thing to note is that simply producing F_2^{1*} at a lower cost abroad and keeping all else constant is no equilibrium. This can be seen in two ways. One is to infer from equation 7 that the capital rental on K_2^{1*} is increased, exceeding the marginal value productivity of capital in fragment 1 which violates the equilibrium condition 3. The other is to infer from equation 7 that the opportunity cost of obtaining F_2^{1*} is lower than its imputed value. Industry-1-firms thus face a clear incentive to extend production, not only of fragment 2, but also of fragment 1. From an economy-wide perspective, we must also note that outsourcing F_2^{1*} would imply an excess supply of domestic labor, thus exerting a downward pressure on the domestic wage rate. But once the domestic wage rate has fallen to $(1+\zeta)\, w^f$, firms will be indifferent between producing fragment 2 at home and abroad. In describing the "outsourcing-equilibrium" we must, therefore, replace condition 2 by

$$pQ_1^1 F_{1L}^1 = pQ_2^1 F_{2L}^1 = Q_L^2 = (1+\zeta)\, w^f, \tag{9}$$

and correspondingly replace the labor market clearing condition by

$$L \;\geq\; L_1^1 + L^2, \quad \text{and} \tag{10}$$

$$L_2^{1f} \;=\; L_2^1 - \left(L - L_1^1 - L^2\right), \tag{11}$$

where L^2 is the profit-maximizing labor employment in industry 2, and L_1^1 and L_2^1 are the profit-maximizing employments in fragment-1 and fragment 2 production, respectively, in industry 1. These are determined by equation 9. In equation 11, L_2^{1f} is the amount of foreign labor used when domestic industry-2-firms secure part of fragment 2 via outsourcing.

Condition 9 ties down the domestic wage rate to the "effective" foreign wage rate. Although the use of foreign labor is restricted to fragment 2, substitutability between labor and capital and between the two fragments, including mobility of domestic capital across fragments provides enough leverage for the domestic wage rate to be forced down to $(1+\zeta)\, w^f$. This must, of course be mirrored by an appropriate formulation of the labor market clearing condition. Thus, inequality 10 requires that all employment in sector 2, plus fragment-1-employment of industry 1, must rely on domestic labor. The need not, however, exhaust all domestic labor supply L. A labor market equilibrium obtains if the remainder is employed in domestic fragment-2-production. This is expressed by equation 11 which states that if profit-maximizing fragment-2-employment L_2^1 exceeds the domestic labor left from fragment 1 and industry 2, then it will draw on outsourcing, i.e., by using foreign labor L_2^{1f}. In other words, equation 11 determines the equilibrium amount of outsourcing in terms of foreign labor employment used to secure fragment 2. Given linear homogeneity of $F_2^1(\cdot)$, the concomitant level of foreign direct investment is determined by

$$K_2^{1f} = \frac{L_2^{1f}}{L_1^1} K_1^1. \tag{12}$$

This equation states that the capital allocated to fragment 2 in order to guarantee condition 3 is in turn located abroad and domestically, in accordance with domestic and foreign labor employment determined by 9 through 11.

Assuming that condition 8 is fulfilled, an "outsourcing-equilibrium" of this kind is depicted in figure 2 where equilibrium values are indicated by primed symbols. The situation portrayed is one where fragment 2 is partly produced abroad and at home. I shall henceforth call this partial outsourcing. The line segment GS on the M_{1L}^1-schedule may be interpreted as a *"cum-outsourcing"* labor demand schedule for fragment-1-production in industry 1 which, given the above assumptions, needs to take place domestically. Notice that the dashed segment DG dose not belong to that schedule. I will return to this below.

Once w has moved to $(1+\zeta)\, w^f$, profit-maximizing industry-2-employment has increased to $L^{2\prime}$. As regards industry-1-firms, we observe indifference between complete and partial outsourcing. *Complete* outsourcing would imply that they draw on foreign labor for all of their profit-maximizing fragment-2 employment, which we identify in figure 2 as $L^{1\prime} - L_1^{1\prime}$. In this case, $L_2^{1f} = L_2^1$ and there is excess supply of domestic labor, hence it cannot be an equilibrium. Alternatively, domestic firms may secure their equilibrium amount of fragment 2 by *partial* outsourcing, i.e., by using $L - L^{2\prime} - L_1^{1\prime}$ of domestic labor (alongside the appropriate amount of capital) for domestic production of fragment 2, and by going offshore in order to produce the remainder of fragment 2 with foreign labor employment determined from equation 11. In figure 2, L_2^{1f} may be read as the distance between points N and R. Obviously, this is consistent with

domestic labor market equilibrium. For a domestic wage rate below $(1+\zeta)\, w^f$ there is excess demand for domestic labor, for a wage rate above there is excess supply. Hence, $w' = (1+\zeta)\, w^f$, with partial outsourcing of the kind just mentioned, is the only equilibrium.

