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Valuing the Outputs of Multifunctional Agriculture

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1. Getting a Sense of the Valuation Task

The intuition is fast gaining ground that agriculture in its considerable variety produces a broad range of valuable outputs in addition to the commodities that generate most of its revenue. Governments in the relatively well-off countries are encouraging these non-commodity outputs: examples include countryside stewardship programs in Europe, landcare programs in Australia, and conservation provisions of recent American farm bills. Governments encourage multifunctional outputs through education and persuasion, and often by subsidizing favored agricultural practices and technologies. My assigned topic today – valuing the outputs of multifunctional agriculture – suggests that a rather dramatic step is starting to receive consideration in some agricultural policy circles: public willingness to pay for the non-commodity outputs of agriculture might be assessed systematically and brought to bear in some systematic way on the incentives facing agriculture producers.

We might be tempted to think of valuing the outputs of multifunctional agriculture as getting a crude sense of the value of agriculture's non-commodity outputs in totality, perhaps on a national or even continental scale. The result might be a single number – so many bazillion Euros for all of agriculture in a nation or continent, or a multiplier to be applied to the value of agriculture's commodity outputs. Such single numbers might be useful to encourage better appreciation of agriculture's contribution to welfare, to shoreup its position politically, and perhaps to justify some income transfers to agriculture. But, suppose that such income transfers became standard practice. They would be incorporated rapidly into the incentives that drive producer behavior. If these payments reflect evaluations that are grossly inaccurate and imprecise, resource allocation and welfare will be impacted for the worse.

In what follows, I will argue first that the costs of getting the valuation wrong are inherently greater in the case of multifunctional agriculture than in many of the cases customarily addressed by environmental economists. Over-estimating the value of agriculture's multifunctional outputs would transfer a little too much money from taxpayers to farmers and induce farmers to produce a little too much multifunctional output – the standard sorts of outcomes from overestimating the value of public goods -- but it would also (under a fairly robust set of conditions) distort commodity markets, reduce commodity imports or increase exports as the case may be, and perhaps depress world commodity prices to some degree. Second, I will argue that getting the valuation of multifunctional outputs right is a much bigger task than is typically undertaken by environmental economists. The right *green prices* (a term I use as shorthand for "the prices of agriculture's multifunctional outputs") are particular and contextual to an extent that is difficult to comprehend, and must be estimated on a national or continental scale, but implemented farm-by-farm. With all due respect to the very considerable efforts and successes of environmental valuation specialists over three decades (Willis *et al*., 1999), I must observe that environmental economists have seldom attempted such a demanding task.

These observations serve merely to set the stage by assessing the valuation challenge: the costs of getting it wrong may be extensive, and the challenge of getting it right is daunting, both to a greater degree than environmental economists typically confront. With the challenge thus defined I will proceed to depict in broad strokes the sorts of multifunctional outputs that we might be called upon to value, and to review briefly the available evaluation methods. Then, I will address some particular challenges inherent in valuing the outputs of multifunctional agriculture, suggest some strategies for overcoming those challenges, and finish with a few comments about the prospects for meeting these challenges.

The cost of getting the green prices wrong is high, and would impact commodity markets and international trade as well as domestic welfare. How might green prices impact commodity markets and prices? To keep things simple, imagine that agriculture produces just two outputs, a commodity c (cheese) and a public good w (wildflowers), all factors and outputs are homogeneous, and production technology is homogeneous. I shall examine two extremes of joint production technology under closed and open economy conditions; to keep things simple, again, the open economy models adopt the small country assumption.

Case 1. Production technology is strictly separable in the joint products (so that the joint products are independent, i.e., changes in p_i do not affect j). If the economy is closed to trade, the markets in cheese and wildflowers will clear separately (Figure 1a): (p_c, c) and (p_w, w) are set independently, and shifts in demand for w do not affect (p_c, c). If the economy is open to trade, (p_c, c) and (p_w, w) are set independently (Figure 1b). Shifts in demand for w do not affect (p_c, c). The commodity market accommodates imports without disturbing (p_w, w). The diagrams assume the country is a commodity importer in the zero-green-payments baseline. However, an analogous set of results could be derived for green payments in commodity-exporter countries – whatever tends to increase domestic production reduces imports or increases exports and, regardless of which it is, tends (if anything) to decrease world prices.

With strictly separable production, optimal green payments optimize domestic welfare and production of green things without influencing domestic or international commodity markets.

Case 2. The joint products are produced in strictly fixed proportions. If the economy is closed to trade, (p_c, c), (p_w, w), and welfare can be optimized by paying p_c for cheese and p_w for wildflowers, or p_{c+w} (= $p_c + p_w$) for either cheese or wildflowers, it does not matter which (Figure 1c). If the economy is open to trade, and D_w is ignored as would be the case in the zero-green-payments baseline, equilibrium in the commodity market is at (p^I_c, c ✍$_{dom,}$ c), while wildflowers are undersupplied at w ✍ (Figure 1d)[1]. Honoring D_w, the price for the cheese-wildflowers bundle becomes $p_c{}^I{}_{+w} = p_c{}^I + p_w$ because p_c is upper-bounded by the price of imported cheese and the demand for the bundle (given that all demands for cheese can be satisfied at $p_c{}^I$) is upper-bounded at D^I_{c+w} . Equilibrium, in general, departs from the closed economy optimum. Imports may be positive, depending on the level of D_w and, given that imports do not deliver wildflowers, equilibrium w is reduced to w^I if $c^I > 0$. In equilibrium, the Kaldor-Hicks welfare gain from cheaper imported commodities offsets the welfare loss from fewer wildflowers. The reader can verify that, should D_w (and hence D^I_{c+w} and p_w) be great enough, it would drive cheese imports to zero, although the commodity price would remain upper-bounded at p^l_c.

