Product Heterogeneity and Cost Allocations in Contingent Trade Protection

Abstract: The WTO allows members to impose contingent protection, including antidumping duties, within agreed constraints. Antidumping proceedings typically name a single captioned product but include large numbers of individual products within that caption. The inclusion of multiple products creates a variety of issues in both antidumping and other contingent protection instruments, issues that have been prominent in national actions and WTO dispute settlements, but have been largely ignored in research. In this work I focus on the most important such area, the allocation of costs among products in antidumping proceedings. I develop a comprehensive economic analysis for allocation issues, and couple it with the accounting tools that must be used for its implementation. I apply this to the most active area of controversy in this area, the inconsistent national practices in allocating costs to individual goods. These results have direct relevance in other contingent trade contexts, such as injury determinations and subsidy pass-through analysis.

Keywords: Product heterogeneity, international trade, antidumping, WTO

JEL classifications: F13, M41

1. INTRODUCTION

The World Trade Organization agreements permit signatories to apply a limited set of contingent trade restrictions to imports. “Contingent” in that they are permitted only if certain criteria are met, these restrictions are intended to remedy a trade problem rather than provide simple protection. Narrowly defined, these are the antidumping duty, countervailing duty, and safeguard remedies. The first permits tariffs in the face of imports sold below “normal” value; the second permits tariffs in response to subsidized imports; the third permits a variety of responses to rapid, injurious increases in imports. Importantly for our purposes, the WTO agreements describe each of these in terms of actions against a product from an exporting country: the Antidumping Agreement (ADA) permits tariffs with respect to “the product exported from one country to another” (World Trade Organization Antidumping Agreement (2013), Article 2.1); the Agreement on Subsidies and Countervailing Measures (SCM Agreement) allows countervailing duties to be imposed on “the product under consideration” (World Trade Organization Agreement on Subsidies and Countervailing Measures (2013), Article 15.1, FN 6); the text of the Agreement on Safeguards consistently refers to its application to “a product” (World Trade Organization Agreement on Safeguards (2013), Article 2.1). In no case do these agreements acknowledge potential issues that may arise when the subject product is in fact many different products, caught under a single caption.

Consistent with the language of the Agreements, the economic analysis of trade administration law and practice is often framed as if all trade proceedings involve single,
homogeneous goods. But proceedings routinely involve complex families of products, reflecting the reality of business practice. The calculations and judgments of trade cases often raise a host of issues created precisely by this multiplicity of products. Antidumping calculations rely on the assignment of costs and benefits to individual products within the “product” subject to a proceeding, require the aggregation of dumping margins across individual products, and involve difficult issues arising from comparisons between different products across markets. Subsidy rates may vary depending on the relative content of subsidized inputs in the various products manufactured by a firm. The injury analyses of safeguards, as well as those for anti-dumping and countervailing duty investigations, encompass differential impacts across products within the general definition of the domestic industry. In all three types of proceedings, the scope definitions of subject products are often a matter of serious dispute.

Practice concerning the treatment of heterogeneous products has developed case by case, both at the level of national administration and with respect to the WTO’s dispute resolution process. To some extent, the issues involved have appeared so diverse, and the difficulty in their articulation so great, that a case law approach has seemed sensible, allowing the flexibility to evolve responses against a variety of facts. But with an absence of guidance from the Agreements and the paucity of discernible themes in case law, national authorities have been largely free to develop policy concerning product heterogeneity. This has led to a lack of predictability in trade administration, a result fundamentally at odds with the purposes of the WTO.1

Issues involving product heterogeneity in fact raise many common questions and systematic economic analysis can provide efficient, consistent resolution of these questions. This work focuses on heterogeneous products in antidumping proceedings, and in particular on the most active area of current dispute, the allocation of costs to individual products. There are two reasons for this focus. First, antidumping calculations raise the most complex and fundamental issues concerning heterogeneous products. Resolution of some of these issues will benefit other areas, such as injury analyses. Second, current cases involving cost allocations are active at the national administrative, national judicial, and WTO dispute settlement levels. These proceedings display a wide variety of differing national responses to very similar situations, despite numerous earlier disputes involving much the same issues. Current national practices make all too clear that there is no cumulative value to these cases; the fact of multiple products within an overarching case “caption” continues to provide considerable scope for play by national authorities. A careful application of economic analysis to the cost allocation problem, informed by accounting practice in this area, provides a

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1 See Jackson (1997), Chapter 4, and the many sources cited therein, for discussion of the motivations behind the WTO Agreements.
systematic analytic basis to assess the issues currently bedeviling antidumping administrative practice and judicial reviews, and by extension those of other contingent trade remedies.

2. ANTIDUMPING PRACTICE WITH HETEROGENEOUS PRODUCTS

Many previous works have explored the overall history and rationale of antidumping practices and I provide only a brief synopsis here, before considering the case of proceedings that include multiple products. Canada in 1904 introduced the first antidumping law that took action based on a firm’s relative pricing in its home and export markets, defining dumping as net export prices lower than net home prices. Numerous countries had adopted such laws by the 1920’s. Detailed in Viner’s (1923) review, the rationales were several, including the fear of predatory pricing that would be beyond the reach of a country’s competition authorities.

The official action in response to dumping was, by and large, an antidumping duty imposed on imports, a tariff set equal to the amount by which the exporter’s home prices exceeded its prices to the importing country. The measurement of this tariff was deliberate: removing the “underpricing” through a corrective tariff was viewed as restoring a level playing field, leaving markets at the same point as if all participants behaved “fairly”. Low prices for imports were not actionable in themselves; they needed to be below a “fair” or “normal” price; Jackson (1997) provides an extensive review. Regardless of the near-unanimous condemnation of economists throughout the life of these laws, they flourished and eventually came to be reflected first in the articles of the General Agreement on Tariffs and Trade (GATT) in 1947, and eventually in the Antidumping Agreement (ADA) of the World Trade Organization (WTO) in 1994.

The WTO's ADA largely encoded the existing practices of its signatories. Antidumping actions are prosecuted by the government of one country against imports from another country. Dumping itself characterizes the behavior of individual firms, not countries, so while a case will name a country, it will be prosecuted against individual exporters from that country. The eventual outcome of a proceeding, if dumping is found, is a tariff set equal to the excess of the “normal” value of the offending exporters over their export prices to the country investigating the alleged dumping. While this duty is generally on a company-specific basis, reflecting different costs and prices for the different exporters involved, the finding of dumping applies to the exporting country generally, often with an "all others" tariff applied to firms not directly involved in the action.

The actual antidumping calculation can be notoriously complex, but we need consider only the basic elements; Vermulst (2005) provides the most thorough single account. Domestic sales are the preferred basis for normal value under the ADA (Article 2.1). The chief alternative
is the cost of production, in which case export prices may be compared to costs rather than domestic sales (ADA Article 2.2). The role of costs is more extensive than this dichotomy suggests, however. Even if domestic sales are used for normal value, costs may play a prominent role in the calculation of domestic net prices due to the potential elimination of below-cost sales as being out of the "ordinary course of trade" (ADA, Article 2.2). Also, production costs may be used to adjust for physical differences between the domestic and exported merchandise (ADA Article 2.4). Finally, while the ADA gives preference to domestic sales over cost of production as the basis for normal value, rules concerning "special market situations" (ADA Article 2.2.1) and the preferences of antidumping authorities lead to production costs being used for normal value far more than their place in the ADA's hierarchy would suggest.2

Previous published work has noted much of the preceding. However, previous analyses have failed to focus sufficiently on an important aspect of antidumping proceedings, the definition and composition of the product under consideration. The product under consideration refers to the allegedly dumped product as a whole and will typically be named in the case caption, e.g., Certain Softwood Lumber Products from Canada. The language of the ADA suggests that the product under consideration is a well-defined homogeneous good: “For the purpose of this Agreement, a product is to be considered as dumped …” (ADA, Article 2.1, emphasis added.) The exports are always referred to as “a product” or “the product under consideration”, and the comparison sales used for normal value are those of “the like product”. Indeed, a newcomer to the ADA could be forgiven for thinking that a case involves a single, irreducible product, but a glance at the scope of antidumping proceedings indicates that this is not so. (See Section 3, below.) Nearly every case involves numerous separate products that differ materially in commercial value or production costs. In practice the dumping comparison is at the level of the individual product, not at the level of the overall product under consideration (Vermulst (2005), at 12-14). The administering authority looks for an identical product sold in the domestic market for each individual exported product for the dumping comparison. If a viable identical product cannot be found, national practices vary somewhat;3 in the United States, the next most similar product sold in the home market is then examined,

2 Normal value may also be based on surrogates for domestic prices, such as third country prices, or on surrogates for the company's own costs, most notably the use of surrogate factor costs in the cost of non-market economies. Surrogates involve the same issues of product heterogeneity as the use of domestic prices or the company's own costs for normal value.