What happens in figure 2 if the M^1_{1L}- and Q^2_L-schedules are flatter and closer together, so that they intersect above the $(1+\zeta)\, w^f$-line? One might perhaps be tempted to conclude that in this case, there will be complete outsourcing, governed by the first order condition on fragment 2, and a domestic wage rate which is higher than $(1+\zeta)\, w^f$. However, such a situation cannot be an "outsourcing-equilibrium". Any difference between the domestic wage rate and $(1+\zeta)\, w^f$ implies that the marginal value productivity in fragment-1-production at home is higher than in fragment-2-production abroad. If capital is mobile between fragments and between countries, as we have assumed, and given linear homogeneity of technology, this discrepancy of marginal productivities of labor may be closed by moving capital abroad, thus increasing the capital intensity of fragment-2-production and lowering it in domestic fragment-1-production. In other words, non-equalized marginal value productivities of labor in the two fragments also implies a discrepancy in the marginal value productivities of capital. This violates condition 3, and it creates an incentive to increase foreign direct investment. In figure 2, this shifts the M^1_{1L}-schedule to the left until the intersection point with the Q^2_L-schedule lies on the $(1+\zeta)\, w^f$-line. Note the importance of capital mobility between different fragments for this result.[10] Hence, comparing with the "no-outsourcing-equilibrium", our first conclusion is that the possibility of outsourcing to a low-wage country in the presence of international capital mobility provides enough leverage for the domestic wage rate to be forced down to $(1+\zeta)\, w^f$. There is thus a clear distributional effect to the advantage of capital. Notice that under our assumption of constant final goods prices, all factor price effects amount to real income effects.

4.2 A welfare comparison

How does this "outsourcing-equilibrium" compare with the "no-outsourcing-equilibrium" in terms of welfare? Our assumption of given terms-of-trade allows us to resort to the familiar "calculus of areas", relying on figure 2. Thus, areas DCRK and EDKT measure the additional capital rental obtained by domestic firms on producing and assembling fragments 2 and 1, respectively. Of this, ECUT is a pure redistribution effect from domestic labor to capital. CRU,

[10] This result is reminiscent of the point, first emphasized by Dixit & Norman (1980), that in a specific-factors setting international mobility of the factor which is also mobile between sectors always ensures international factor price equalization, while mobility of a specific factors need not do so. In our case, it is sector specific capital which is moving internationally. But the fact that it is coupled with outsourcing makes it equivalent, in terms of factor price effects, to a movement of foreign labor.

then, is the inframarginal gain that the home economy obtains on the use of foreign labor in outsourcing fragment 2. Moreover, CUN is a gain from reallocating domestic labor towards industry 2 where the initial marginal productivity exceeds the opportunity cost of labor. Hence, duly taking into account the fixed cost of international fragmentation, the overall welfare effect is measured by the triangle CRN minus the fixed-cost-rectangle DCIF. As figure 2 shows quite dramatically, this need not be positive.

We may thus conclude the following. First, barring fixed cost, international fragmentation creates an unambiguous welfare gain for the economy at large, coupled with a redistribution to the advantage of domestic capital in both industries. Secondly, the presence of a fixed cost element in cross-border linking of fragments may – but need not – cause outsourcing to be detrimental for the economy as a whole. For a given size of the fixed cost element Z, the net welfare gain is the larger, a) the larger the wage difference $w^* - (1+\zeta)\, w^f$, b) the larger the share of fragment 2 in value added, and c) the more elastic labor demand in both industries. Notice that in b) it is the share of fragment 2 as such, not the amount of outsourcing that takes place if outsourcing is partial.

It is worth trying to obtain some intuition for the potential welfare loss in a world without any policy intervention. The intuition is as follows. Domestic firms replace domestic labor by foreign labor as long as foreign labor commands a wage rate which is lower than its marginal value product, and if the cost advantage from doing so covers the fixed cost. If all domestic labor so released from fragment-2-production finds alternative use where it generates the same value (income) as it did before, then all of the net-cost-savings effect of outsourcing shows up as a positive welfare effect for the economy at large. But if alternative labor employment is subject to diminishing marginal returns, which in our case is implied by the presence of specific factors, then the economic value generated by reallocating domestic labor is less than its previous income. Notice that a welfare loss is impossible if there are diminishing marginal returns but no fixed costs, nor if there are fixed costs but no diminishing marginal returns. Optimizing behavior in a distortion-free economy ensures that labor reallocation takes place until the marginal value productivity of *all* labor employed equals the "effective" foreign wage rate. All of the income loss thereby suffered by domestic labor shows up as a gain in capital incomes. On top of this, capital owners will reap inframarginal gains. Profit maximizing firms will guarantee that the redistribution effect plus the inframarginal triangle is enough to cover any fixed cost. But they are not concerned with whether the triangle *alone* is enough to compensate for the (rectangle) fixed cost of fragmentation.[11]

[11] One might have been tempted to view outsourcing in the presence of foreign direct investment as an indirect way for the domestic economy to reap a "quasi-immigration surplus" – not by labor coming in, but by capital

