



Venice Summer Institute 2005

Workshop on “Recent Developments in International Trade:
Globalization and the Multinational Enterprise”

18-19 July 2005

Venice International University, San Servolo



Gains from Trade and Fragmentation

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Paper prepared for presentation at the
CESifo Venice Summer Institute Workshop,
“Recent Developments in International Trade:
Globalization and the Multinational Enterprise,”
July 18-19, 2005.

June 27, 2005

ABSTRACT

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This paper discusses the welfare effects, on groups, countries, and the world, of fragmentation. Fragmentation here is defined as the introduction of a technology that permits a production process to be split into separate parts, with the fragments able to be done in different locations. Standard results of trade theory and the gains from trade are then examined to see what they suggest about the gains from fragmentation. The main points made are, first, that it is easy to find examples in which fragmentation hurts particular groups and countries, and even in some circumstances the world. But I also argue that fragmentation is likely to increase world income overall, and therefore that it is likely to be beneficial on average. Based on that, together with our general ignorance of what the more specific effects of fragmentation are likely to be, we should resist attempts to use policies to interfere with it.

Keywords: Fragmentation
Gains from trade

JEL Subject Code: F1 Trade

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I. Introduction

A hot topic these days in the trade field is international outsourcing, or what is coming to be called “offshoring.” This seems to mean the relocation of some aspect – but not all – of an industry’s productive activity to another country. This has been happening for years in the form of trade in manufactured intermediate inputs, but recent advances in information technology have made it possible to do this with certain productive services as well, and the word “offshoring” seems to have accompanied that development. In the public mind, offshoring seems to mean the “exporting of jobs,” and it suggests a pure loss to the country from which it occurs and especially for the workers who are replaced. This was no less true when the offshored jobs were primarily manufacturing jobs, but the recent inclusion of services has extended the threat from offshoring to an additional part of the population. The threatened workers do not so far include economists, however, and to many of us offshoring just means the most recent manifestation of the international trade that we have been writing about for two centuries. It suggests, to us, gains to the participating countries and the world, if not necessarily to everyone within them.

There are a variety of ways that offshoring could have adverse effects, at least to some, that I am not best qualified to deal with. These include macroeconomic effects if

* This paper was motivated by serving as discussant of Markusen (2005). I have benefited particularly from talking with Juan Carlos Hallak about this topic.

labor markets function poorly. They include intellectual property issues, if hosts of an offshored activity copy a technology that they didn't previously possess. And they include the related effects that such a transfer of technology may have on the terms of trade, as was emphasized in a recent paper by Samuelson (2004) and has been examined recently by Jones and Ruffin (2005). I will focus instead on only a simpler and well-defined part of the issue: what happens, in static models of trade, when it becomes possible to split a productive activity into parts that can now be done in different locations? If, as a result, production that was previously done in one country is now done in two, what effect does this have on the welfare of the world, of the countries, and of groups within the countries? I will call this, as I and others have done before, the issue of trade and fragmentation.

In what follows, I will recall some of the basic results of trade theory regarding the gains from trade, and then ask how these results can inform us regarding the gains from fragmentation.

II. Lessons from the Gains from Trade

The gains from trade have been a major focus of economics almost since the discipline began. Our current understanding, though, seems to date from contributions of Samuelson (1939, 1962), as elaborated by many authors such as Ohyama (1972) and Dixit and Norman (1980). Much of this literature has dealt carefully with delineating what is to be meant by a country "gaining" from trade, an issue that I don't want to dwell on here. In the end, most treatments say, in essence, that if trade could potentially benefit all members of country's population if their preferences and income were identical, then

it is regarded as benefiting the country even though this assumption manifestly does not hold. The justifications for this inference are various, usually resting on the potential for some sort of income redistribution among the country's consumers.

The main lessons from the gains-from-trade literature for a country are the following:

Lesson 1: Free trade is better than autarky.

Lesson 2: Restricted trade (that is, trade that is less than free, restricted by trade barriers such as tariffs) is better than autarky.

Lesson 3: For a small country (that is, too small to influence world prices), free trade is better than restricted trade.

Beyond these three results – which of course hold only under particular idealized assumptions, such as perfect competition, absence of externalities, etc. – the literature primarily tells us what we do *not* know. We do not know, even under idealized conditions, that any move in the apparent direction of free trade is beneficial, even for a small country.