3 Based in part on the net sales price vis-a-vis the production costs for the specific product, the authority determines whether domestic sales of that product are a viable basis for comparison to export sales of the same product. Some authorities have a two part test, assessing domestic sales viability both for individual products and for the like product as a whole, presenting another example of practice not anticipated in the ADA.
whereas many other countries move directly to costs as the basis for normal value. Thus a mix of price-based and cost-based comparisons is common in dumping proceedings due to the mix of prices and costs across individual products within the scope of a proceeding.

Perhaps because the matter of heterogeneous products is not explicit in the ADA, academic and policy analyses to date overwhelmingly have ignored the issues that these products raise. This leads to a disjoint between practitioners in trade administration, for whom matters of product definition and diversity constitute a huge portion of the effort and argument in specific cases, and most academic authors in the field, who assume that the “product under consideration” is just that, a single, homogeneous product. Published statistical analyses of the causes and effects of contingent trade protection have used data at the level of the proceeding, the tariff code (see, for example Bown’s (2011) excellent survey of use of contingent protection across countries, based on 6 digit Harmonized System codes), the firm (Blonigen (2004), for example, studies firm learning in repeated antidumping actions), or the plant (Pierce (2011)), with little need to consider the fact that a single observation within any of these categories will typically involve a large number of separate products. The literature that concerns incentives for dumping has occasionally considered why companies might dump in the presence of two or more products; for example, Moraga-Gonzalez and Viaene (2005) provide a theoretical basis for dumping to be an optimal firm strategy in the presence of two qualities of a product. But this literature has in no instance considered the implications of multiple products in the antidumping institutional context. A few analyses have noted special issues that arise when similar rather than identical products are compared; Kelly (2011), for example, points out that the use of similar merchandise for normal value amounts to the use of surrogates and creates a potential for a double-count of antidumping and countervailing duties. But these have provided little or no guidance for developing policy to deal with the fact of multiple products.

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4 Vermulst (2005) notes that the ADA itself does not contemplate comparisons at a level below that of the product under consideration and so no rules are set forth concerning the identification or treatment of individual products. Also, the ADA does not place restrictions on the definition of the product under consideration, even though that definition largely determines the scope of the proceeding. (WTO ADA, especially Article 2.1.) The ADA does specify, however, that the product under consideration be compared to the "like product" in the domestic market to establish normal value, where like product means, in order of preference, the identical product or one that "has characteristics closely resembling those of the product under consideration". Vermulst notes the confusion that this creates, in that "like product" also refers to the domestic product of the importing nation for injury purposes.

5 As an important illustration, academic analysis often focuses on the export side of the dumping equation as the area in which a company can best control its outcome, under the theory that raising export price both lowers dumping and increases unit revenue, while lowering the domestic price often lowers dumping but also lowers unit revenues. However, often small changes in normal value can have outsize effects on dumping margins, leading practitioners to focus heavily on relatively small clusters of domestic sales or products.
A more legally oriented literature has taken note of the frequency of multiple product issues. Lindsey and Ikenson (2001), in documenting the spread of U.S. antidumping practice to other nations, note that the choice of costing methods for joint products – the subject of this paper – created dumping margins in a South African case against American chicken parts. Analyses of the "zeroing" issue, such as that by Vermulst and Ikenson (2007), often note that the existence of multiple products created an important, distinct issue in the zeroing controversy ("product zeroing"), one that complicated the zeroing issue before WTO Panels and the Appellate Body for several years and involved dozens of antidumping cases. But these analyses have included the matter of product heterogeneity only incidentally, while pursuing analysis of other themes in trade practice.

Despite this scant attention, issues concerning individual product costs occupy a large and growing place in AD controversy at the administrative and judicial levels. In Section 3 we provide statistics demonstrating the prevalence of product heterogeneity in dumping cases. In this work we seek to address the paucity of systematic research on the underlying economics of these issues (Section 4) and the role of accounting conventions (Section 5) in resolving them. The importance of these issues is suggested by the preceding review and is explored further in Sections 6 and 7. Our narrow objective is to resolve the issues involved in dealing with multiple products in a central area of current controversy, the development of individual product costs in cases in which a production input or process is shared across multiple individual products. In so doing, we hope to take the first steps in addressing the broader gap in current research concerning heterogeneous products.

3. EMPIRICAL ASPECTS AND CONTROVERSIES

Nearly all antidumping cases involve heterogeneous products. This fact is unsurprising, given the typical case captions and the requirement that any factors affecting price comparability, including physical differences, be reflected in the dumping comparison. To test the prevalence of heterogeneous products, we reviewed all cases initiated by the administering authorities in three jurisdictions that actively use antidumping, the United States, the European Union, and Canada, from 1995 through 2010. We chose these jurisdictions because of their active use of antidumping measures and their relative transparency in describing the product coverage of those measure. Table 1 presents the results. The overwhelming majority of antidumping activity involved heterogeneous products, whether measured by the number of cases or by the captions, that is, the named products under investigation.
Table 1: Proportion of Antidumping Cases That Involved Multiple Products: 1995 - 2010

<table>
<thead>
<tr>
<th>Basis</th>
<th>Country</th>
<th>Initiations</th>
<th>Multiple HS Codes</th>
<th>One HS Code, Multiple Products</th>
<th>One HS Code, One Product</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number</td>
<td>% of Total</td>
<td>Number</td>
<td>% of Total</td>
</tr>
<tr>
<td>Cases</td>
<td>United States</td>
<td>455</td>
<td>325</td>
<td>125</td>
<td>27%</td>
</tr>
<tr>
<td>Cases</td>
<td>European Union</td>
<td>435</td>
<td>269</td>
<td>151</td>
<td>35%</td>
</tr>
<tr>
<td>Cases</td>
<td>Canada</td>
<td>167</td>
<td>141</td>
<td>25</td>
<td>15%</td>
</tr>
<tr>
<td>Captions</td>
<td>United States</td>
<td>186</td>
<td>125</td>
<td>57</td>
<td>31%</td>
</tr>
<tr>
<td>Captions</td>
<td>European Union</td>
<td>189</td>
<td>113</td>
<td>66</td>
<td>35%</td>
</tr>
<tr>
<td>Captions</td>
<td>Canada</td>
<td>66</td>
<td>60</td>
<td>5</td>
<td>8%</td>
</tr>
</tbody>
</table>

Notes:
HS Codes refers to Harmonized System Codes. “Captions” refers to the products against which cases have been initiated; for example, the five European Union initiations of investigations against Hair Brushes would be counted as one caption. The “Initiations” and “Multiple HS Codes” columns are derived from Bown (2012). “One HS Code, Multiple Products” is the author’s calculation based on review of the product descriptions by the administering authorities in each country. “One HS Code, One Product” is the residual; in these cases, it could not be determined from the public records whether there were multiple products, so this represents a maximum possible number of cases or captions involving only a single product.

Table 1 conveys the widespread existence of heterogeneous product, but the sheer scale of product differentiation can be seen only by reference to individual cases. Administering authorities typically create product control numbers, based on combinations of characteristics, to identify individual products. The use of product control numbers routinely leads to very large numbers of uniquely identified products. By way of example, the U.S. case against Softwood Lumber from Canada, a case in which the joint cost allocation issue was central, involved hundreds or thousands of individual products, despite involving only a few Harmonized System codes at the 8 digit level.6

A count of how many WTO disputes have involved issues arising due to multiple products is difficult to obtain, since these issues often underlie the cited areas of disagreement and have no consistent article or language for their reference. The zeroing cases alone number twenty-one requests for consultations since 2001 and often have involved the “product zeroing” issue.7 Several cases have involved the particular issue of the allocation of joint products, the core concern of this paper. For example, in a dispute arising from a safeguards

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6 See the original Report of the Panel in Softwood Lumber from Canada (WTO (2013), DS264), which lists fewer than 10 HS codes while referring to “hundreds or even thousands” (FN 333) of products contained within the scope definition.

7 Bown and Prusa (2010) list 18 cases to date; we identified 3 since that time from the WTO’s dispute settlement case listing (World Trade Organization (2013)).
case, *United States – Definitive Safeguard Measures on Imports of Wheat Gluten from the European Communities*, (WTO (2013), DS166: Panel Report 31 July 2000), the allocation of costs between joint products, primarily wheat gluten and wheat starch, was central to the U.S. injury finding and was challenged by the European Communities. In *United States – Softwood Lumber from Canada* (WTO (2013), DS264), perhaps the most important joint product case ever prosecuted at the national level, Canada challenged the U.S. failure to adjust for alleged cost differences between individual products, an argument based upon joint costs. In the ongoing case *China – Anti-Dumping and Countervailing Duty Measures on Broiler Products from the United States* (WTO (2013), DS427), the question of the allocation of joint costs is central, with China having rejected an allocation used internally by the respondent companies.