With fixed-proportions production and the economy open to commodity imports, green payments influence domestic production of commodities. With zero green payments, imports – by replacing domestic commodity production -- may devastate green production, reducing domestic welfare. Optimal green payments, accurately reflecting demand for green things, optimize domestic welfare but may serve to reduce or exclude commodity imports. Excessive green payments reduce domestic welfare while further impeding market access for imports, and they would tend to depress world prices of commodities in the case (not illustrated in Figures1b and d) of a country large enough to impact world prices.

Joint production technologies in multifunctional agriculture will seldom be strictly separable or strictly fixed-proportions, and several authors have elaborated the possibilities: fixed-proportions, complementarities, independence, and competitive relationships among outputs (Blandford and Boisvert, 2002; Gatto and Merlo, 1999; Romstad *et al.*, 2000). Despite the broad range of possibilities, the following generalizations are plausible.

2. *For many green products, production conditions are likely to involve some degree of complementarity with commodity production*, which implies that green payments are likely to increase domestic commodity production and reduce commodity imports (or increase exports).

3. *Green products that reduce pollution from farming are likely to be competitive with commodity production*, which implies that green payments to reduce pollution are likely to reduce domestic commodity production and increase commodity imports (or reduce exports).

Optimal green prices generate domestic welfare optima, but the character of these optima depend on underlying conditions (here I have considered jointness and independence in production, and whether the economy is open or closed to trade in commodities). Under fairly robust conditions, green payments (in general, including optimal green payments) will affect domestic commodity production, often but not always reducing imports and increasing exports. These implications for trade will bring increased pressure for detail and precision in the virtual prices that support green payments. The more precisely targeted are green payments -- making relatively fine distinctions reflecting the economic value of green products -- the easier it is to explain and justify them in standard efficiency and welfare terms. The blunter the green pricing instrument – in the extreme, all farmers would receive identical green payments per hectare or per unit of commodity production -- the more the whole enterprise looks like (and probably is) a crude attempt to subsidize domestic farming regardless of the impacts on international trade.

This presents a clear challenge to the valuation enterprise. Imagine nonmarket valuation specialists had overestimated the value of damage from the *Exxon Valdez* oil spill. Had the overestimate survived political and legal scrutiny, the harm done would have been relatively confined: too much money would have been spent on restoration, and many people would each have suffered rather modest diminutions in their retirement expectations to the extent that Exxon stock was included in their retirement plans. In the case of overestimating the value of multifunctional agriculture, too much green production would be forthcoming, and taxpayers would see their wealth diminished a little – impacts analogous to those in the *Exxon Valdez* hypothetical example – but, in addition, commodity markets would be impacted with effects on imports, exports, and perhaps world prices. The burden to get the values right in the case of multifunctional agriculture is if anything greater than valuation specialists usually encounter.

The right green prices are contextual, particular, and richly detailed. In the real world, the land factor is heterogeneous and producers differ in their costs of producing both commodities and green things. Location matters to demand because transportation costs loom larger for some commodities than others, and demand for green things depends on the size of the population affected. The virtual price of wildflowers is now p_{wj}, where j identifies the particular circumstances relevant to that virtual price, which include at least the following: the quality of wildflowers, which is likely to be multidimensional (profusion, variety, prevalence of preferred species, longevity, etc.); location (visibility from residential areas, major transportation routes, tourist attractions, even highway rest stops, would increase demand); the size of the population that lives in the viewshed, visits it, or travels through it; and the availability at each location of complements and substitutes for wildflowers in generating human utility. It follows that j is a vector of contextual variables.

The green products of multifunctional agriculture are not limited to wildflowers. In the previous section, I defined cheese as a homogeneous commodity produced on farms, which was a bit of a stretch: in the real world, cheese spans the range from generic commodities produced in industrial plants to highly specialized artisanal cheeses produced on farms according to local tradition. While the market distinguishes among these cheeses and prices them differentially, the multifunctionality idea takes seriously the possibility that there are unpriced public benefits associated with traditional on-farm cheese production.

Agriculture produces multiple commodities and multiple green things. One list (Romstad *et al*., 2000) of the multifunctional outputs of agriculture includes biodiversity, cultural heritage, openness, borders/mosaics, active landscape, recreation access, food security, food safety, food quality, rural settlement, scientific/educational value, and negative external effects[2]. It follows that *w* is not a single heterogeneous commodity, but a vector of multifunctional outputs of agriculture.