4.3 Persisting wage gap

A final point worth elaborating on is that the foreign wage rate may not be a constant. Indeed, if the foreign economy similarly operates in a specific factors context, then we must expect that domestic firms face an upward-sloping supply curve for foreign labor when going offshore with fragment 2. This case is illustrated by figure 3 where $\Omega(w^f)$ depicts the upward-sloping foreign supply of labor. This schedule mirrors the fact that in drawing on foreign labor, domestic firms will effectively bid up the foreign wage rate in line with an upward-movement along a marginal value productivity schedule for alternative use of labor in the foreign economy. Given the fixed cost Z and variable costs ζ of international fragmentation, there is a threshold level for the foreign wage rate equal to $w^* / \left(1 + \zeta + Z / L_2^{1*}\right)$, above which there is no outsourcing; see equation 8. For wage rates w^f equal to, or lower than, this threshold level, home firms will demand foreign labor in their attempt to secure a cost-advantage through outsourcing. The crucial point now is that due to the fixed cost Z this labor demand is discontinuous at $w^f = w^* / \left(1 + \zeta + Z / L_2^{1*}\right)$. As this level is reached from above, home firms will jump from a zero demand to Z, due to the fixxed networking cost, plus the variable labor input L_2^{1f} which is determined from the above mentioned equilibrium conditions. In figure 2, this threshold level of L_2^{1f} is equal to the horizontal difference between points H and R'. It is clear from the above discussion of the "outsourcing-equilibrium" pertaining to figure 2 that the variable labor input increases, as the wage rates falls below this threshold level. In figure 3, this is depicted by a downward sloping schedule $L^f(w^f, \zeta)$, with origin at point Z. MOre specifically, the term $L^f(w^f, \zeta)$ must be interpreted as a reduced form relationship between the foreign wage rate w^f and L_2^{1f}, determined by the equilibrium conditions discussed above. This relationship is, of course, also determined by ζ, the variable "iceberg"-cost of fragmentation. The case considered above was one with a perfectly elastic foreign labor supply curve with a wage rate equal to w_0^f. The interesting point highlighted by figure 3 is not so much that an imperfectly elastic foreign supply of labor gives rise to a higher equilibrium wage rate, such as w_1^f for the supply schedule $\Omega_1(w^f)$, and a correspondingly lower welfare gain (higher loss), coupled with a less severe domestic redistributive effect. The more interesting point is that if foreign labor supply is sufficiently inelastic, as in the case of schedule $\Omega_2(w^f)$. In this case, despite the wage gap $w^* - w_2^f$, an equilibrium with outsourcing does not exist. As a consequence, the wage gap will persist. The reason is that the fixed cost element Z gives rise to the above mentioned discontinuity in the domestic demand for foreign labor that arises from outsourcing.

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moving to foreign labor. The above argument shows that this is misleading.

5 International fragmentation without foreign direct investment

If for some reason foreign direct investment is ruled out, outsourcing of fragment 2 requires that domestic industry-1-type capital be available in the foreign country. In addition, fragment 2 can now be obtained from abroad only via arms-length transactions. As compared to the previous case, then, outsourcing involves an additional cost due a loss of the internalization advantage mentioned above. Assuming that this is not prohibitive, we may capture it in our model by suitably interpreting the cost of international fragmentation, both in its fixed component Z, and its variable part ζ.

The easiest case is one where domestic firms considering international fragmentation face a perfectly elastic supply not only of foreign labor, but also of capital. Then, if foreign production of fragment 2 similarly relies on a constant returns to scale technology, the foreign unit cost of this fragment is constant. If the fragment is supplied under conditions of perfect competition, then this unit cost equals the price that domestic firms face if they purchase fragment 2 abroad, instead of producing it at home. Outsourcing, then, simply means that fragment 2 may be imported at a given price per unit. Hence, instead of tying down the wage rate to $(1+\zeta)\, w^f$, the possibility of international fragmentation now ties down the price of fragment 2 to a level below $\tilde{p}_2^*$.

For simplicity, we now assume for the cost of fragmentation that both the variable "iceberg"-term ζ and the fixed term Z are expressed in units of fragment 2, rather than foreign labor. Then, again starting with the "no-outsourcing-equilibrium" (denoted by starred variables), firms face an incentive for international fragmentation if the condition

$$\tilde{p}_2^* \Big/ \tilde{p}_2^f \; - 1 > \zeta + Z \Big/ F_2^{1*} \tag{13}$$

is met. This is the analogue to condition 8 above, and we assume that it holds.

The "outsourcing-equilibrium" without foreign direct investment can now be described as follows:

$$\begin{aligned}
pQ_1^1 F_{1L}^1 &= Q_L^2 = w, && (14)\\
pQ_2^1 &= \tilde{p}_2^f, && (15)\\
\tilde{p}_2^f F_{2L}^1 &\leq w, \quad \text{with} \quad \left(\tilde{p}_2^f F_{2L}^1 \leq w\right) L_2^1 = 0, && (16)\\
\tilde{p}_2^f F_{2K}^1 &\leq pQ_1^1 F_{1K}^1, \quad \text{with} \quad \left(\tilde{p}_2^f F_{2K}^1 - pQ_1^1 F_{1K}^1\right) K_2^1 = 0, \quad \text{and} && (17)\\
pQ^1 &= \tilde{p}_1 F_1^1 + \tilde{p}_2^f F_2^1 && (18)
\end{aligned}$$

Equation 14 is the familiar first order condition on labor employment in industry 2 and fragment 1 of industry 1. These are activities which can only take place domestically. Condition 15 states

that, given the possibility of outsourcing fragment 2, this component of value added will always be carried out to the extent where its marginal value productivity in final assembly equals its constant supply price $\tilde{p}_2^f$. Conditions 16 and 17 govern domestic production, if any, of fragment 2, with the remainder of the profit-maximizing quantity of this fragment being secured via outsourcing. In these conditions, the term pQ_2^1 has already been replaced by $\tilde{p}_2^f$, using 15. The final equation states the zero-profit condition, determining the effective price of the first fragment which can only be produced at home.

A crucial point to be noticed about this equilibrium is that 15 determines a unique marginal "assembly-value-productivity" of fragment 2. Given linear homogeneity of $Q^1(\cdot)$, this implies unique average products Q^1/F_1^1 and Q^1/F_2^1, respectively. Denoting the inverse of these productivities (the input coefficients) by f_1^1 and f_2^1, respectively, condition 18 determines the effective price of fragment 1 as

$$\tilde{p}_1 = \left(p - f_2^1 \tilde{p}_2^f\right) \Big/ f_1^1. \tag{19}$$

The reader will recognize a strong analogy to the literature on effective protection.