While at its broadest this work concerns the impact of multiple products in trade cases, the specific focus is the allocation of production costs. Cost issues arise in many antidumping contexts: the testing of home market sales for ordinary course of trade (ADA Article 2.2.1), the use of costs as the basis for normal value (ADA Article 2.2), the adjustment for physical differences in merchandise across markets (ADA Article 2.4), and to some extent in the allocation of selling and movement expenses (ADA Article 2.4). Currently the United States, the European Union, China, and many other national governments routinely require cost data from responding companies and routinely include a cost recovery test to home market sales. Consequently, if there are multiple product codes included within the caption of the case, costs have to be developed for each separate product code, guaranteeing that the respondents and antidumping authorities will face issues arising from individual product costing.

Cost issues frequently find their way to the WTO’s Dispute Settlement Mechanism. The Dispute Settlement Body received its first Request for Consultations in January 1995. Through 2012 it had received a total of 454 requests, of which 95 cited the Antidumping Agreement. Of these 95, 31 cited one or more of Articles 2.1, 2.2, 2.2.1, 2.2.1.1, or 2.2.2 and involved cost of production. The relative role of both antidumping generally and disputes concerning production costs has increased over time; in the latter half of the disputes, from numbers 228 through 454, over a quarter (62) cited the Antidumping Agreement, of which 25 involved production costs. (Authors’ compilation from World Trade Organization (2013).) Since production costs may arise in other contexts, such as article 2.4, the prevalence of cost issues may be greater than these statistics indicate.

As a coda, we note that an approach by a national authority that raises dumping margins can lead to similar behavior by other nations. Concerning chicken products, South Africa in 2000 created high dumping margins through the method the Board on Tariffs and Trade used to allocate the costs of chickens to individual parts, one that conflicted with the accounting methods used by the respondent companies (South Africa, Board on Tariffs and Trade
(2000)). This same approach was adopted, in turn, by the Ukraine (United States Department of Agriculture (2009)), China (United States Department of Agriculture (2011)), and Mexico (United States Department of Agriculture (2012)) in antidumping proceedings against chicken products. Practices that exploit product heterogeneity may flow freely across borders, leading to major impacts on trade for the affected products.

4. AN ECONOMIC ANALYSIS OF PRODUCT COSTING

Economic analysis provides considerable insight concerning principles for associating costs with individual products. For context, we will consider a business “enterprise”, defined here as an entity with costs and associated revenues accumulated in financial accounts that are independent of those of other enterprises. Profit maximization requires that managers increase or decrease the levels of their control variables to maximize the excess of revenues over costs. With centralized information and decision-making, the question of allocations within the enterprise need not arise, since the profit maximization objective concerns totals at the enterprise level.

Should it be necessary to separate costs by product, with decision-making to some extent decentralized and dependent in part on individual product costs, costs should be associated with revenues in a manner that allows the decentralized decisions to replicate enterprise-level profit maximization.\(^8\) However, the presence of joint costs or common costs complicates this task. Joint costs occur when the production of one product necessarily involves the production of another, typically due to the nature of an input. For example, crushing soybeans necessarily produces both soybean oil and soybean meal. Common costs also are shared by multiple products within some time frame, but due to convenience or efficiency rather than physical necessity. For example, a rail spur may be used to transport two different products, but could be used to transport just one.\(^9\) Antidumping actions often involve common cost issues, but these issues are largely factual, concerning the relationship of a common facility or activity to the products that benefit from it. Our concern here is with joint costs, which raise more fundamental issues of how the dumping calculations should address cost allocations generally.

We will first consider single product and separable production costs as base lines, then address the more complex case of joint production. The Appendix provides mathematical modeling for each step, as well as providing references.

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\(^8\) Even if an enterprise does not have the objective of maximizing profits, this alignment of revenues and relevant costs is necessary for management purposes.

\(^9\) This distinction follows modern accounting and economic literature; see the review in Manes and Cheng (1988). Older usage often treated the terms informally, at times considering them synonymous.
a. **Product costing with separable production costs**

The simplest case, profit maximization for a single product in isolation, has a straightforward, textbook solution. The firm increases the level of a control variable, usually taken as production quantity, as long as additional units are profitable. At the point where the last increment to production earns no profit, the firm no longer will increase production, for the marginal revenues of further units produced will lie below their marginal costs. Lower production would sacrifice profitable units; higher production would include units produced at a loss. This is the familiar scale condition of setting quantity at the point where marginal revenue equals marginal cost.\(^\text{10}\) (Appendix, Equation A.1.) It is perfectly possible to observe this rule and still lose money on a product, so the firm also needs to compare the product’s total revenues and total costs at the optimal scale and determine whether to make the product at all. If total revenues exceed total costs at that point, there are positive net revenues, that is, profits. (Appendix, Equation A.2.) This second condition, cost recovery, will be important in the application of these principles to the dumping context.

The enterprise may produce multiple products but with manufacturing costs that are separable by product: costs incurred in producing one product do not affect the production of any other product and there are no shared costs. If the enterprise decentralizes decision-making to the level of the product, maximizing profit for each product individually also maximizes profit for the enterprise as a whole. (Appendix, Equation A.3.) This is true both in terms of optimal scale — the individual products’ marginal profits sum to the marginal profits for the enterprise — and in terms of overall cost recovery — the individual products’ net revenues sum to the net revenues for the enterprise.

b. **Product Costing with Joint Costs**

Joint costs break down the independence of product manufacturing decisions. Antidumping cases provide many examples in which a single input is processed into multiple products (see Section 6 for a sampling of specific cases): a head of cattle yields, after slaughter, various cuts of meat and the hide; a chicken yields leg pieces, breasts, and so forth; a log entering a saw mill is processed into various dimensions of lumber, plus wood and bark chips. Grading at the end of a production process can identify different product qualities resulting from the same production process: a steel tube may be classified as prime quality or limited use for oil drilling applications, with widely differing commercial values.\(^\text{11}\) The common element is

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\(^{10}\) The decision rule provides that the manager should increase production if marginal revenue exceeds marginal cost. In the frequent practical circumstance that marginal revenue still exceeds marginal cost at production capacity, the decision rule provides that the firm produce at full capacity.

\(^{11}\) Section 6 provides information on specific cases. The antidumping cases will typically include many, but not all, of the joint products. Mexican cases against U.S. beef have included meat cuts but not the hides; the U.S.
that an expenditure – for purchasing a head of cattle, for manufacturing steel pipe, etc. – results in multiple products that face differing demands. The output decisions are not made independently for different products: the physical fact of the shared input suggests limited scope for varying individual product outputs.\(^{12}\)

Joint production occurs in fixed or variable proportions. Under fixed proportions, an input leads to outputs in constant proportions that the processor cannot alter. A chicken will produce two breast cuts and two leg cuts, regardless of the processor's efforts. Variable proportions occur when an input leads to joint products, but the processor can affect the proportions of these products to some extent. A log can be processed into multiple dimensions of lumber and the saw mill has some flexibility in determining how much of which dimensions should be produced.

The first-best solution to the problem of profit maximization centralizes the decisions concerning optimal production quantity and, if applicable, product mix, to allow comparison of the net effects of alternatives. The scale decision compares the marginal cost of another unit of the input to the \textit{sum} of the marginal revenues of the resulting outputs (Appendix Equation A.7). Variable proportions also require determination of optimal product mix, an additional decision at the margin that affects optimal scale as well (Appendix Equation A.9). In both cases, the cost recovery criterion requires that total revenues exceed total costs at the optimal scale and product mix (Appendix Equations A.8).

In some contexts, including anti-dumping cases, attempts are made to assign costs to the individual output products and compare them to the individual revenues of those products. The attempt to separate costs is at odds with the first-best economic treatment and has created controversy and litigation in a number of prominent antidumping cases, as considered in Section 6. But the fact remains that antidumping analysis to date has demanded this separation, which raises the question: are there better, or worse, ways to proceed in allocating the joint costs?

The firm faces problems of optimal scale, optimal product mix, and cost recovery. With an allocation of the joint costs to the individual products, total cost for the joint product forms case against Canadian lumber included the many types of lumber but not the wood or bark chips; etc. The joint products overlap the boundaries of the dumping cases, meaning that the allocation of joint costs will affect not only relative costs for the individual products subject to the case, but the total amount of cost assigned to “the product” named in the case caption.