Note that all of the products on the Romstad list (or any other) are themselves multidimensional, just like wildflowers. It follows that p_{wj} is a very complicated vector of function-specific and context-specific virtual prices paid to farmers to ensure that society enjoys an optimal supply of green things from farming. Optimality involves variety, quantity, quality, location, and availability of substitutes and complements. The valuation task is demanding and challenging, again to an extent greater than the valuation community customarily encounters.

4. Valuation Methods – Concepts, Techniques, Advantages And Limitations

Economic valuation attempts to provide an empirical account of the value to people of the services and amenities produced by multifunctional agriculture. We ask a lot of these value accounts. They should serve simultaneously as a utilitarian account of the contribution of multifunctional agriculture to human welfare, because a plausible case that policy should respond to these values requires at least that much (Randall, 1999), and as a fount of efficient virtual prices to direct resource allocation.

Welfare change measurement. The foundation of economic valuation is welfare change measurement: the value of some proposed action is the money-metric welfare change it will generate. The conceptually valid measures of welfare change are willingness to pay (WTP) for benefits, and willingness to accept (WTA) for costs. WTP is the amount of money the individual would pay willingly to get a desired good, service, or state of the world, rather than go without. WTA is the amount of money that would induce the individual willingly to give up the good, service, or state of the world. These welfare measures are readily defined in market terms — WTP is buyer's best offer, and WTA is seller's reservation price — but by no means are restricted to commodity markets. Some people are willing to pay serious money for improvements in the quality of life. Some willingly would accept a lower level of amenities if compensated with real money: some people would actually move to a less attractive location if promised a large enough pay raise.

In general, WTA is equal to or greater than WTP in absolute value. For small changes in the quantity of efficiently allocated and priced goods, WTP and WTA and market price tend to converge. For all-or-none changes in highly-valued things, WTA and WTP may diverge dramatically (Randall and Stoll, 1980; Hanemann, 1991). These values – individual WTP and WTA in total or at the margin for services and amenities, and individual demand for commodities -- are functions of baseline and incremental quantity, availability of substitutes and complements, and various attributes of the demander. Aggregating these individual values to the affected population requires unweighted summation of individual WTP, WTA, or demand, as the case may be[3].

WTP (or WTA) for an increment (decrement) in some natural resource or amenity captures the *total economic value* of the prospective change, which is the sum of *use value* and *passive use value* and, as such, offers a complete account of economic value[4]. *Use value* is generated when a person uses the environmental service actively, typically by consuming it directly or combining it with other goods and services and the person's own time to "produce" an activity that generates utility. Recreation experiences, for example, are "produced" by combining on-site amenities with travel services, recreation equipment and the participant's time. Use value includes the expected value of future use. If uncertainty attends future availability of the amenity or future demand for it, and potential users are risk-averse, *use value under uncertainty* may include *option value* and *quasi-option value*. Use value is likely to be reflected (at least, in part) in behavioral evidence such as purchases, visits, and so on. *Passive use value* captures the intuition that people may enjoy genuine satisfaction from "just knowing" (i.e., enjoying the assurance) that a particular state of the world (say, a cultural landscape) is being maintained in good condition. There is no general expectation that passive use values involve overt activities, or leave behavioral traces. However, contributions to voluntary organizations providing preservation, and political support for pro-preservation policies are consistent with passive use value.

Methods of Valuation

Valuation requires evidence of WTP and WTA, and such evidence may be generated by direct and indirect observations from existing markets or from surveys and/or experiments designed by the researcher.

Direct and indirect evidence from existing markets. While it is hard to imagine a market for multifunctional agriculture in the large, various components thereof are marketed routinely. Consider a diverse farming landscape. Agricultural commodities, and perhaps timber or firewood, may be produced and sold. The landscape may provide catchment for water that is valued by downstream farmers and urban residents. Tourists and nature-lovers may devote real resources (money and time) to visiting the landscape. People may buy homes nearby, so as to have access to the amenities. The productivity and value of these various activities depends on the way the landscape is managed, so management decisions will generate costs and benefits that are reflected, to various degrees, directly or indirectly in markets.

***Market demands and prices**.* For small quantities of commodities relative to the size of the total market, assuming the market itself is competitive and undistorted by policy, market prices multiplied by quantity changes provide the measure of gross economic value. Where relatively larger quantities are involved, the effect of quantity changes on market price has to be considered. Gross value is then defined as the consumers' surplus, i.e., the area under the demand curve and between the baseline and alternative quantities of the commodity.

Where it is hard to observe directly market demands for agriculture's contribution to (say) water supply and quality, the analyst may look to market evidence concerning substitutes. For example, the *avoidance cost method* might value improved water quality by observing the household water filtration costs avoided; and the *replacement cost method* might value increased water catchment by calculating the cost of additional reservoir capacity that would serve the same purpose. In both cases, these methods provide an upper-bound value for the particular services they address: the services cannot be valued at more than the cost of avoiding the need, or replacing the service with a perfect substitute; but they could be valued lower than that, in the event that effective demand would not clear the market for these services at these prices.