That is, for example, in the presence of multiple tariffs, reducing or eliminating one of them may reduce welfare rather than raise it. Only if the tariff that is reduced is the highest of all tariffs in *ad valorem* terms, can the case be made that this is welfare improving.¹ And certainly, reducing tariffs, even all of them, against one trading partner while keeping them unchanged against others may reduce welfare, as we have known since Viner (1950). About the only thing that we do know seems to be that an equi-

¹ See Kowalczyk (1992).

proportionate reduction in all tariffs, if they are specified and reduced in specific form rather than *ad valorem* form, will be welfare beneficial.²

What does this have to do with fragmentation? One way of interpreting what has happened with fragmentation is to imagine that international fragmentation has always been possible technologically but that implicit barriers to trade have kept it from happening. The rise of international fragmentation can then be thought of as the manifestation of reductions in these barriers, from prohibitive to nonexistent. We can then apply the lessons of gains-from-trade theory to suggest what we do and do not know about the gains from fragmentation.

Most immediately, if a country were small and if, aside from any trade that might arise from fragmentation, trade were free, then the opportunity to engage in international fragmentation would be a move from restricted trade to free trade and the country would have to gain, per Lesson 3. But that seems to be all that we can say, based on the above lessons, since the other two start from autarky and thus are not relevant to anything currently of interest. And on the contrary, the larger implication of this literature for fragmentation seems to be that, if a country is either large enough to affect its terms of trade, or if *not* all other aspects of its trade are free, then international fragmentation may cause its welfare to fall.

In the following sections, I will look individually at several questions about the welfare effects of fragmentation. It is possible, of course, that the negative message just derived is not in fact correct if one takes into account more fully the nature of fragmentation. That is, to say that welfare may fall is not to say that it will fall, and there

² Again, see Kowalczyk (1992), who shows the negative result that equi-proportionate reductions in *ad valorem* tariffs may lower welfare.

may be characteristics of fragmentation that make it different from other forms of trade liberalization. So I will look at some particular models that have appeared in the literature and that provide examples of what may happen with fragmentation. In addition, I will look at more than just the effect on a country, first focusing more narrowly on groups of factor-owners within a country, and then more broadly at effects on the world as a whole.

III. Can Fragmentation Hurt a Country?

The answer, as I have already suggested, is yes. The most obvious way that fragmentation can hurt a country as a whole is by causing a worsening of its terms of trade. Of course, if a country is too small to affect world prices, and if fragmentation becomes a new possibility only for it and not for other countries (perhaps because they already have it), then this cannot alter world prices and cannot hurt the country on that account. But the introduction of fragmentation, because it tends to be based in part on new technologies, is unlikely to be confined to a single country unless that country is simply a laggard behind its adoption in the rest of the world. And if fragmentation becomes a new possibility for all countries, then of course that can easily alter world prices to the benefit of some and the detriment of others.

An example can be found in Deardorff (2001b), where a Ricardian model has two countries producing and trading two goods, initially without fragmentation. It then becomes possible to fragment the technology for producing one of them into two parts, with each country having its own labor requirements for accomplishing each part. The model illustrates the possibility that this new ability to fragment may cause a change in

world equilibrium relative prices, and it is possible that one country's terms of trade could worsen sufficiently that it is made worse off, even accounting for the new technological ability that fragmentation represents.

That model is abstract, so it may be helpful to sketch a more concrete example that is loosely based on the model. Suppose that the world produces two products, a numeraire good in the production of which all countries are equally productive, and a traded service, which I'll call banking, in which their productivities differ. The technology of banking requires two activities: data entry and accountancy. Our country of interest is more productive than the world in accountancy, but less productive in data entry. Initially, however, these two activities must be done in the same place, and as it happens we have a large enough advantage in accountancy to more than offset our disadvantage in data entry, with the result that we have a comparative advantage in banking. Thus, at the start, we export banking even though we are not so good at one of activities that it requires. Suppose further that, even though we produce only banking services, the world demands somewhat more than we can produce and therefore the world price of banking is determined in the rest of the world, where its comparative disadvantage in banking makes the relative price higher, in terms of the numeraire, than the cost to us if we were to produce the numeraire ourselves. Indeed, it is this higher world price that yields for us a substantial gain from trade.