\(^{12}\) Accounting theory and practice often distinguish "byproducts" from other joint products on the basis of their relatively low value. For the centralized scale and cost recovery decisions, this distinction serves no economic purpose. The Appendix includes an example of a product with negative commercial value (disposal costs); its presence does not change the centralized decision. However, when costs are allocated, an intermediate step is required for products that have negative value, in which their negative value (disposal cost) is assigned to the products with positive sales values. See the Appendix for further discussion.
a control total for the individual product costs.\textsuperscript{13} As demonstrated in the Appendix, the optimal allocation methods differ for decisions at the margin (optimal scale and product mix) and for cost recovery (Appendix Equations A.12 and A.13). Moreover, in many circumstances the scale and product mix decisions have enormous information requirements that would make allocation at the margin especially difficult. Fortunately for our present purposes, antidumping is concerned primarily with cost recovery, and the cost recovery decision can be decentralized by allocating joint costs to individual products based upon the revenues they earn. The profit rate will be the same for each product as for the overall enterprise. Therefore the incentives at the individual product level will mirror those at the enterprise level with respect to the decision of whether to produce: if overall production is profitable, production of each product will be profitable, and if overall production is below cost, the same is true for individual products. Any other allocation method risks leaving some individual products with a different profitability outcome from the joint set of products, leading to incorrect decision-making at the individual product level.

This is shown by example in Table 2. A single input leads to two joint outputs; overall, production is profitable. An allocation of the joint costs based upon revenues leads to the same profit rates at the individual product level as for the overall operation. An allocation based upon weight leads to one product being considered below cost. Decentralizing the production decision with the weight allocation method would lead the Product 2 manager to conclude that production and sales should be shut down. Without central intervention, this would in turn leave Product 1 bearing the full costs of production, leading to its shutdown as well. A weight-based allocation, if used for decision-making, is incompatible with overall rational behavior by the firm. From an antidumping perspective, the weight allocation would reject sales of Product 2 as being below cost, despite the fact that the allocation is an artificial contrivance against a backdrop of enterprise profitability. A value-based allocation avoids this mistake.

\textsuperscript{13} This condition, sometimes referred to as “additivity” (see, e.g., Hughes and Scheiner (1980)) or “tidiness” (Biddle and Steinberg (1984)), is routine in antidumping proceedings.
Joint production processes often yield products that require further processing or other steps prior to sale, costs that are specific to those products. The oil and the fiber resulting from oilseed processing likely have different packaging requirements, for example. The point at the end of the joint process is called the split-off point, although one has to keep in mind that there may be a succession of joint processes and thus more than one split-off point for a given final product. If the processing following the split-off point is not discretionary, the preceding analysis extends with little effort, and one uses marginal revenues to determine optimal scale and product mix (Appendix, Equation A.14). A common, equivalent approach in accounting is to subtract the costs incurred after the split-off point from revenues for each product, leaving net revenues at the split-off point. The cost recovery criterion requires a simple comparison of total costs (joint and individual) to total revenues for the optimal scale and product choices.

If the further processing is discretionary for at least some of the joint products, the firm faces the decision of whether to engage in that further processing or simply sell the products at the split-off point. That decision will be based on whether the further processing adds value, that is, whether the additional costs incurred are exceeded by the additional revenues. But the profitability of further processing could depend on the scale of production and so cannot be treated in isolation from the production decisions for the joint product. As shown in the Appendix, the further processing option adds an additional potential set of revenues, at the
margin and in total, for the optimization and cost recovery decisions, but does not fundamentally change the nature of those decisions. \(^{14}\)

If joint costs must be allocated with optional further processing, the sales value may be ambiguous – the value of the joint products, or the joint products after further processing? – or may not exist for the individual joint products if further processing always occurs. However, the allocation logic is still to preserve, if possible, the profitability condition of the whole at the individual product level. Consequently, allocations that replicate the centralized decisions at the margin require an allocation based upon marginal revenues for each possible scale, product mix, and further processing possibility. For cost recovery, the optimal allocation starts with total costs, including further processing, and uses revenues as allocators (Appendix, Equation A.15). This results in each product reflect the profitability percentage of the whole, so that the cost recovery decision can be decentralized.

5. THE ANTIDUMPING CONTEXT AND THE ACCOUNTING TREATMENT OF JOINT COSTS

The question of cost allocation often is framed as an accounting issue in antidumping proceedings. This is not surprising, for while the reasoning is fundamentally economic, accounting systems provide company managers with the information needed for economic decision-making and provide antidumping authorities with the information to prosecute antidumping proceedings.

The ADA itself makes limited references to company accounting, at Article 2.2.1.1:

For the purpose of paragraph 2, costs shall normally be calculated on the basis of records kept by the exporter or producer under investigation, provided that such records are in accordance with the generally accepted accounting principles of the exporting country and reasonably reflect the costs associated with the production and sale of the product under consideration.

Thus the ADA sets a default of using company records for calculating costs, provided that those records are consistent with generally accepted accounting principles and reasonable with respect to the product under consideration. While Article 2.2.1.1 goes on to mention

\(^{14}\) Existing literature occasionally states that the further processing decision is independent of the joint production decision, but in general this is not correct for the question of scale. It is true that for any given output of the joint process, the enterprise can maximize profits by comparing the further processing costs to the resulting incremental revenues; if positive, the further processing should be done. But the overall optimal scale for the joint product, including its potential further processed progeny, requires a comparison of the combined profit possibilities of joint production and further processing.
timing aspects of cost allocations, the ADA is silent on the matter of the allocation of costs to individual products within the product under consideration. Nevertheless, these limited references have become the focal points on issues of product costing brought to WTO dispute resolution procedures. Because of considerable confusion in WTO dispute resolutions and other antidumping forums concerning the nature and role of accounting in product costing, a brief summary of the nature and role of accounting follows.

Accounting serves first to gather and record information in systematic ways, for example, transactional data in journals. In this respect company accounting largely sets the ambit of the possible in antidumping proceedings. Since proceedings are retrospective in terms of their analysis, it is very difficult for companies to rely on anything other than data already developed in providing information to the antidumping authorities. Second, financial accounting systems provide reports that allow outsiders to evaluate a company’s operations. A country’s Generally Accepted Accounting Principles (GAAP) guide the development of financial accounting practices, with emphasis on the accurate portrayal of a company’s financial condition and the expression of financial data on a comparable basis from one company to another, at least within an industry. Revenues and expenses are typically aggregated at an enterprise level, often for the firm as a whole. Third, accounting may provide information relevant to tax authorities, with requirements varying widely among jurisdictions. Fourth, accounting provides information useful to a company’s managers. This may include the outputs of the financial accounting system, but frequently additional managerial accounting is necessary for effective management. A major aspect of managerial accounting is that it often provides individual product costs. Management accounts typically share some touch points with financial accounting: financial accounts may provide managerial systems with control totals of costs and revenues to be used in more detailed managerial analysis; managerial accounts may provide financial accounting with individual product costs to value work-in-process and finished goods inventories. But in general management accounts are developed for internal usefulness, not external reporting. GAAP consistency relates to financial accounting, not to how a company chooses to develop numbers for its internal management purposes. (Garrison at al, (2006)).

Given this, what does the practice of managerial accounting have to say about the allocation of costs, and particularly joint costs, to individual products? As a rule, managerial accounting aims to associate costs with the revenues to which they give rise. This is consistent with the ADA’s goal of a reasonable association “with the production and sale of the product under consideration”, although the latter refers to the collective, allegedly dumped, product. However, management accounts serve the needs of management and so must balance this aim against the costs of creating more complex systems. This creates potential tensions between
the accuracy of competing approaches, their usefulness, and their difficulty in implementation and regular use. (Garrison et al (2006)).

When costs are separable by product, managerial accounting systems typically will trace costs to particular products and have those products bear the burden of those costs in management decisions. This may pertain to costs directly associated with each product only, or it may involve the allocation of common costs to products as well. While the details may be the matter of debate in any individual case, antidumping practice routinely accepts company costs traced to particular products and then requires that most remaining overhead and general expenses be allocated to particular products as well.

Concerning joint costs, a considerable portion of the research on optimal allocation approaches has appeared in accounting journals, as indicated by the references in the Appendix. The textbooks in the field have absorbed the research and typically identify three chief approaches to pure joint products that have no further processing. (See, e.g., Horngren et al (2012).) First, the joint costs can remain joint, not allocated to particular products at all. Second, the joint costs can be allocated to products based upon relative sales value. Third, the joint costs can be allocated to products based upon physical measures, such as weight. These approaches reflect the balance of accuracy and practicality characteristic of managerial accounting. Since joint costs by definition are joint, accounting guides instruct that individual product allocations of those costs should not be used for managerial decision-making, favoring the first method. However, as noted above, at times an allocation to products is necessary and will affect decision-making. When allocations are necessary, accounting theory favors the use of value as an allocator “... because generating revenues is the reason why a company incurs joint costs in the first place.” (Horngren et al 2012 at 586.) Finally, at times an allocation is necessary for reasons not associated with managerial decision-making, or the nature of the allocation has a small impact on the outcomes; in such cases methods of allocating joint costs over physical measures of outputs may be acceptable if such allocations are easier to implement and maintain and have little impact on decision-making.