Travel cost methods. Recreationists spending their money and time to visit the forest leave a trail of indirect evidence about their WTP for the services and amenities it provides, and travel cost methods attempt to tease out this WTP. Assuming *weak complementarity* (Bradford and Hildebrandt, 1977) between on-site quality of amenities and goods and services used in traveling to the site (so that if going there was too expensive, the individual would be indifferent to changes in site quality), the value of an increment or decrement in site quality is measured as the integral between demands for visits at the baseline and alternative levels of site quality. An important caveat is essential: these demands are based not on observed prices of visits but on inferred costs of visiting. A large literature attests to the difficulty that researchers have experienced in estimating the cost of travel time (Bockstael, 1995), but this is symptomatic of a general difficulty: it is inherently difficult for the researcher to observe the cost of a visit, i.e., the value of opportunities foregone in order to make the visit (Randall, 1994).

The random utility model (RUM) has become the travel cost model of choice (Bockstael, 1995; McFadden, 2002), because its systematic treatment of substitute sites allows it to characterize site quality more completely. RUM models are therefore more useful than basic travel cost models for valuing changes in environmental amenity levels. Their disadvantage arises from their substantial information needs, which in practice lead often to the use of very large data sets and simplifying analytical assumptions that impose rigidities so that the results are to some degree influenced by analytical choices of the researcher.

Hedonic price analysis. Imagine a heterogeneous good such as house, or automobile. It is a reasonable hypothesis that the price of a particular house or car reflects its particular characteristics. If a statistical analysis succeeds in explaining the price of houses as a function of their characteristics, and one of those characteristics is the level of an environmental amenity, then the marginal impact of changes in the amenity level on house prices should provide evidence of amenity values. This is the intuition behind hedonic price analysis. A hedonic price function, relating house prices to characteristics (typically, three kinds of characteristics: on-site characteristics such as the number of bedrooms, neighborhood characteristics such as school quality, and environmental amenities such as access to an attractive cultural landscape), is estimated. The first derivative of the hedonic price function with respect to the environmental characteristic of interest is its hedonic price (or marginal implicit price), which measures the marginal value of the amenity.

The literature suggests that hedonic price analysis has succeeded, in a fairly wide range of circumstances, in generating plausible estimates of marginal hedonic prices for various housing characteristics including environmental amenities. For valuing nonmarginal changes in amenity levels, however, it is necessary to estimate hedonic demands (i.e., demands for amenities). There have been many attempts to find conceptually-valid methods of identifying hedonic demands (e.g., Bartik, 1987; Epple, 1987), but no method has yet proven generally acceptable.

Hedonic price analysis currently is enjoying a burst of new energy, as advances in spatial econometrics have spawned explicitly spatial, "general equilibrium" hedonic analyses that have potential application to multifunctional agriculture (Epple and Seig, 1999, Seig *et al.*, 2001).

Evidence from surveys and experiments. If we design and ask the questions with enough care, perhaps people can provide reliable evidence of amenity values by telling us their WTP or WTA directly; or by telling us what they would do (e.g., buy/not buy, vote yes/no, or choose this alternative rather than that) given well-specified choice situations that we construct for them, in order to generate data that we can analyze to infer their WTP or WTA. This is the intuition behind contingent valuation and contingent choice experiments, which sometimes are called stated preference (SP) methods. The great advantage is that the researcher controls the context of choice, which opens up the possibility of estimating total economic value, passive use value, and various relatively inaccessible use values. A further advantage is that information can be obtained to value amenity levels beyond the existing range; if a prospect can be described by the researcher and comprehended by the respondent, it can be valued. The potential disadvantages lie in the self-reported nature of the data: some people might seek to answer strategically, some might answer carelessly, and some might struggle mightily (but hopelessly in the end) to provide valid responses to questions that just cannot be answered meaningfully. Economists, weaned on the admonition to ✌watch what people do, not what they say✍, approach these methods with a well-developed skepticism; yet results, while mixed, have been encouraging enough to stimulate a proliferation of applications.

To address the SP methods, I employ the standard categories of contingent valuation (in which responses to one or just a few choice questions provide the basic data for valuation) and contingent choice experiments (where value is inferred from responses to a, sometimes lengthy, sequence of pairwise choices). Nevertheless, the basic project underlying these methods is to learn about value from people◘s self-reports; and as development and testing of these methods proceeds apace, we can expect new approaches to emerge and existing categorizations to become obsolete.

Contingent valuation. The essential elements of a contingent valuation (CV) exercise are a description of the default and alternative situations (respectively, what you get if the proposal fails, and if it passes) and the institutional environment, the valuation question, and the policy decision rule (how does the answer to the valuation question affect whether the proposal passes or fails?). The valuation question may take various forms, which has implications for the kind of analyses required for estimating WTP or WTA (e.g., Hanemann, 1984), and for the incentives for truthful response (Hoehn and Randall, 1987).

There is already an extensive literature on contingent valuation applications, and attempts to validate CV include tests for internal consistency and tests of convergent validity with value estimates obtained with different methods. While encouraging results have been obtained (e.g., Carson *et al.*, 1996; Smith and Osborne, 1996), critics have raised enough doubts (e.g., Hausman, 1993) that CV remains a controversial, if widely applied, method.