Now suppose that a new communication technology makes it possible to produce banking services with data entry and accountancy happening in different locations. Our banks will naturally begin to outsource the data entry, which can be done more cheaply abroad. The problem for us as a country can be seen quite simply: by outsourcing data

entry we push down the world price of banking, which is our export, and we hurt our terms of trade.

Now if it were possible for us to outsource *all* data entry, then our gain from trade would only increase, as we would be specializing even more completely than we had before in what we do best, accountancy. But suppose that the world does not demand enough bank services for us to occupy our entire labor force producing only them, now that our potential output is expanded by our ability to outsource the data entry that we were not good at doing before. If that is the case, then we will have to produce the numeraire good as well, and this does indeed require a fall in the relative price of banking.

Notice, incidentally, that this example – in both the abstract model of Deardorff (2001b) and the banking example described here – does not involve any transfer of technology to the rest of the world as occurs in Samuelson (2004). Productivities differ across countries in both data entry and accountancy, but these productivities do not change when fragmentation becomes possible. However, fragmentation does in general permit activities within industries to be allocated more efficiently across the globe, and this tends to reduce those industries' costs. It is not surprising, then, that such a fall in costs can lower prices as well, and thus worsen a country's terms of trade.

A second way that fragmentation can hurt a country is if its markets are already distorted and fragmentation makes a distortion worse. The adverse effect of that worsening may more than offset the cost reduction that is permitted by fragmentation.

In tariff theory we know, for example, that a reduction of a single tariff, if it is not the country's highest tariff, can be welfare worsening. This might occur if the liberalized

good is a strong complement for another good with a higher tariff. For then the rise in imports of both, when the lower tariff is reduced, can cause the country's import-weighted average tariff to rise and reduce its welfare.³ By a similar mechanism, fragmentation might permit the outsourcing of an activity that is strongly complementary to an input that is imported subject to a high tariff. In such a case it might make the distortion caused by the tariff worse and reduce the country's welfare.

I don't doubt that there may be other mechanisms by which fragmentation might reduce a country's welfare, both if fragmentation becomes newly possible for only a country's own industry, and especially if it alters the structure of production throughout the world. Countries differ greatly in their positions in world markets and in their own trade and other policies, and it would be surprising if examples of loss from what is in effect a new technology could not be constructed. But this is not at all to suggest that loss from fragmentation will be in some sense more common than gain. I will say more about this below, but for now it bears mentioning that it is just as easy, if not more so, to construct examples in which countries gain from fragmentation.

IV. Can Fragmentation Hurt Groups within a Country?

Again the answer is yes, even more easily. We know from Heckscher-Ohlin (H-O) trade theory that a change in relative prices is very likely to reduce the real wage of at least one factor of production. So if groups within a country derive their incomes from different factors, some group will lose from any change in relative prices. And fragmentation is sure to cause prices to change. The only chance for owners of a losing factor not to lose

³ I thank Juan Carlos Hallak for suggesting this example, which he says he heard in a talk by Peter Neary.

would be if fragmentation creates some other source of gain in which they share. That may happen, but it is certainly not assured.

The effect of changing relative prices on real factor returns is of course familiar as the Stolper-Samuelson Theorem, which takes its strongest form in the textbook two-good, two-factor model with incomplete specialization.⁴ But a fall in the real wage of some factor is equally assured if there is incomplete specialization and if there are many goods and factors, as well as in the specific-factors model. To offset this, we would need additional benefits from complete specialization, or from some non-H-O properties such as increasing returns to scale, imperfect competition, or variety.⁵

Exactly which groups of factor owners may lose from fragmentation, on the other hand, is very much an open question. The presumption in much public discussion has always been that “outsourcing” would be of unskilled-labor-intensive inputs and that it would therefore drive down the wage of unskilled labor. More recent concern with “offshoring” has focused on services, sometimes provided by more skilled workers such as computer programmers, medical technicians, or engineers, and the expectation has been that it would lower the wages of these occupations. That may well be, although theory has suggested that this outcome is not assured.

Jones and Kierzkowski (2001), for example, showed that international fragmentation could as easily have one effect on relative factor prices as another, depending on the detailed factor intensities of the fragments and the industries prior to fragmentation. Deardorff (2001a) explored further such options, showing in particular

⁴ See Stolper and Samuelson (1941) and, for a review of more recent developments, Deardorff (1994).