Further processing costs introduce greater complexity but present little challenge to the basic accounting approaches. If available, sales values at the split-off point are preferred as joint cost allocators even if further processing also can take place, since these isolate the joint cost allocation problem from the question of whether to further process or to sell a particular joint product. Often the individual joint products are not sold at the split-off point but instead are further processed. Then the optimal method remains the use of the market value at the split-off point, but this is often approximated through a net realizable value approach, in which the further processing costs are subtracted from the individual product prices to reach a proxy for that value. Accounting sources recognize this as a second-best approach when allocation is
required but values for the joint products are not directly ascertainable. (See the discussion at Horngren et al (2012), Chapter 16.) In the Appendix, we demonstrate that the net realizable value method will reach the same conclusion regarding cost recovery as the first-best allocation method, based upon value-based allocation of all costs, for each individual product; see Appendix, Equations A.16 and A.17.

6. TREATMENT OF JOINT COSTS: ANTIDUMPING PRACTICE AND POLICY

Joint cost issues in antidumping have involved not only the national administrative agencies, but national judiciaries, NAFTA panels, and the WTO dispute settlement mechanism. These issues date back at least to the U.S. federal court decisions in IPSCO (United States Court of Appeals for the Federal Circuit (1992)) and have occurred nearly continuously since. Unfortunately, the actions have not led to a convergence on the treatment of such costs, but a continuing divergence of approaches that often smacks of protectionist opportunism by national authorities.

Administering authorities, particularly in the United States, have used value allocations at times even when company accounting applies a volumetric standard. In the landmark case on Softwood Lumber from Canada, the U.S. Department of Commerce applied value-based costs, but to a level more aggregated than that of the individual product, leading to the WTO appeal concerning the adjustment for physical differences in merchandise. Neither the U.S. nor any other authority has lain down rules or even consistent guidelines concerning the use of value versus volume allocations in cases; indeed, the U.S. adopted a volume-based methodology in Greenhouse Tomatoes from Canada at almost the same time that it adopted a value basis in lumber with similar facts (cases listed at United States Department of Commerce (2013)). Some authorities have embraced volume-based allocations when doing so conflicts with company accounting, thereby increasing dumping margins dramatically through the mechanism shown in Section 4. This has occurred in several poultry cases in which lower value cuts are exported, one of which is currently before a WTO Panel in China – Broiler Products from the United States (World Trade Organization (2013)) and another before a NAFTA Panel in Mexico – Leg Quarters from the United States (NAFTA Secretariat (2013)). Other examples abound, some of which are provided in Table 3; to the extent that there is a theme, it is that administering authorities have used volumetric allocations when relatively low-valued products are exported, and value-based allocations when relatively high-valued products are exported. Overall, present practice is united only in disunity, often displaying opposite policies in response to similar facts.
Table 3: Sample Antidumping Proceedings Involving the Issue of Cost Allocations to Joint Products

<table>
<thead>
<tr>
<th>Case Caption</th>
<th>Country</th>
<th>Allocation Basis</th>
<th>Additional Issues</th>
<th>Forum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broiler Parts from the United States</td>
<td>China</td>
<td>Value</td>
<td>Weight</td>
<td>1, 2</td>
</tr>
<tr>
<td>Chicken Drumsticks and Thighs from the United States</td>
<td>Mexico</td>
<td>Value</td>
<td>Weight</td>
<td>1, 3, 4</td>
</tr>
<tr>
<td>Softwood Lumber from Canada</td>
<td>United States</td>
<td>Volume</td>
<td>Value</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td>Magnesium Metal from Russia</td>
<td>United States</td>
<td>Unclear</td>
<td>Value</td>
<td>1, 4</td>
</tr>
<tr>
<td>Beef from the United States</td>
<td>Mexico</td>
<td>Value</td>
<td>Weight</td>
<td>1, 3, 4</td>
</tr>
<tr>
<td>Oil Country Tubular Goods from Canada</td>
<td>United States</td>
<td>Weight</td>
<td>Weight</td>
<td>1, 4</td>
</tr>
<tr>
<td>Barium Carbonate from China</td>
<td>European Union</td>
<td>Unclear</td>
<td>Weight</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes:
1 = National administrative antidumping authority; 2 = WTO Dispute Settlement process; 3 = NAFTA Panel; 4 = judicial process within the country imposing duties (e.g., Court of International Trade for the United States).
Sources: European Commission (2013); Mexico Ministro de Economía (2013); United States Department of Commerce (2013); NAFTA Secretariat (2013); World Trade Organization (2013).

In the remainder of this section we apply the principles of the preceding sections to the antidumping context, focusing on the core question of the choice of allocation methods. Section 7 concerns claims that the antidumping context introduces unique elements that attenuate the application of economic and accounting concepts to the allocation of joint costs.

The ADA Article 2.2.1.1 provision that the records used to calculate costs “reasonably reflect the costs associated with the production and sale of the product under consideration” may hint of tautology but in fact is substantive. While not explicit, the language allowed the continuation of the practice of using fully-absorbed costs in antidumping product costing.¹⁵ The language refers to the records that form the basis for the reported costs, and so imposes a

¹⁵ United States Congress, Statements of Administrative Action: , http://ia.ita.doc.gov/regs/uraa/saa-ad.html : “Again reflecting current U.S. practice and improving on the 1979 Code, Article 2.2 provides that national authorities should calculate costs on the basis of exporter’s and producer’s records, provided that such records are in accordance with generally accepted accounting principles in the exporting country and reasonably reflect the costs associated with producing and selling the merchandise.”
general consistency requirement between the costs as reported and the costs recognized in company aggregates. While possibly unintended, this allows the interpretation that records used to calculate individual product costs, and by extension the product costs themselves, be consistent with costs for the overall product under consideration or like product; this is equivalent to the additivity requirement of Section 4, implemented in the cost recovery tests of the Appendix. The language does not imply that particular cost allocation approaches must be condoned explicitly by GAAP, as recognized by a WTO Panel in United States – Softwood Lumber from Canada.  

Apart from the very thin guidance of Article 2.2.1.1, the ADA provides some indirect guidance in the matter of cost allocations. Article 2.2.1 provides that “sales of the like product ... at prices below per unit (fixed and variable) costs” may be disregarded only if (among other restrictions) they “do not provide for the recovery of all costs within a reasonable period of time”. Article 2.4 provides that “A fair comparison shall be made between the export price and the normal value”, suggesting that any cost differences between comparison products should be correctly calculated. In practice, the anti-dumping comparison involves a backward-looking comparison of average costs and net domestic unit prices to determine if sales are profitable, and a separate comparison of average costs and net export unit prices to determine if dumping exists when constructed value is used. Consequently, the difficult problems of the allocation of costs at the margin, do not arise in the anti-dumping comparison. We need ask only if the allocation methods are reasonable or unreasonable under the cost recovery criterion.

The economic and accounting principles analyzed above agree that it does not make sense to allocate the costs of the joint input or process to individual output products. The idea of antidumping – restoration of a level playing field – also is consistent with not separating these costs, since the implication is that firms should behave rationally. This leads to an obvious but never implemented approach: for the comparison of costs to revenues, which is described in Article 2.2.1 (the “cost test”), the comparison should be between revenues earned on the joint products, collectively, and the cost for the joint input or process.  

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16 “Thus, Article 2.2.1.1 does not in our view require that costs be calculated in accordance with GAAP nor that they reasonably reflect the costs associated with the production and sale of the product under consideration. Rather, it simply requires that costs be calculated on the basis of the exporter or producer’s records, in so far as those records are in accordance with GAAP and reasonably reflect the costs associated with the production and sale of the product under consideration.” WTO (2013): DS264 (2004), Report of the Panel, at 7.237.

17 Article 2.2.1 provides that “Sales of the like product ... at prices below per unit (fixed and variable) costs of production ... may be treated as not being in the ordinary course of trade ... “, language that appears to allow, although not require, a comparison of unit product costs to individual sales prices. But the same paragraph provides that below-cost sales can be eliminated only if they “are at prices which do not provide for the recovery of all costs within a reasonable period of time”. The methodology described in the text concerns the recovery of costs across joint products and lies squarely within the restrictions of Article 2.2.1 on the elimination of below-cost sales.
2.2.1 is phrased in terms of unit costs, the arithmetically equivalent comparison can be made by treating revenues and costs identically in converting them to per unit amounts: that is, total revenues for the jointly produced products and the associated joint cost should be divided by the same quantity. For joint products that collectively earned more revenue than the joint cost incurred, no sales of any of the products would be treated as below cost; for products that collectively earned lower revenues than the joint costs, further examination under the additional criteria of Article 2.2.1 would be necessary.