Contingent choice experiments. In contingent choice experiments, data generated by a sequence of pairwise choices are analyzed with RUM models to generate value estimates (Adamowicz, 1998). As Adamowicz, *et al.*, (1994) demonstrate, contingent and actual choice data can be combined, to extend the range of data points and to test for consistency between the two kinds of data. These methods, too, have disadvantages: a lengthy sequence of pairwise choices may tax respondent patience, and the RUM analytical framework imposes rigidities on the analysis.

Contingent choice experiments are a fairly recent development, so the evidence concerning their performance is rather thin. Initial applications have emphasized site-specific amenity use values, but there is no inherent reason why they could not be used to estimate passive use (Adamowicz, 1998) and total values.

Experimental methods are not limited to stated preference approaches. Real money experiments have long been used to test hypotheses about people's behavioral response to incentives of various kinds, and offer the prospect of enriching our understanding of contingent as well as real-money responses.

A perspective on nonmarket valuation methods. Valuation data vary along two dimensions of quality: consistency with the conceptual framework of welfare change measurement, and reliability of the data itself. For example, data generated by market transactions are convincing in at least one respect ☝ paying real money is the sincerest expression of WTP; accepting a payment and relinquishing the amenity is the sincerest expression of WTA ☝ but may, for a variety of reasons, fail to measure the correct value concept: price typically indicates marginal value but the proposal may involve nonmarginal changes, market distortions of various kinds may distort prices, markets may be incomplete or otherwise imperfect, or the environmental service involved may be nonmarketed. Data generated in surveys and/or experiments often can be addressed to exactly the right value measure (because the researcher controls the valuation context), but doubts may be raised as to whether responses to survey and/or experimental situations are reliable predictors of actual behavior. The valuation researcher is often faced with one or another form of this dilemma: ✌harder✍ data may depart from the ideal, while conceptually-valid measures may be ✌softer✍. In some cases where ✌hard✍ data departs from the ideal value concepts, economists have developed ingenious methods of inferring the ideal values; however, there is always the risk that in so doing they may be forced sometimes to substitute assumptions for evidence and structure for information, so that the resulting value estimates are to some degree artifacts of the methods used and research decisions made. Finally, for measuring some kinds of use values, passive use values in general, and total economic value, observations from existing markets are entirely inadequate, so that recourse to survey and/or experimental techniques is essential.

Regarding particular empirical methods, *contingent valuation* is poised, I believe, for major advances arising from information and communications technologies that will facilitate the melding of quantitative and qualitative methods, surveys and experiments, and modes of administration. *Contingent choice experiments* have enjoyed a recent boom, especially in economic assessment of natural resources damages. Yet, there are unresolved difficulties of two kinds: the challenges in communicating the nature of choice objects, and the limits of RUM modeling. Recent developments include *combining contingent valuation and contingent choice experiments* (Adamowicz, 1998).

Travel cost methods have a long-familiar upside – visitation data are generated by actual choice behavior. The down-sides are long-familiar, too: difficulties in observing the opportunity cost (i.e., the "price") of travel, and the limits of RUM modeling. *Combining stated and revealed preference methods* -- e.g., combining CV and travel cost methods (Cameron, 1992) -- permits convergent validity tests and extension of traditional TC models beyond the restricted realm of extant prices, quantities, and quality levels. *Hedonic price analysis* is used widely despite unresolved problems in deriving valid hedonic welfare measures, but for many purposes marginal characteristic valuations are useful. Recent developments in explicitly spatial, "general equilibrium" hedonic analyses are promising.

SP methods and "the requirements of economic theory". Whereas revealed preference methods have limited applicability to passive use values, total economic value, and certain kinds of use value, stated preference methods have the potential to estimate total economic value and all of its components. However, SP data exhibit persistent deviations from "the requirements of theory", a fact that has long energized critics and worried practitioners. Evidence is accumulating that data generated by “real money” experiments exhibit quirks that are similar in direction, if not always in degree (Camerer and Hogarth,1999; Horowitz and McConnell, forthcoming; McFadden, 1999). We are learning, slowly, about human behavior rather than (merely) exposing problems with SP methods. Perhaps economists need reminding that responding to a survey and participating in an experiment are behaviors.

The “deviations from the requirements of theory” charge has focused *inter alia* on the inconsistent part-whole relationships, “embedding” effects, etc., that have disturbed many commentators regarding CV: for multi-component prospects, the sum of component values estimated independently typically exceeds the value of the total package, and the independently-estimated values of components tends to be higher, the earlier they are listed in the valuation sequence. This phenomenon is consistent with economic theory (Hoehn and Randall,1989) and has been demonstrated in market demand systems (Randall and Hoehn, 1996), but some commentators believe that CV exacerbates it. Evidence from real money experiments and the real world itself offers some insights:

5. There is an emerging folk theorem that helps explain what is going on: people, especially those who are relatively inexperienced in the markets involved, tend to pay too much for small things and too little for big things. We observe this in CV but also in real-money trading experiments (List and Shogren, 1999).
6. The “warm glow” argument – that CV respondents announce “too high” WTP for relatively modest public goods because so doing makes them feel good – has its real world counterpart: real world public goods markets do not always clear. We are familiar with the underprovision case in the real world, and with claims that

contingent public goods markets may be susceptible to overprovision. But the real world generates overprovision examples, too[5].