⁵ See Brown, Deardorff, and Stern (1993) for a discussion of how these “New Trade Theory” effects may interact with the Stolper-Samuelson mechanism.

that fragmentation may actually drive relative factor prices in different countries further apart. All of this was reinforced in the simulations of Markusen (2005).

V. Can Fragmentation Hurt the World?

Here I would like to argue that the answer is no, or at least that this is so in the absence of distortions with which fragmentation might adversely interact.

The argument is simple, if we keep in mind the definition of fragmentation as a new technological possibility that becomes available to a country or to the world. Such a possibility, since it does not reduce the availability of any previous technology, can only expand the world's production possibilities. Then, in the absence of distortions, a perfectly competitive free-trade world economy is known to maximize the value of world output on the world production possibility set, and this maximum cannot fall. On the contrary, it will rise if the new technology is used at all by users who find it strictly preferable to previous practice.

From this one concludes that, while fragmentation may hurt particular countries or groups within countries as the previous sections suggested, it must always benefit other countries or groups by at least as much, and probably more. This means, in turn, that if it were possible to redistribute income across countries and/or groups without creating distortions, then such redistribution could accompany the introduction of fragmentation so as to leave everybody in the world at least as well off. As usual with our gains-from-trade propositions, the gain to others may be of little comfort to those who lose, since no one seriously expects sufficient compensation to take place. But from the safety of the academic ivory tower, we trade economists are accustomed to

concluding that it is good. I will ask in the next section whether there might be some other interpretation to buttress this conclusion.

But first I want to address the rather serious qualification to the result just mentioned: that it holds only in a perfect world with no distortions. Like the role of distortions in section III, the presence of distortions can render harmful an otherwise desirable change if it makes the impact of the distortion worse. This is of course the message of the Theory of the Second Best, which we owe to Lipsey and Lancaster (1956). Even though this theory is customarily applied to the effects of reducing one distortion, such as a tariff, in the presence of another, it applies just as well to any change that would otherwise be welfare improving, such as an improvement in technology. And fragmentation is exactly such a new technology.

How might fragmentation therefore hurt a distorted world? It is not hard to construct an example, although it is purely hypothetical.

Suppose that there existed a good the production or consumption of which imposed a large negative externality on the world, and the production of which required two activities or inputs that, as it happened, did not both exist in any single country of the world. Suppose, for example, that production of cigarettes required both tobacco – which could only be grown in a few places on Earth where the soil was appropriate – and the delicate hands of a genetically distinct population of cigarette rollers to roll the tobacco into cigarettes, with this population living only in parts of the world that lacked tobacco soil. To avoid letting simple trade solve this problem, suppose that tobacco before it is rolled into cigarettes is extremely perishable, so that once cut from the plant it becomes useless in minutes if not rolled immediately. The result of these tortuous assumptions,

clearly, is that the world would have no cigarettes and – here the strain on reality is less severe – people would be healthier.

Now suppose that fragmentation of this technology becomes possible, so that growing tobacco and rolling it into cigarettes can after all be done in different locations. How? Perhaps a preservative that allows the tobacco to survive shipment. Or perhaps some extraordinary extension on the arms of the cigarette rollers so that they can reach from where they live to where the tobacco is grown and do their job. (I did say that this was hypothetical.) Now, suddenly, the world gets a thriving cigarette industry, and people start to die of lung cancer, though before that some of them live more happily because of the joys of smoking. Whether the world is better off or worse off depends on weighting the internalized benefits against the externalized costs, but it is certainly possible, at least if the costs do include truly external ones from second hand smoke, that the introduction here of fragmentation has lowered world welfare.

As usual with second best arguments, however, the cause of the loss is not really fragmentation, but rather the absence of a first-best policy to deal with the externality. If countries had been willing and able to tax cigarette smoking by an amount that equaled the external cost to society, then whatever smoking took place after fragmentation would provide benefits exceeding this cost and the world would have gained. If such benefits could not exceed the costs, then the industry would not appear at all, even when fragmentation made it technically possible, and the possibility of fragmentation would have had no effect at all.

This example rested on the existence of an externality, the presence of which is well known to undermine the welfare theorems of economics. What if the only distortion

were a tariff? Again I think one can construct an example of welfare loss due to fragmentation, although it is not as stark.