Figure 4 helps to pin down the factor price effects of outsourcing in this case without foreign direct investment. The two isoquants v_1^{1*} and v_2^{1*}, respectively, show bundles of domestic capital and labor which generate a unit value of fragment 1 and 2 of industry 1 in the initial "no-outsourcing-equilibrium". Notice the additional assumption, not made above, that fragment 2 is relatively labor intensive. The position of these so-called unit-value isoquants are determined by the imputed prices $\tilde{p}_1^*$ and $\tilde{p}_2^*$ of the initial equilibrium (see equations 4 and 6 above). The common capital rental for both fragments is r^{1*}, the wage rate is w^*. Given the industry-specific capital stock K^1, the full employment quantities of the two fragments are F_1^{1*} and F_2^{1*}, generating industry-1 labor demand L^{1*}.[12] This, together with labor industry-2 labor demand (not drawn in this figure) gives overall labor market equilibrium.

Now consider what happens if Z and/or ζ fall so that condition 13 is satisfied and the possibility of international fragmentation becomes an attractive option for domestic firms. In Figure 4, this implies an outward shift of the unit-value isoquant for fragment 2, with a simultaneous inward shift for the unit value-isoquant for fragment 1. This follows from equation 19 above.[13] It is important that the positions of unit-value isoquants v_2^{1f} and v_1^{1f} are solidly locked in for

[12] The two vectors F_1^{1*} and F_2^{1*} add up to the sector-1 total factor use at point G^{1*}.

[13] Notice, however, that we cannot invoke constant input coefficients f_i^1 for the comparison across the two regimes with and without outsourcing. f_i^1 is constant only within the outsourcing regime where $\tilde{p}_2$ is tied to the foreign supply price of fragment 2, $\tilde{p}_2^f$, and where optimizing firm behavior ensures equation 15. But from condition 13 it follows that the regime switch as such implies an increase in f_2^1 and a fall in f_1^1, hence the above mentioned shift in unit-value isoquants obtains.

the outsourcing regime. This, in turn implies that a simultaneous production of both fragments is viable only at factor prices $\tilde{w} < w^*$ and $\tilde{r}^1 > r^{1*}$. It is now readily seen that with these factor prices full employment of the industry-1 capital stock requires a labor input of $\tilde{L}^1 > L^{1*}$. In figure 4, the corresponding vectors of factor use are drawn by dashed lines. Remember that industry 1 no longer has the option of foreign direct investment. With $\tilde{w} < w^*$, industry 2 would similarly want to employ more labor than initially, hence $\tilde{w}$ implies excess demand for domestic labor.

Let us, therefore, assume that the wage rate starts to increase. As by assumption fragment 2 is more labor intensive than fragment 1, the ensuing cost effect is more severe for this fragment and domestic production is no longer economically viable. Suppose the wage rate were to rise to its original level w^*. Drawing a line which starts at point $1/w^*$ on the horizontal axis, and which is tangent to v_1^{1f}, allows us to determine the capital rental and the capital intensity for fragment 1 which is compatible with the zero profit condition. In figure 4, this is drawn as a dotted line. In this way, we recognize that the labor demand generated by industry 1, with its entire capital stock used in fragment-1-production only, is lower than L^{1*}. Unsurprisingly, with industry 1 being completely specialized on the capital intensive fragment 1, the initial wage rate is now coupled with excess supply of domestic labor. Hence, the "outsourcing-equilibrium" must have a wage rate lower than w^*. At the same time, and by analogous reasoning, we conclude that the capital rental in industry 1 is higher in this equilibrium than in the "no-outsourcing" regime.

This result, however, crucially depends on the factor intensity assumption for the two fragments. If figure 4 is drawn with an opposite factor intensity assumption, the outcome is the opposite. In the previous section we have seen that, in the presence of foreign direct investment, outsourcing of any fragment to a country with a wage rate sufficiently low to cover the cost of international fragmentation depresses the domestic wage rate to a level which is determined by the foreign wage rate and the variable cost of fragmentation. And this is true whatever the factor intensities of the fragment which is a candidate for outsourcing. The case considered in this section might similarly be one where the outsourcing condition is satisfied due to a lower foreign wage rate (not compensated for by a sufficiently higher capital rental). Yet, the factor price effect is no longer independent on factor intensities. If it is a relatively capital intensive fragment that moves "offshore", then the domestic wage rate is bid up in real terms. The difference is entirely due to the fact that in this section we assume an environment where international fragmentation cannot be coupled with foreign direct investment, and where firms must rely on arms-length transactions to exploit the cost advantage that the foreign economy offers for some fragment of the value added chain. Intuitively, one expects that labor is bound to

be more favorably (less adversely) affected by international fragmentation if this is not coupled with domestic capital moving abroad via foreign direct investment. This leaves more domestic capital to work with the labor set free via outsourcing, which must enhance labor's marginal productivity. However, this is not enough to guarantee a rise in the real wage rate if the fragment leaving the country is more labor intensive than the one left behind.

A further interesting difference to the case with foreign direct investment is that international fragmentation is now complete in the sense that the domestic industry is always completely specialized in one fragment only. This has to do with the fact that a given foreign supply price of fragment 2 uniquely determines the effective price of the other fragment, provided that the price of the final product is indeed constant. As a consequence, there is a unique pair of factor prices for labor and industry-1-capital which support simultaneous production of both fragments. But these factor prices are at odds with full employment, hence equilibrium requires a different set of factor prices which render one of the fragments a loss-making activity.