Toward more robust empirical generalizations. The growing research program that seeks to validate and extend the findings of revealed preference studies, stated preference studies, and real-money experiments in at least two ways -- formal tests of convergent validity, and combining data from several sources in a single model – offers the prospect of more robust valuations, extended to a broader range of amenity quantity and quality levels.

The urge to generalize empirical findings has motivated *meta-analysis* (e.g., Smith and Osborne, 1996), which seeks to draw empirical generalizations from a set of particular studies, and *benefits transfer*, BT, (Bergstrom and de Civita, 1999, Smith *et al.*, 2001, Van den Bergh and Button, 1999), which seeks to control valuation research costs by applying the findings of particular local valuation studies to a broader set of sites. These methods, too, have their limits: the economists' craving for methodical novelty has limited our ability to find data sets of sufficient commonality for robust meta-analysis, while the empirical tests of BT models have not yet vindicated the decision-makers' enthusiasm for the savings in research costs that BT promises. There is a pressing and largely unsatisfied need for systematizing our empirical knowledge about the value of environmental amenities –one can imagine a regularly updated "environmental price index" that tracks how virtual prices for a bundle of amenities change over time.

7. A Valuation Strategy for Multifunctional Agriculture

In valuing the outputs of multifunctional agriculture, we are dealing mostly with public goods and, typically, with local public goods. To get a sense of the value of something local and particular (e.g., preserving several square kilometers of classic pastoral landscape, whether it be Norman bocage, Luneberg heath, or Swedish savannah) is fairly easy[6]; to get a sense of the value of agriculture's contribution to landscape aesthetics on a continental scale is harder; to get a valuation scheme that does both of the above in consistent fashion is "frontier" stuff – but, I shall argue, it is not impossible to imagine ways of doing it decently well.

A valid valuation scheme for complex policies is theoretically demanding (Hoehn and Randall,1989) and, in general, a valid total valuation cannot be obtained by independent piecewise valuation, i.e., adding-up the component values, each estimated independently[7].

A valuation structure is needed that avoids the independent piecewise valuation problem and reflects the aggregate willingness of demanders to pay[8]. Here, I suggest two strategies that might serve to generate decently good estimates of the value of outputs for multifunctional agriculture that are consistent as we move from single to multiple components of multifunctionality, and from local to continental spatial scales.

1. This strategy begins with a contingent valuation estimate of holistic WTP for the multi-component green outputs of agriculture on a continental scale. It is likely that the resulting aggregate WTP would be an under-estimate: first, being a holistic valuation, it avoids the over-estimation problems of independent piecewise valuation; and, second, the truism that people tend to over-value little things and under-value big things would

likely apply to the holistic total valuation of multifunctional agriculture on a continental scale. This holistic total valuation would then serve as an upper-bound on the sum of all the local and particular component values, which would be estimated by decomposition CV procedures and subjected where possible to convergent validity tests involving estimates obtained with revealed preference techniques. This procedure would ensure that the local and particular virtual prices that influence on-farm resource allocation are consistent with the continental-scale and holistic total value. The conjecture that contingent holistic valuations are likely to be under-estimates is if anything reassuring. As governments move to implement a richly-detailed set of demand-based virtual prices for green products, it seems best not to overshoot at the outset: the virtual prices can always be adjusted upward later, as experience suggests.

2. Using contingent choice experiments and the techniques of random utility modeling and conjoint analysis, with a sufficiently large sample of respondents each addressing only a small sample from the whole array of alternatives, it should be possible to estimate a consistent set of particular and local virtual prices for the green products of agriculture (McFadden, 1978, Ben-Akiva and Lerman, 1985, esp. 261-275). This approach was demonstrated in a study of more than 1,300 recreational sites in Maine (Parsons and Kealy, 1992). For multifunctional agriculture, we want to know for the relevant population the marginal rates of substitution between members of a set of goods including at least one marketed commodity and many green goods. One might imagine each respondent addressing a sample of one priced good (to serve as a numeraire) and perhaps five green products assigned according to some sampling scheme. Rather than a RUM model (as would be appropriate for a site selection problem), conjoint analysis may be indicated because multiple levels of each of the

public goods should be considered. Green payments to individual producers should vary with the level of production of the public goods[9].

My intuition is that both of these valuation schemes are promising. In either case, the research task would be large, as would the sample of respondents necessary to get reliable value estimates. And, I should emphasize that these valuation schemes have not been demonstrated on the scale that would be necessary to obtain consistent estimates of the value of outputs from European multifunctional agriculture.

Targeting Virtual Prices at the Farm Level

At the operational level, the valuation process should be designed to produce value functions rather than point estimates. The value of a particular green output (e.g., wildflowers) produced at a particular location would be a function of product quality, availability of substitutes and complements, the size and demographic characteristics of the demander population, and perhaps other variables. To specify the quality attributes of the particular green product and its substitutes and complements, both for estimating the value functions and for applying them at the local level, science-based data may play an important role (Hoehn *et al*., 2001).