Suppose that the manufacture of cars requires an input of steel and the combined activities of design, which does not use the steel, and assembly, which does. Consider a country that has comparative advantage in both design and assembly, due to its endowments of various types of workers, perhaps, but a comparative disadvantage in steel. And suppose that initially design and assembly have to be done in the same place. If there were free trade, the country would import steel and produce (both design and assemble) cars, and export them. But now suppose that for some extraneous political reason the country has a tariff on imports of steel, pushing its price above the world price. Depending on the sizes of its advantages in design and assembly, it may still have a comparative advantage in producing cars, in spite of the higher priced steel.

But now suppose that it becomes possible to fragment production into separate design and assembly stages that can be done in different places. By moving assembly abroad, car companies can continue to exploit their comparative advantage in design while giving up their comparative advantage in assembly in return for lower priced steel. Steel imports go down, as do car exports which are presumably shipped directly from the now-foreign assembly plants to their final markets.

I believe that this change could be harmful for the world. The tariff on steel was reducing steel imports below their free-market levels, and presumably also reducing the extent to which the world took advantage of the home country's comparative advantages in design and assembly. Fragmentation, here, reduces steel imports still further, although it may increase the use of steel in producing cars. More important, it reduces the extent

to which the world benefits from the country's comparative advantage in assembly, which has moved offshore to a place where, if it were not for the lower priced steel, costs would be higher. On the other hand, it has made it possible to benefit *more* from the country's services in car design. So the outcome may be good or bad. But it seems clear that this is an example in which, in the presence of a tariff, the introduction of a form of fragmentation could be harmful to the world.

VI. Should We Care about the World?

Of course we should, in the sense of caring about everybody in the world. But what I mean here is: Should we care about the effect of fragmentation on the aggregate welfare of the world, as defined here and routinely in international trade theory? That is, if we believed that the world were close enough to an undistorted state for the results there to be meaningful, would we then find useful the result that fragmentation benefits the world? Or alternatively, if we believed not only that distortions exist but also that they correlate with the effects of fragmentation in a way that it will lower world welfare, should we then oppose fragmentation on that account alone?

Perhaps not, in both cases. Some might argue that, since compensating income redistribution will never occur, what matters is how we weight the effects on winners and losers, not whether the winners could compensate the losers if we made them do it. Most likely, I think, many would regard a change that benefits the rich and hurts the poor as undesirable, even if the money-value of the gain in the sense of, say, equivalent variation is somewhat larger than that of the loss. And a change that does the opposite might be welcomed, again even if it fails the compensation test. If so, then the questions about

trade and fragmentation should focus not on their aggregate welfare effects but on their effects on income distribution. That would take us back to section IV, where we would ask how fragmentation affects the wages of skilled versus unskilled workers. And it would take us into the whole literature on “trade and wages” where such questions have been addressed, both theoretically and empirically.⁶

But while I certainly think that questions about income distribution are important, I also think that results concerning aggregate world welfare are worth pursuing for fragmentation as well, just as they are for more traditional questions of international trade. For the fact is that we are incredibly ignorant about what distributional effects will be, when we think about fragmentation in general and not in very specific cases. If the theoretical literature teaches us anything, it is that anything can happen. For any given country, or even any given group within a country, the general possibility of fragmentation may be helpful or harmful. And while it might be possible, with sufficient information about the details of a particular example of fragmentation to remove this ambiguity empirically, this could surely not be done for all the forms of fragmentation that are arising over time in the world.

In our ignorance, therefore, the best that we may be able to do is to take a bet on whether fragmentation overall is likely to be good or bad. And for that, in the case of an undistorted world economy, the aggregate welfare result is clear. Because it says that fragmentation must raise world welfare, it is also saying that it raises individual welfare *on average* across the world’s countries and groups. Unless, therefore, you have reason to think that a person, group, or country that you care about (the poor, for example) will

⁶ See Freeman (1995).

be affected systematically differently from the average, for all forms of fragmentation, than you should bet in favor of fragmentation rather than against it.