Actual antidumping practice has not accepted this alternative,\textsuperscript{18} but as indicated in Table 3 it has adopted allocations of joint costs to individual products based on their respective revenues, and allocations of joint costs — but not associated revenues — evenly over some physical measure of production, such as weight. As shown in Section 4, a value allocation has the benefit of replicating, at the individual product level, the cost-recovery decision at the joint product level. From an antidumping perspective, this has the great advantage of bringing the level playing field rationale to the level of the individual product cost allocation. The profit of each product forms the same proportion with respect to either cost or to revenues as does the profit on the joint product as a whole. Consequently the product-specific costs can serve as a valid proxy for the economic decisions facing the firm at the level of the joint product.

The alternative of allocating the joint costs evenly over some physical measure of production has no such benefit. By allocating only costs, and not revenues, evenly over products by physical units, the association of cost and revenue is broken and no longer reflects the economic decisions at the level of the joint product. If the individual products vary widely in value, there is simply no connection between the cost assigned to a product and the revenue earned from that product. The purpose of the antidumping comparisons is not realized, whether in the context of normal value and export price, or in the application of the cost test to domestic sales. In terms of cost recovery, the situation of Section 4 is highly likely, wherein sales of entire products will appear to be below cost due to the accidents of the allocation.

The conflicting results of value allocations versus physical measure allocations have led to extensive controversy and litigation in antidumping, in part because of the lack to date of a consistent economic rationale, and in part because of the confusion concerning the role of accounting in many antidumping decisions. The attraction of using a physical allocation measure in cases in which value allocations are appropriate is clear: it creates artificially high

\textsuperscript{18} The method has been proposed in at least one U.S. proceeding, Greenhouse Tomatoes from Canada. The Department of Commerce rejected the proposal on the legal grounds that it had the discretion to use product-specific costs; it did not explain why it was appropriate to do so. (United States Department of Commerce (2013): Final Issues and Decision Memorandum for the Investigation of Greenhouse Tomatoes From Canada, Feb. 22, 2002; Comment 5. \texttt{http://ia.ita.doc.gov/frn/summary/canada/02-4532-1.txt})
antidumping duty margins when the export mix contains relatively low-valued products. Consequently, without clear decisions from WTO dispute settlement procedures or national courts, the temptation to use an incorrect methodology will persist.

7. FURTHER ISSUES CONCERNING JOINT COSTS AND ANTIDUMPING

Beyond the central question of whether and when value allocations are appropriate, anti-dumping authorities have often claimed that the “anti-dumping context” requires adjustment of these principles in particular cases. Here I will consider three leading arguments for the claims of antidumping exceptionalism: potential circularity in using prices in the allocation of costs; whether all geographic markets should be used in establishing value for the allocation of costs; and the implications of price volatility on value allocations.

a. Potential circularity. The concern about circularity has taken two forms. The first is that if product costs are determined through an allocation of a joint cost to specific products based on value, those costs cannot then be compared to the values to determine cost recovery because doing so is circular. As analyzed in Section 4, this is incorrect; indeed, the value allocation is the only means to assure an appropriate comparison at the product level for cost recovery purposes. The second form is that value allocations open the door to manipulation; most often this is phrased in terms of lower prices in the export market leading to less cost assigned to the products involved. The argument fails. A value allocation, properly done, will find all joint products to be above or below cost; lowering revenue on one product jeopardizes overall cost recovery, but does not favor that product over the other joint products; all will have the same profit percentage.

19 Cases involving joint costs often include considerable discussion of the treatment of further processing costs, incurred after the split-off point, but this tends to be treated as a practical calculation issue. U.S. practice, at least, has been to subtract the further processing costs from selling price to reach a surrogate for the value of each product at the split-off point. In effect this assigns all profit to revenues at the joint product level prior to the cost allocation. While this has an arbitrary air, the Appendix shows that it is consistent with the first-best approach for cost recovery assessment. Also, antidumping comparisons often adjust selling prices for expenses, such as movement charges, without profit allocations, effectively bringing the price back to the factory gate for comparison to costs or other net-back prices. The deduction of manufacturing costs after the split-off point as a device for allowing a cost allocation is in the same spirit. Finally, accounting practice widely acknowledge this net realizable value approach as a suitable approximation in many cases. See Horngren et al (2012).

20 This argument occurs, for example, in the June 8, 2012 final determination in the Mexican investigation of Chicken Drumstick and Thighs from the United States: “... circularity is demonstrated (the market value determines the cost of the product) and that circularity becomes a problem when there is a special market situation...” (Paragraph 215)

21 Arguments on this point have made a false parallel to rate-setting exercises, in which the rate (price) permitted by a regulator based upon costs should not be used to allocate costs. In the case of all revenues arising from the joint costs being regulated, the rate-setting exercise should be at the level of overall costs and revenues,
b. **Markets for the value-based allocations.** The analysis of Sections 4 and 5 implicitly treated all geographic markets as contributing to the values used to allocate costs and, from the point of view of replicating a rational firm decision, there is no reason to amend this except perhaps on materiality grounds.\(^2\) However, antidumping proceedings have repeatedly witnessed the argument that since cost allocations primarily affect normal value, and the ADA reflects the historical preference for normal value being based on domestic market sales, value allocations of costs should be based on domestic market sales only. A variant of this argument is that value allocations should be based on a combination of domestic and third country sales, since the latter can also serve as a basis for normal value. In effect, this approach excludes the export sales suspected of being dumped from the value allocations; however, the rationale arises not from a concern of circularity, but from the nature and purpose of normal value as being a base case against which a firm’s export activity should be assessed.

The original concept of normal value is captured perfectly in its name: companies have a market in which they behave normally, without predatory actions, subject to forces of competition. Historically, antidumping law and practice have considered this to be the domestic market, leading to the primacy of domestic sales as the basis for normal value in the ADA. While economics provides little support for the idea that one market provides a “normal” mode of behavior against which actions in other markets can be assessed, this nonetheless is fundamental to antidumping law and practice. In this light, the use of just domestic sales as cost allocators has the attraction of treating the calculation of normal value as a unified piece of the overall antidumping calculation, particularly in the application of the cost recovery test to domestic sales. But the logic of doing so cannot be called economic, but rather institutional or legal. From an economic point of view, the association of costs and revenues should include all sales of joint products. From an accounting point of view, however, materiality and practicality may suggest using only domestic sales if doing so does not materially distort decision-making or if the costs of including export sales are too high.\(^3\)

---

\(^2\) A firm may often be in a position in which the effects of including additional markets in value allocations will have sufficiently small effect on product costs that it can be ignored. This could result if the cost allocation itself played little or no role in the firm’s decision-making, if values in additional markets tended to be similar to those in some smaller set of markets, or if the additional markets are small. Antidumping analysis routinely respects materiality as a criterion in cost allocations.

\(^3\) Companies that use value allocations for costs may often use domestic sales alone simply as a practical matter; record-keeping may provide faster access to domestic sales by product than to exports by product, and the practical differences may be small.
c. **Volatility of prices.** A surprisingly widespread argument is that volatile prices make value-based allocations of costs less appropriate for anti-dumping calculations. (See, for example, United States Department of Commerce (2013), *Issues and Decision Memorandum for the Final Results of the Antidumping Duty Administrative Review of Certain Softwood Lumber Products From Canada*, Dec. 12, 2005, Comment 10.) Anti-dumping calculations use historical costs during some time period, frequently a single year. From an economic perspective, joint costs for that period would be compared to the total revenues to which they gave rise to assess whether costs were recovered. If an allocation of costs to particular products is necessary, it should replicate at the individual product level the outcome at the joint product level, which as we have seen requires a value-based allocation. Price volatility does not affect this conclusion. Indeed, value allocations will allow costs to reflect the same volatility, reducing the chances that volatility alone will create dumping margins. Accounting texts sometimes point to price volatility as discouraging value allocations, but this is for the purely practical reason of the difficulty of incorporating rapidly moving prices into value allocations and using the resulting cost figures in decision-making. Antidumping comparisons, based on costs over a historical period, do not face the same difficulty.

8. **CONCLUSION**

The matter of cost allocations in anti-dumping creates a seemingly cacophonous set of argument and counter-argument, but economic analysis cuts through much of this. The first-best approach to joint cost allocation is not to do it: the joint costs should be compared to the sum of the revenues on the joint products, both for the cost test and in the use of constructed value as a basis for normal value. If the first-best approach is not applied, the preferred alternative is one that most closely matches the first-best, which is to allocate joint costs to individual products based on sales revenues.