To this point, the discussion of valuation has been addressed implicitly to the demand side but, in order to maximize welfare, we would need equilibrium virtual prices that attend also to supply conditions, which reflect the direct and opportunity costs of producing green things. These costs vary across farms, reflecting local conditions. Estimating a set of general equilibrium green virtual prices turns up the challenge yet another notch. An alternative approach, and preferred (I think), would be to focus the valuation process on estimating green demands. Armed with demand information, and conceding that farmers know more than anyone else about their own supply conditions, the planner would then attempt to design a bidding process for farmers seeking contracts to produce green things, that would maximize social surplus across all green products ands all farms.

There are logical limits, as will be immediately recognized, to implementing targeted virtual prices at the level of the individual farm: such an objective should not be pursued beyond the point where transactions and monitoring costs exceed benefits at the margin. The goal of keeping these costs within reason might be facilitated by specifying particular technologies (e.g., artisanal cheese), and age and style of farm buildings (as is done for historic districts), and by establishing particular multifunctional agriculture zones where particular virtual prices would be paid to farmers in compliance.

8. Conclusions

Following a brief review of the array of valuation methods that may find application in this task – a review that, I hope, makes the case that the valuation tool chest is better than half full -- I offered a perspective on some of the current issues that exercise valuation specialists. Rather than endorsing particular techniques to the exclusion of others, we should seek in so far as possible to take advantage of multiple methods, which permit tests of convergent validity and combining data from several sources in a single model methods to extend the range of amenity levels that can be valued.

Upbeat as we might be about the valuation toolkit, it is well to recognize that environmental economists have seldom if ever attempted a task so demanding as valuing the outputs of multifunctional agriculture. First, the costs of getting the valuation wrong are inherently greater in this case than in many of the cases customarily addressed by environmental economists: in addition to inducing inefficiencies in the public goods markets, wrong green prices would (under a fairly robust set of conditions) distort domestic and international commodity markets. Second, getting the green prices right is a considerable task. The right green prices are contextual and richly detailed, and must be estimated on a national or continental scale, but implemented farm-by-farm. Consistency as we move from single to multiple components of multifunctionality, and from local to continental spatial scales, is a substantial conceptual and empirical challenge.

I outlined two valuation strategies that may offer promising approaches to this demanding task (of course, there may be others that did not occur to me, but are at least as promising). However, it is only fair to concede that these valuation schemes have yet to be demonstrated on the scale that would be necessary to obtain consistent estimates of the value of outputs from European multifunctional agriculture. I am, nevertheless, acquainted with quite a few valuation specialists who would be excited by an opportunity to get started!

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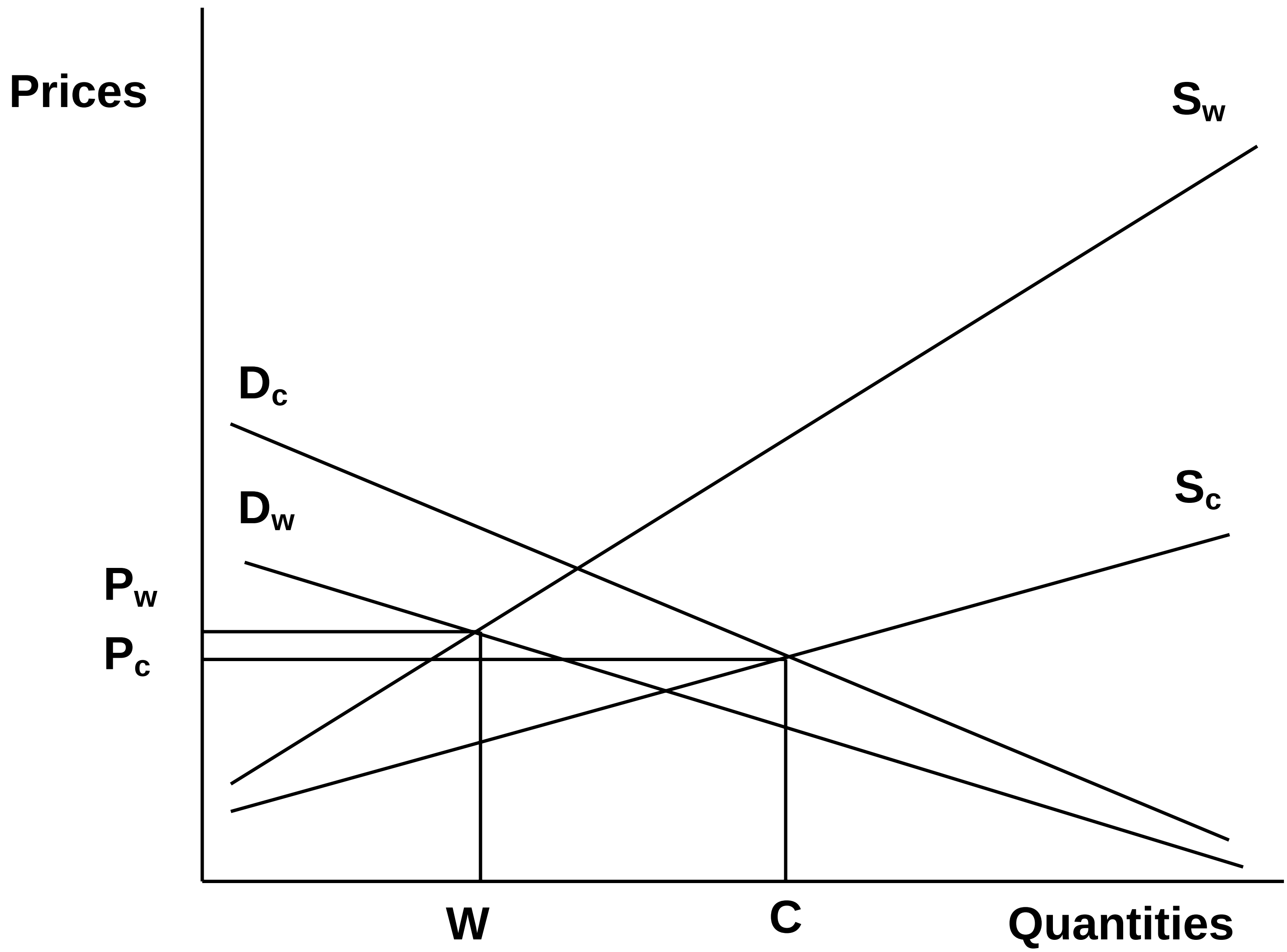