Now in the case of traditional trade – rather than fragmentation – we actually do have reason to expect systematic departures from the average. That reason is the Stolper-Samuelson Theorem. If we view the world as comprised of relatively high paid skilled workers and relatively low paid unskilled workers, the former more abundant in the rich world and the latter more abundant in the poor world, then Stolper-Samuelson tells us systematically that trade will make the income distribution more uneven in the rich world and more even in the poor, or more importantly that it will raise real wages of unskilled workers in the South and lower them in the North. One could easily have an opinion on which of these effects to take most seriously. And even without that, one could hardly comfort the losers from trade with the argument that they might just as well have been born into a different group or country, so the average is all that matters.

On the other hand, although the message of Stolper-Samuelson is clear, it is not at all clear that it tells the whole story of the effects of trade, for all sorts of reasons that trade theorists have explored. And these reasons tend – as I see it, at least – to add all sorts of reasons why particular groups may be affected differently by trade than Stolper-Samuelson suggests, both within the framework of the Heckscher-Ohlin model (adding more factors, for example, or allowing for complete specialization) and outside it (the New Trade Theory).

On the other hand, these same extensions and modifications of simple trade theory also tend to add more reasons why the effects of trade on aggregate world welfare are likely to be positive, with the gain presumably therefore larger than might have been

expected from the simple model. Therefore, they reinforce the conclusion both that, in our ignorance we should look at the average effects of trade, and that these average effects are probably positive.

Returning to the question of fragmentation, I would say that this conclusion is even stronger. In the case of fragmentation we do not even have a simple result like Stolper-Samuelson. That is, even in the simplest model where Stolper-Samuelson tells the whole story for trade, the introduction of fragmentation in a particular industry may help or hurt, say, unskilled labor in either country. This is the message we saw above from Jones and Kierzkowski (2001) and Deardorff (2001a). And of course more complicated models will yield even greater confusion, if that is possible – see Markusen (2005). That being the case, the result that fragmentation raises total – and therefore average – world welfare may be the best that we can do.

Of course, this result is true only in an undistorted world, which most people would regard as pretty remote from the one we live in. What do distortions do to this conclusion? I've argued in Section V that in the presence of distortions, fragmentation can lower aggregate world welfare. But to say that it can, does not by any means mean that it will. For every example where fragmentation hurts a distorted economy, I am sure one could construct another example where it helps.

The issue, in all cases, will be whether fragmentation makes the harm done by the distortion worse, usually by shifting activity further away from what would have been optimal, or does it reduce that harm by shifting activity toward the optimum. On average one might suppose – again if we are completely ignorant about the details of what will happen, as I believe in essence that we are – that fragmentation is as likely to do one as to

do the other. And in that case, the fact that fragmentation must systematically expand what the world is able potentially to do with its given resources should mean that, again, on average fragmentation will be beneficial.

VI. Conclusion?

My conclusions about the gains from fragmentation, then, are very similar to the conclusions of trade theory more generally about the gains from trade: It is certainly true that examples of fragmentation can be found that lower the welfare of particular individuals, groups, and countries, and even of the world as a whole if they interact negatively with existing distortions such as externalities and tariffs. But in an important average sense, fragmentation is very likely to expand world welfare.

So what? I have treated fragmentation here as a technological change that makes it possible to do something that was not possible before, on the grounds that much of the visible fragmentation today seems to have been made possible by improvements in the technologies of communication and transportation. Does anyone seriously propose reversing those technological changes, even if it were possible? Of course not. So perhaps it doesn't matter from a policy perspective whether fragmentation is good or bad – it is simply an unavoidable fact of modern life.

But people do propose using policies to prevent those technologies from being taken advantage of, especially through fragmentation. In my own state of Michigan, our governor (whom I otherwise largely respect) has tried to limit the state government's purchases from firms that outsource abroad. John Kerry (whom I also otherwise respect), in his run for U.S. president, railed against "Benedict Arnold Companies" that betray our

nation by sourcing abroad, and he proposed a change in the tax code that was supposed to discourage this. And while at the moment U.S. concerns about trade seem to be more traditional – textiles from China, sugar from the Caribbean – I will be surprised if we do not hear more demands for policies to interfere somehow with firms that shift activities abroad.

These policies will seldom be as simple as an import tariff, just because fragmentation today often does not involve a physical product crossing a border. Therefore our standard arguments against tariffs, and the associated labeling of those who favor them as “protectionists,” will seem not to apply. We will need to be creative in arguing against them. This will be especially hard given our tendency, as I have illustrated in this paper, to find particular cases in which fragmentation has adverse effects.

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