The anti-dumping context does not weaken these principles; in fact, with its focus on historical costs and cost recovery, anti-dumping presents an apt application of these joint cost principles. The interesting question of which markets to use for allocations does arise from the nature of the dumping comparison, but does not in itself undercut the principles of the recovery of joint costs.

The cost allocation principles have relevance to issues that arise frequently in injury analyses. This can be direct, as in the case of joint cost allocations in the *Wheat Gluten* safeguards case noted in Section 3, or through attempts to draw product boundaries in determining the effects of imports. The principles also appear in the calculation of countervailing duties. In the CVD case concerning *Softwood Lumber*, for example, the U.S. allocated a total subsidy amount on timber cutting rights to sawmills based on volume of
timber, then to the products produced from the sawmills based on their relative value. (United States Department of Commerce (2013)) Perhaps coincidentally, each decision tended to increase the subsidy rate assigned to the subject product, lumber, relative to the alternative.

The analysis here develops the basic economic approach to a problem arising from product heterogeneity, relates it to accounting treatment of the same problem, and applies the analysis to antidumping practice. At one level, our intent has been to show that there is no need to view economic, accounting, and antidumping approaches to the problem as necessarily being in conflict; rather, there is an underlying unity. More broadly, we hope that this paper can be taken as an opening proposal to bring recognition to the issues created by the heterogeneity of the products involved in a typical trade dispute. The WTO agreements place restrictions on the use of protective measures by individual signatories for the mutual benefit of all. The silence of those agreements on the issues involving multiple products invites mischief, or genuine disagreements, on the part of individual signatories.
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APPENDIX: PROFIT MAXIMIZATION WITH JOINT PRODUCTS

**TABLE A.1**

*List of Symbols*

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>Quantity of the input</td>
</tr>
<tr>
<td>i</td>
<td>Index variable for outputs</td>
</tr>
<tr>
<td>n</td>
<td>Number of output products</td>
</tr>
<tr>
<td>J(x)</td>
<td>Joint cost of production for the n joint products</td>
</tr>
<tr>
<td>q_i</td>
<td>Quantity of each output i</td>
</tr>
<tr>
<td>R_i(q_i)</td>
<td>Revenues for each output i</td>
</tr>
<tr>
<td>J_i</td>
<td>Joint costs associated with each output i</td>
</tr>
<tr>
<td>ε_i</td>
<td>Physical conversion factor from output i to input x</td>
</tr>
<tr>
<td>ε_i</td>
<td>Vector of physical conversion factors for products other than i</td>
</tr>
<tr>
<td>π</td>
<td>Enterprise profit</td>
</tr>
<tr>
<td>C_i(q_i)</td>
<td>Further processing costs after the split-off point for output i</td>
</tr>
</tbody>
</table>

---

**a. Profit maximization without joint costs**

This base case of a single product is familiar from microeconomic principles (see, for example, Varian (2009)); we adapt it from optimal usage of inputs to optimal output quantities and provide the extension to multiple, independently produced products. Adopting the standard assumption that output q is a monotonically increasing function of input x, we can express the problem in terms of input quantity as the control variable:

**Optimal Scale, Single Output Product:**

\[
\max \pi(x) = R(x) - J(x) \quad (A.1)
\]

\[
\text{FOC: } R'(x) = J'(x)
\]

\[
\text{SOC: } R''(x) < J''(x)
\]

The first order condition indicates that marginal revenue equals marginal cost and the second order condition indicates that marginal profit is decreasing at the optimum. The optimal scale
could represent a minimal loss point rather than a maximum positive profit, so we also require that the firm recover costs:

**Cost Recovery, Single Output Product:**

\[ R(x) \geq J(x) \]  \hspace{1cm} (A.2)

The analysis of multiple products with separable production functions is a simple extension. Costs of different products are not related, so costs as well as revenues can be indexed by \( i \). The sum of the individual product profits equals total revenue less total costs:

\[ \sum_{i=1}^{n} \pi_i(q_i) = \sum_{i=1}^{n} (R_i(q_i) - J_i(q_i)) = \sum_{i=1}^{n} R_i(q_i) - \sum_{i=1}^{n} J_i(q_i) = \pi \]  \hspace{1cm} (A.3)

Since firm profits are simply the sum of individual product profits, there is no loss due to decentralization of decision-making to the product level:

**Optimal Scale, Multiple Independently Produced Products**

\[ \max (R_i(q_i) - J_i(q_i)) \text{ for all } i \]  \hspace{1cm} (A.4)

**Cost Recovery, Multiple Independently Produced Products**

\[ R_i(q_i) \geq J_i(q_i) \]  \hspace{1cm} (A.5)

Products that do not recover costs at optimal scale will not be produced.

b. **Profit maximization with unallocated joint costs**

With fixed proportions, the physical conversion factors \( \epsilon_i \) from output \( i \) to input \( x \) are constants, with the input related to the outputs through:

\[ \sum_{i=1}^{n} \epsilon_i q_i = x \]  \hspace{1cm} (A.6)

The physical conversions are incorporated in the maximization function through revenue \((R_i(q_i) = R(x/ \epsilon_i))\) with only the scale of the input \( x \) as a choice variable:

---

\[ ^{24} \] The scale problem may show cost recovery as an inequality constraint, in which case the Kuhn-Tucker conditions will yield the cost recovery condition from the first order conditions. Here I wish to keep cost recovery as a separate condition due to its importance in the antidumping context.
Optimal Scale, Fixed Proportions:

\[
\begin{align*}
\max \pi(x) &= \sum_{i=1}^{n} R_i(q_i) - J(x) \\
\text{FOC: } \sum_{i=1}^{n} R_i'(x) &= J'(x) \\
\text{SOC: } \sum_{i=1}^{n} R_i''(x) &< J''(x)
\end{align*}
\]  

(A.7)

The first order condition is that the marginal cost of the input equals the sum of the marginal revenues of the various products made from it (Figure A.1) and the second order condition is that marginal profit is decreasing at the optimum. Effectively, the fixed proportions problem is identical to the single product problem, with the firm needing only to sum revenues (total and marginal) across the products.\(^{25}\)

Cost Recovery, Fixed Proportions: Overall revenues must equal or exceed the joint costs:

\[
\sum_{i=1}^{n} R_i(q_i) \geq J(x)
\]  

(A.8)

There is no requirement that the individual product revenues all be non-negative; some products may have disposal costs. Given fixed proportions, the company cannot avoid low value outputs if they occur for technical reasons. Figure A.1 provides a three product example.

\(^{25}\) One can treat the fixed relationships of input to outputs as constraints in the maximization problem, with the resulting Lagrange multipliers corresponding to marginal revenues; see Weil (1968).
FIGURE A.1:
Equilibrium Conditions with Multiple Outputs from a Single Joint Input

Notes:
The input product x yields three outputs in fixed proportions. Output 1 is sold at a constant price, Output 2 at a price that decreases with quantity, and Output 3 at a constant negative price, indicating disposal costs. The total marginal revenue is the vertical sum of the three individual product marginal revenues. Optimal scale is where the marginal cost of the joint input equals the total marginal revenue of the outputs; as drawn, the second order condition is met.

With variable proportions, some tradeoff between outputs is possible. In the extreme case, full variable proportions, the firm would equate the marginal revenue product for each output to the marginal cost of the input, effectively treating the profit maximization of each product independently since the joint input would no longer need to be identified with multiple products. The solution becomes that of part (a), above. In the more interesting case of constrained variable proportions, some tradeoff between outputs is possible, but positive production must occur for more than one output product. A two product case is shown in Figure A.2.
FIGURE A.2

Optimal Interior and Corner Solutions under Variable Proportions and Constant Relative Output Prices

Notes:
The figure illustrates a range of production possibilities for two joint products with limited variable proportions. Shown are the limiting expansion paths. The lower bound, taken alone, reflects fixed proportions; the upper bound shows diminishing proportions of product 2 in the output mix as the input quantity increases. Three production possibility frontiers are shown, as well as price ratios, the latter assumed constant for ease of comparison. At the lowest level of production there is a corner solution, favoring as much production of Product 2 as possible, at the middle level there is an interior solution where the rate of product transformation equals the price ratio, and at the upper level there is a corner solution favoring as much Product 1 as possible. As illustrated, the equilibrium expansion path favors an increasing proportion of Product 1 in the output mix as the input quantity increases.