The difference regarding *distributive* consequences notwithstanding, the *welfare* comparison between the "no-outsourcing-equilibrium" and the equilibrium where international fragmentation takes place, is the same, qualitatively, in this case and the one with foreign direct investment considered above. We may draw on analogous reasoning in the sense that the argument pertaining to labor in the previous section now applies to fragment 2 as a whole. Specifically, if the condition for outsourcing is fulfilled, the domestic economy obtains fragment 2 at a price which is lower than the opportunity cost of producing it at home. Outsourcing releases domestic labor *and* capital, initiating their reallocation at a margin where they create a positive net value. However, if this margin is eventually closed due to diminishing marginal returns – in this case returns to a whole fragment in final assembly, as opposed to labor in the production of individual fragments –, and if there is a fixed cost element in cross-border fragmentation, then the net welfare effect is ambiguous. The analogy to the previous case which was dealt with in detail above is quite obvious, hence we need not pursue a more detailed presentation of the argument.

6 Extensions

There are different ways that can be pursued, in order to extend the above results beyond the confines of the present model. For instance, one may allow an arbitrary pattern of fragmentation. Given the pattern of factor price differences between the domestic and the foreign economy, the cost-advantage from outsourcing may quite markedly differ between fragments, depending among other things on their factor intensities and their shares in overall value added. Thus, rather than assuming specific conditions that restrict outsourcing to a single fragment a priori, one may want to endogenize the resulting pattern of international fragmentation by identifying

a borderline between value-added-components that are cheaper to secure from abroad and at home, respectively. A further extension relates to goods prices. Specifically, one may regard as inadequate the assumption of given world prices for final goods. Relaxing this assumption requires a model with at least two countries where goods prices and factor prices for both countries are determined endogenously. I shall not pursue any of these extensions in this section.

Instead, I want to briefly address the question of how the results obtained above carry over to the case where outsourcing may take place in both sectors. A natural further step of generalization then increases the number of fragments within a sector, as well as the number of final goods beyond two. I shall not present a full-fledged analysis of these cases, but, on the basis of the above analysis, a few general insights are quickly obtained. Perhaps the easiest case to look at is a low-wage foreign economy with international capital mobility where outsourcing is coupled with foreign direct investment. It seems reasonable that the costs of outsourcing are different across sectors, and possibly also across fragments. Referring to figure 3, instead of the schedule labelled $Z + L^f(w^f, \zeta)$, we then have a multiple-step schedule which is derived as the horizontal sum of analogous individual schedules. The intersection point of this schedule with the foreign labor supply curve then determines the cut-off point between sectors where outsourcing takes place, and sectors where outsourcing is economically unattractive. The case where an equilibrium with outsourcing does not exist due to fixed costs appears less likely in this multi-sector setting, but it becomes evident that the remainder of the above results are upheld in this more general case.

The same does not hold true, however, if there is no international capital mobility, and outsourcing therefore takes place without foreign direct investment. This can be seen by referring to figure 4 above. If the factor intensity ranking of the fragment that moves "offshore" differs across sectors, then the effect of outsourcing on domestic labor demand is of opposite sign in different sectors. They might therefore tend to offset each other, in which case the overall net effect is unclear a priori. However, from figure 4 it is quite clear that the downward pressure on the wage rate generated by a sector where a relatively labor intensive fragment is secured via outourcing is the more pronounced, a) the larger this sector in terms of its share in overall labor demand, and b) the more pronounced the factor intensity difference between fragments within this sector. Notice that it is only this latter difference that matters for the overall wage effect, and the factor intensity ranking of fragments across sectors is irrelevant.

7 Summary

The recent wave of economic globalization has once more brought to the fore the perennial tension between efficiency and distributional concerns. A typical reaction to concerns about

unwelcome consequences of globalization is that they may entail troublesome distributional consequences, but that at the same time they hold an overall efficiency gain: "No pain, no gain". In economic models this tension is usually acknowledged by a simultaneous consideration of aggregate welfare and factor price effects of specific forms of economic globalization. A case which has recently caught a lot of attention is outsourcing of individual slices of the value added chain to foreign countries who offer some form of cost-advantage, often a lower wage rate. Existing theoretical treatments, mostly relying on Heckscher-Ohlin-type trade models, appear to establish a presumption that outsourcing increases aggregate welfare, but affects factor prices in ways which defy a general conclusion.

In this paper, I have used a simple specific factors model to further explore both the domestic welfare and factor price effects of outsourcing. The model portrays an open economy where profit-maximizing firms produce two final goods, facing perfect competition at given world prices. One of the two sectors is assumed to be a candidate for outsourcing part of its value added process. Labor is the mobile factor, and capital as a sector-specific input which is, however, mobile across different fragments, or components of value added, within a sector.

Outsourcing involves a fragmentation of value added across national borders. Therefore, a steady supply of the final product can only be guaranteed at an extra cost. I have argued that international fragmentation will typically include a *fixed* cost element. This turns out to be important for two reasons. First, in an economic environment where domestic resources which are released as a consequence of outsourcing may be redeployed only subject to diminishing marginal returns (due to specific factors), the presence of fixed cost of fragmentation implies that outsourcing *may* be welfare reducing for the domestic economy, even absent any market distortion. I have identified the factors that are decisive for whether or not this welfare loss arises. And secondly, the fixed cost of fragmentation gives rise to a discontinuity in domestic demand for foreign factors that arises from outsourcing. If this demand meets an imperfectly elastic foreign supply, then an equilibrium with outsourcing *may* not exist, despite the cost advantage given by a low-wage foreign economy. In this case, a situation emerges where there is a seemingly unexploited cost-advantage.

Intuition tells us that the domestic factor price effect of outsourcing depends on the factor intensity of the value-added-component that is moved "offshore". Moreover, one expects that it makes a big difference if outsourcing is coupled with foreign direct investment, so that domestic capital is moved to work with foreign labor, of if it takes place in an environment where foreign direct investment is impossible. In this latter case, international fragmentation relies on arms length transactions for fragments produced entirely by foreign factors, and it may therefore be more difficult for domestic firms to appropriate the cost-advantage from outsourcing. Moreover,

the cost of linking fragments across international borders is likely to be higher than in the case of foreign direct investment.