The existence of a solution for the enterprise planner is conceptually clear; simply break the problem into sequential problems: first determine the optimal product allocation for any given level of the input, then choose the optimal scale based on those outcomes. The following expression provides for the choice of optimal scale and product mix more compactly in a single maximization problem:

*Optimal Product Mix and Scale, Variable Proportions:*


\[
\max \pi(x; q_i) = \sum_{i=1}^{n} \frac{R_i(q_i)}{x} - J(x) \tag{A.9}
\]

subject to: \( \sum_{i=1}^{n} \varepsilon_i q_i = x \)

\( f(\varepsilon_{i\cdot} q_{i\cdot}) \geq \varepsilon_i q_i \geq g(\varepsilon_{i\cdot} q_{i\cdot}) \)

The maximization problem again implies that the sum of the marginal revenues should equal marginal cost. The first constraint is a consistency requirement for the conversion factors. The second set of constraints restricts production possibilities for each output product to lie within the feasible set.  

\[26 \text{ 27} \]

Cost Recovery, Variable Proportions: Overall revenues must equal or exceed the joint costs, that is, must satisfy Equation A.8, above; no modification is necessary for variable proportions.

c. Profit maximization with joint cost allocations

We need to determine whether any allocation of costs can allow the overall profit maximization outcome to be replicated by decisions at the individual product level. \[28 \] For fixed proportions, the maximization problem becomes:

\[
\max \pi(x) = \sum_{i=1}^{n} \frac{R_i(q_i)}{J_i(q_i)} \tag{A.11}
\]

subject to: \( J(x) = \sum_{i=1}^{n} J_i \)

The constraint is the additivity condition, that costs allocated to individual products must sum to total costs. This means that the cost allocated to one product affects the costs, and therefore the maximization problem, of other products, preventing the easy separability of part (a) above.

\[26 \text{ 27} \]

Manes and Cheng (1988) and Johansson (2007) provide extended developments of this approach with the restrictive assumptions that the upper and lower bounds are both linear and that the production possibilities within the feasible range also reflect a linear tradeoff. To our knowledge, the more general form has not been exploited, likely due to the difficulties of expressing closed form solutions. But progress in the economic theory of efficient allocation may require exploring this more general form. As Ray and Goldmanis (2012) note in the common cost context, “... the main feature of any efficient allocation is that it must reflect the firm’s underlying costs. While this point may seem obvious, the linear rules used in practice make allocations without regard to the shape of the firm’s cost function, and this keeps such rules from achieving efficiency.”

\[27 \]

The first order conditions, not shown, are those of Equation A.7 and also will include a family of Lagrange multipliers corresponding to the physical conversion constraints for each product.

\[28 \]

Using the language of Amerishi et al. (1989), such an allocation is economically sufficient with respect to the control variables.
**Optimal scale:** Since the centralized decision maximizes profits, the equilibrium vector of output quantities \( \mathbf{q}_i \) must be replicated in the decentralized decision. Consequently, the first order condition for each product, \( R'(q_i) = J'(q_i) \), requires that marginal cost equal the same marginal revenue that satisfied the overall problem. This is satisfied by allocating total marginal cost to particular products in proportion to their share of total marginal revenue:

\[
J'(q_i) = J'(x) \left[ \frac{R_i(q_i)}{\sum_{i=1}^{n} R_i(q_i)} \right] \to \sum_{i=1}^{n} R_i(q_i) = J(x) \text{ (since } R'(q_i) = J'(q_i))
\]

(A.12)

Thus a marginal revenue-based allocation at the margin allows decentralized decisions to replicate the scaling decision of the enterprise as a whole. No other allocation method can meet the requirement of replicating the optimal quantity vector \( \mathbf{q}_i \). Note that the overall additivity condition is not binding at any given level of \( J(x) \), but its marginal equivalent is. However, the practical applicability of an allocation based on marginal revenues, which may imply a different actual allocation at each level of sales, is likely to be limited at best and this result may be more interesting for what it excludes. For example, marginal allocations based on totals, such as revenues or physical measures, will not in general succeed in replicating the optimum.

**Cost recovery:** The cost recovery requirement can be decentralized using the ratio of product revenue to total revenue as the allocator for total costs:

\[
J_i(q_i) = J(x) \left[ \frac{R_i(q_i)}{\sum_{i=1}^{n} R_i(q_i)} \right] \\
R_i(q_i) \geq J_i(q_i) \text{ for all } i \to R_i(q_i) \geq J(x) \left[ \frac{R_i(q_i)}{\sum_{i=1}^{n} R_i(q_i)} \right] \\
\to \sum_{i=1}^{n} R_i(q_i) \geq J(x)
\]

(A.13)

No other allocation method would reliably return the correct decision on a decentralized basis. Thus the optimal scale decision and the cost recovery requirement lead to separate allocators, unsurprising given that the former concerns the margin and the latter the total cost.\(^{29}\)

If a product earns negative revenue, the decentralized decision encounters the obvious problem that the decision-rule at the level of that product will give the opposite signal to the joint products as a whole: if \( \sum_{i=1}^{n} R_i(q_i) \geq J(x) \), the absolute value of the allocated cost will be smaller than the absolute value of the revenue for that product, leading to a negative profit and a decentralized conclusion that the product should not be produced; the opposite would occur if \( \sum_{i=1}^{n} R_i(q_i) < J(x) \). This is easily addressed by first allocating the negative revenue over the

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\(^{29}\) If production is homothetic and marginal revenues are constant, the two methods obviously coincide. This may be a common circumstance in the case of joint products, since often the input (a log, a chicken, etc.) is variable and is not subject to obvious increasing or decreasing returns to scale.
products with positive revenues in proportion to those positive revenues. Then no joint costs are allocated to that product and the (adjusted) revenues for the other products are used as allocators.

d. Joint cost allocations and further processing

The possibility of further processing affects adds an additional set of output products and an additional control variable, the quantity of each joint product that should optimally be further processed. Conceptually, however, the additional production possibilities simply broaden the compass of equation A.12; the potential complication arises from product-specific further processing costs. The solution requires that the revenues and costs of joint and further processed products be compared both at the margin and in total. In this formulation, the maximization problem for the joint product as a whole is equivalent to that of section (b), but includes further processing costs if they are incurred. Allocations based on these values then follow the results of section (c), with the marginal costs allocated based on marginal revenues and total costs allocated based on total revenues under each scenario. The notational complexities for expressing the decision at the margin are considerable and our primary concern for antidumping purposes is cost recovery, so we have focused on the latter alone in the following.

The cost recovery test requires that the optimal choices of scale, products, and further processing result in a profit: 30

\[ \sum_{i=1}^{n} R_i(q_i) - J(x) - \sum_{i=1}^{n} C_i(q_i) \geq 0 \]  

(A.14)

If a cost allocation is desired, we first associate revenues with costs on a proportional basis, then remove further processing costs to assure additivity: 31

\[ J_i(x) = [J(x) + \sum_{i=1}^{n} C_i(q_i)] [R_i(q_i)/\sum_{i=1}^{n} R_i(q_i)] - C_i(q_i) \]  

(A.15)

We confirm additivity across the products, noting that \( \sum_{i=1}^{n} [R_i(q_i)/\sum_{i=1}^{n} R_i(q_i)] = 1: \)

\[ \sum_{i=1}^{n} J(x) = [J(x) + \sum_{i=1}^{n} C_i(q_i)] - \sum_{i=1}^{n} C_i(q_i) = J(x) \]  

(A.16)

The expressions may seem counterintuitive in that joint costs are allocated with respect to total revenues rather than just those earned on the joint products. But this assures that the

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30 For notational convenience, we leave the total number of products at \( n \), in effect assuming that each joint product leads to no more than one further processed product. The analysis applies equally, although with greater notational complexity, when a joint product can be processed into multiple different final products.

31 As in the preceding section, any negative revenues should first be reallocated proportionately over products with positive revenues, with the negative revenue products receiving no allocated costs.
decision at the individual product level will replicate that at the enterprise level. The allocation is identical to one in which profits are evenly allocated over costs, then the further manufacturing costs and associated profits are deducted from revenues, with the resulting net revenues used as allocators for the joint costs.

Accounting texts often suggest a net realizable value approach as a more practical alternative. In this case, the further processing costs are subtracted from overall revenues, with the resulting revenues per product serving as an allocation basis for the joint costs:

\[
J_i(x) = [J_i(q)] [R_i(q) - C_i(q)]/ \sum_{i=1}^{n}[R_i(q) - C_i(q)]
\]  

(A.17)

This expression differs from A.15 in that the further processing costs attract no profit. Compared to equation A.15, this creates a greater allocation of costs to those joint products with relatively large further processing costs. However, the sign for any individual product cannot flip from that in A.15. The total profitability of the products remains the same, so a cost allocation that respects additivity, based upon net realizable values, must be consistent in sign to the more precise allocation of equation A.15.

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\[32\] Biddle and Steinberg (1984) appear to reference this result, although not providing the proof or sources for it: "While the net realizable value method insures that joint products will all have positive (or all negative) margins, the margins may not be equal. ... Equal margins can be obtained by using another version which allocates joint production costs on the basis of net realizable values less 'normal' profit margins. This method implicitly assumes that further processing costs are part of the joint production costs." (Footnote omitted.)