Less obviously, the question of capital mobility also plays an important role for the domestic factor price effects of outsourcing. Specifically, if outsourcing takes place in an environment of international capital mobility and is therefore coupled with foreign direct investment, then it depresses the domestic wage rate, irrespective of the factor intensity ranking of fragments. The possibility of outsourcing for a single component of value added provides enough leverage for the domestic wage rate to be forced down the level obtaining abroad, adjusted for the variable cost of fragmentation. Moreover, in this case outsourcing may be partial, i.e., part of the respective value-added-component is still secured from domestic production. By way of contrast, if outsourcing takes place in an environment where capital mobility is ruled out, then outsourcing is complete, i.e., the respective component of value added will entirely be secured from abroad. More importantly, in this case the factor intensity ranking of fragmentation matters for the domestic factor price effect. Labor loses if a labor intensive fragment moves "offshore", and vice versa.

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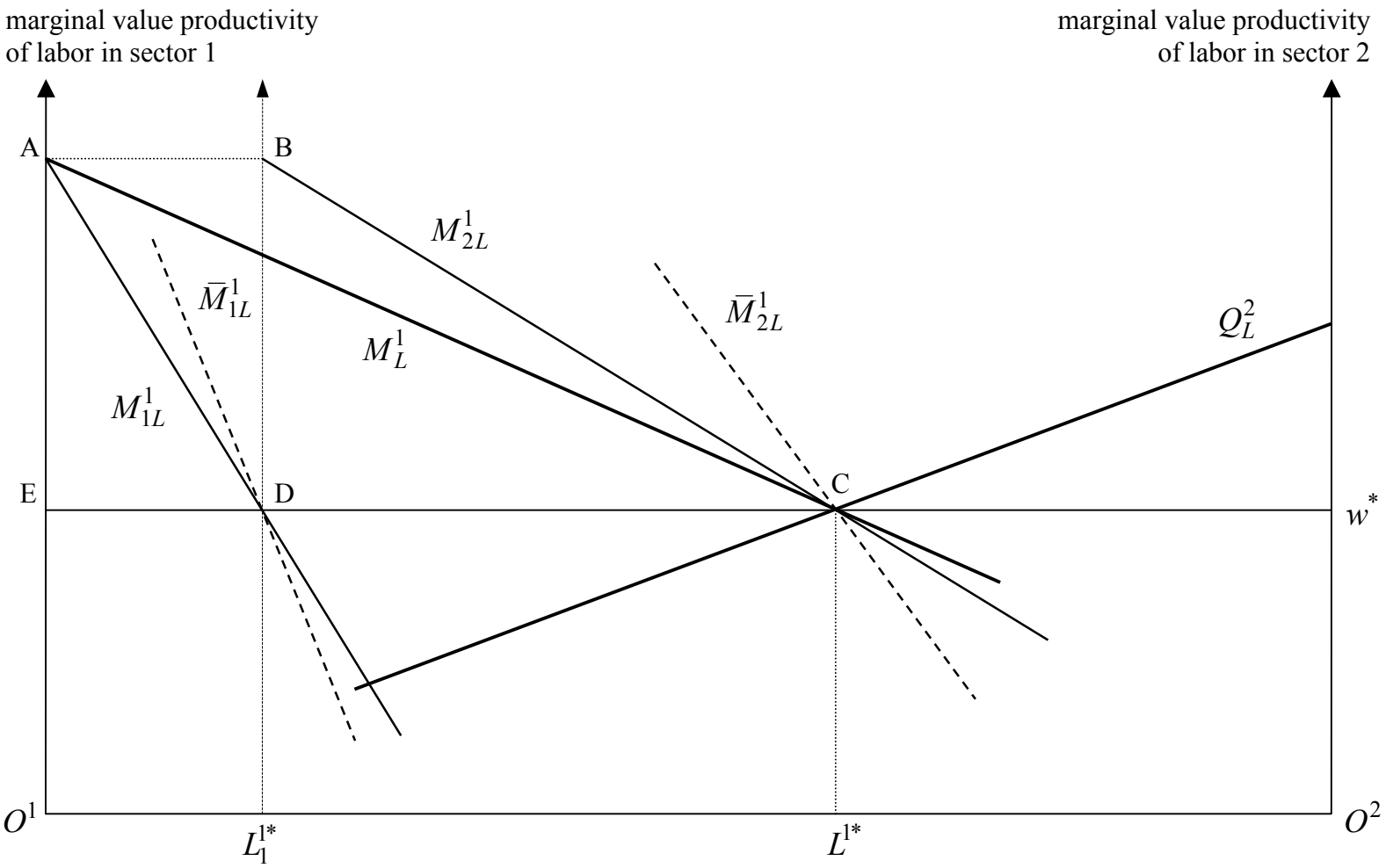

Figure 1: Equilibrium with fragmentable technology in sector 1

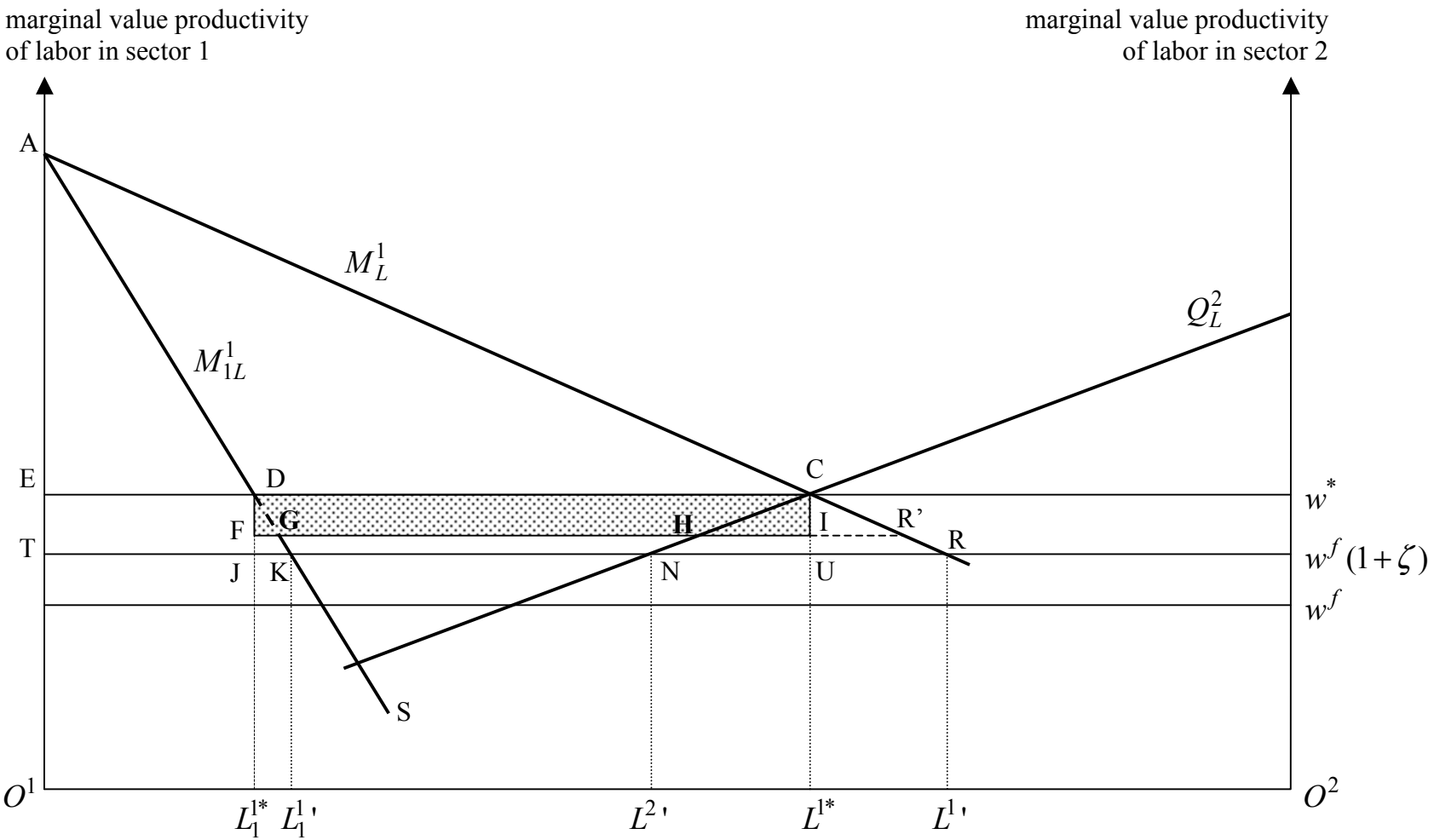

Figure 2: International fragmentation with foreign direct investment

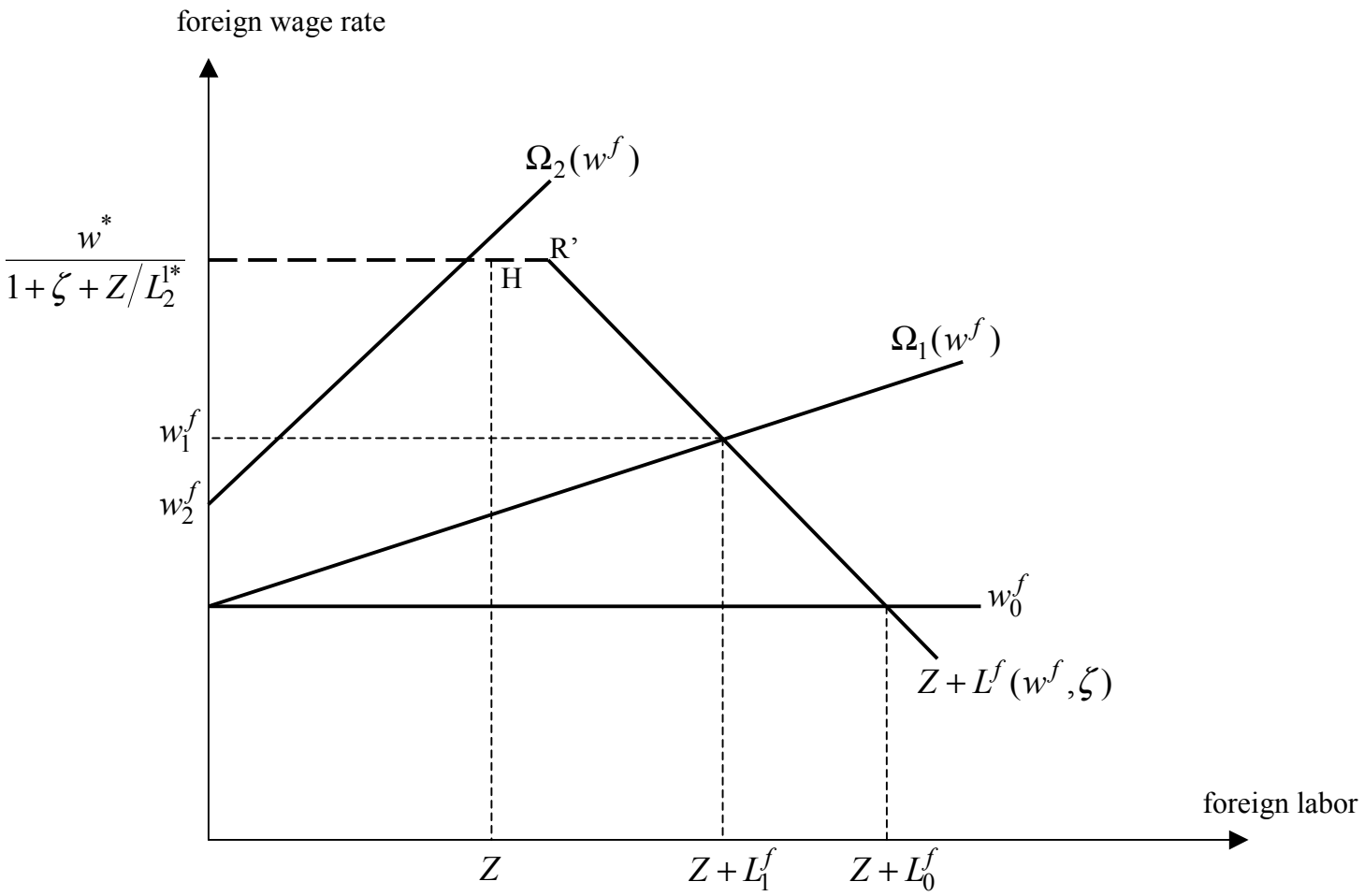

Figure 3: International fragmentation with imperfectly elastic foreign labor supply

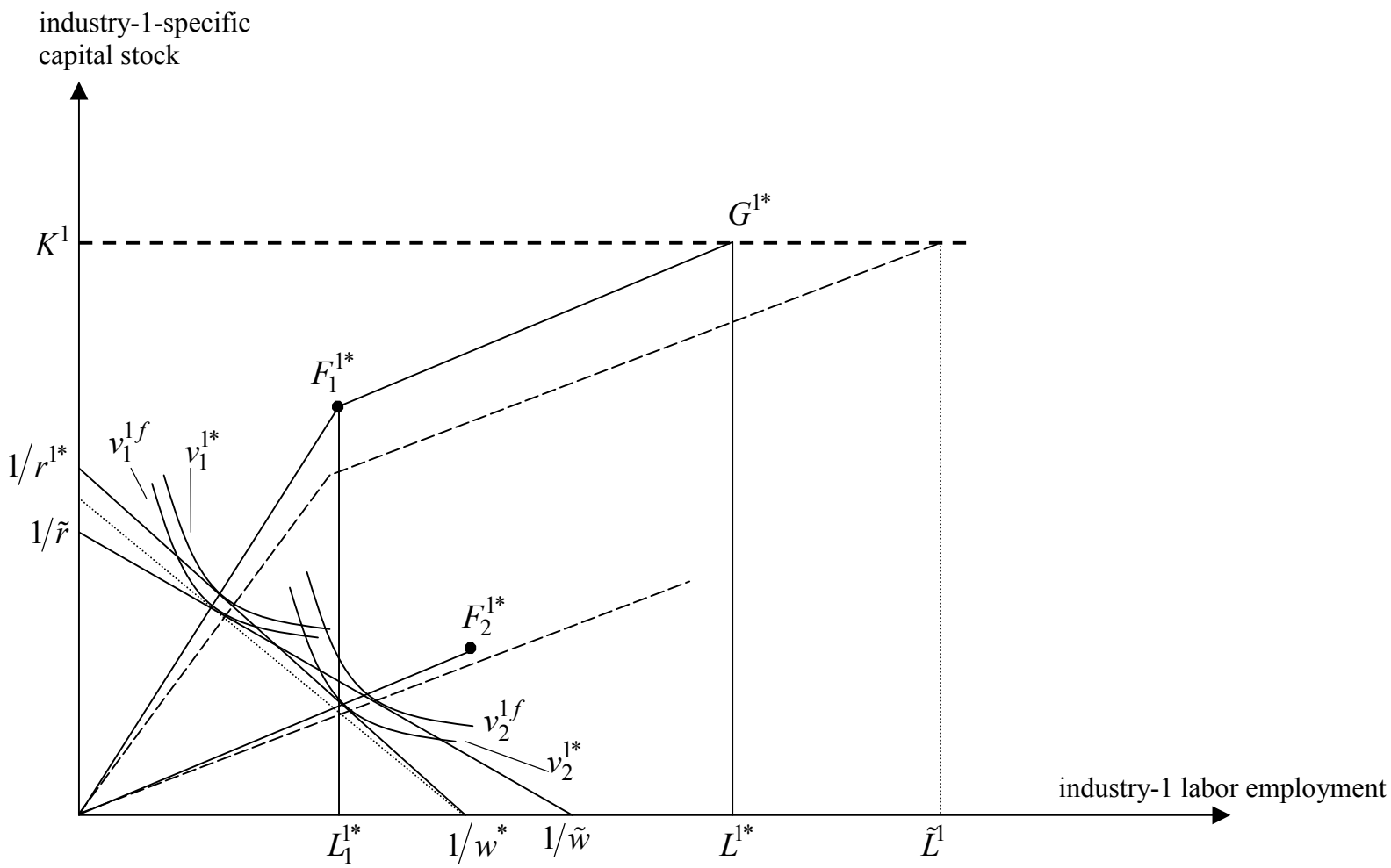

Figure 4: Factor price effect of international fragmentation without foreign direct investment