Fig. 1a. Separable production, closed economy

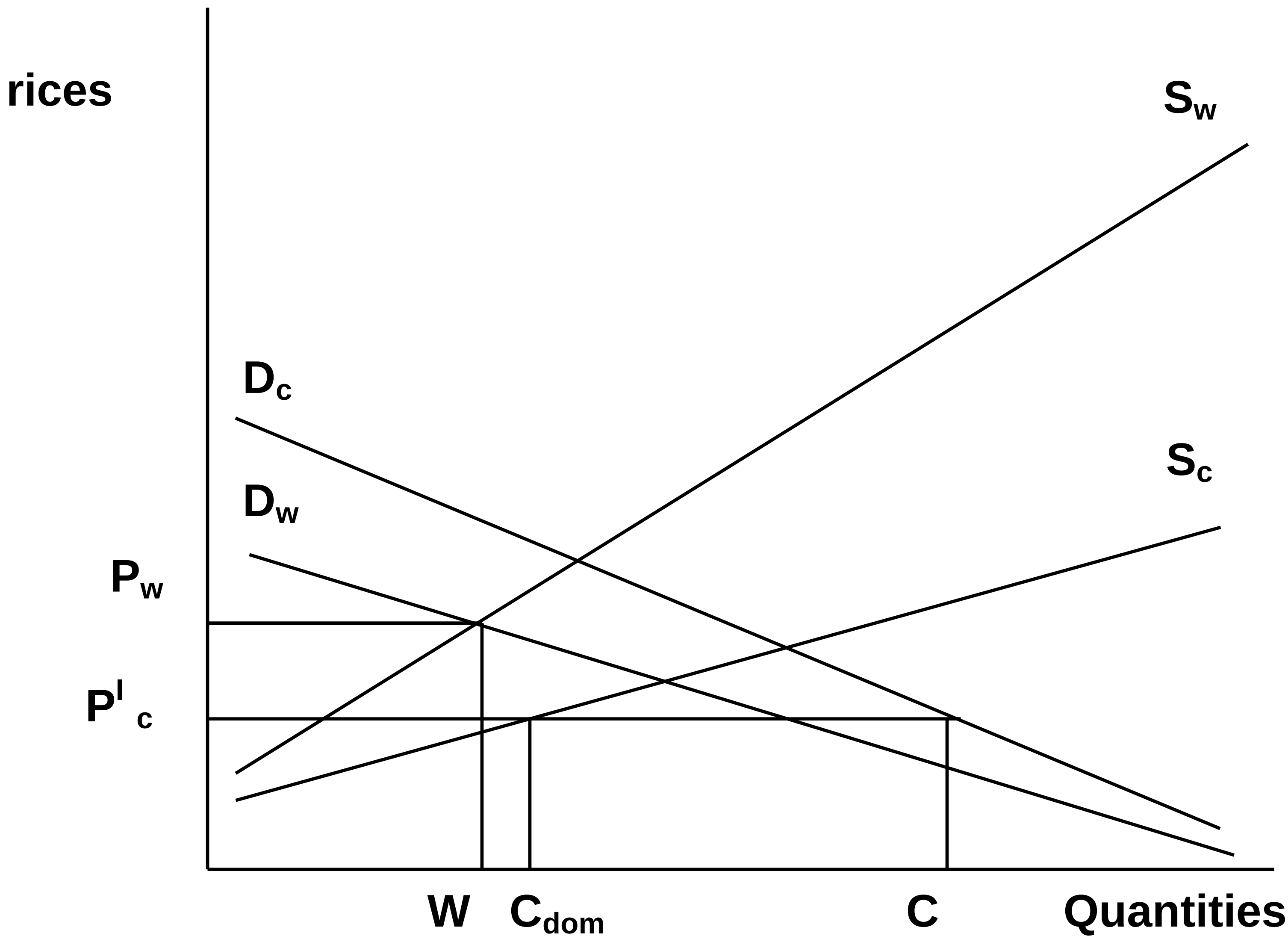
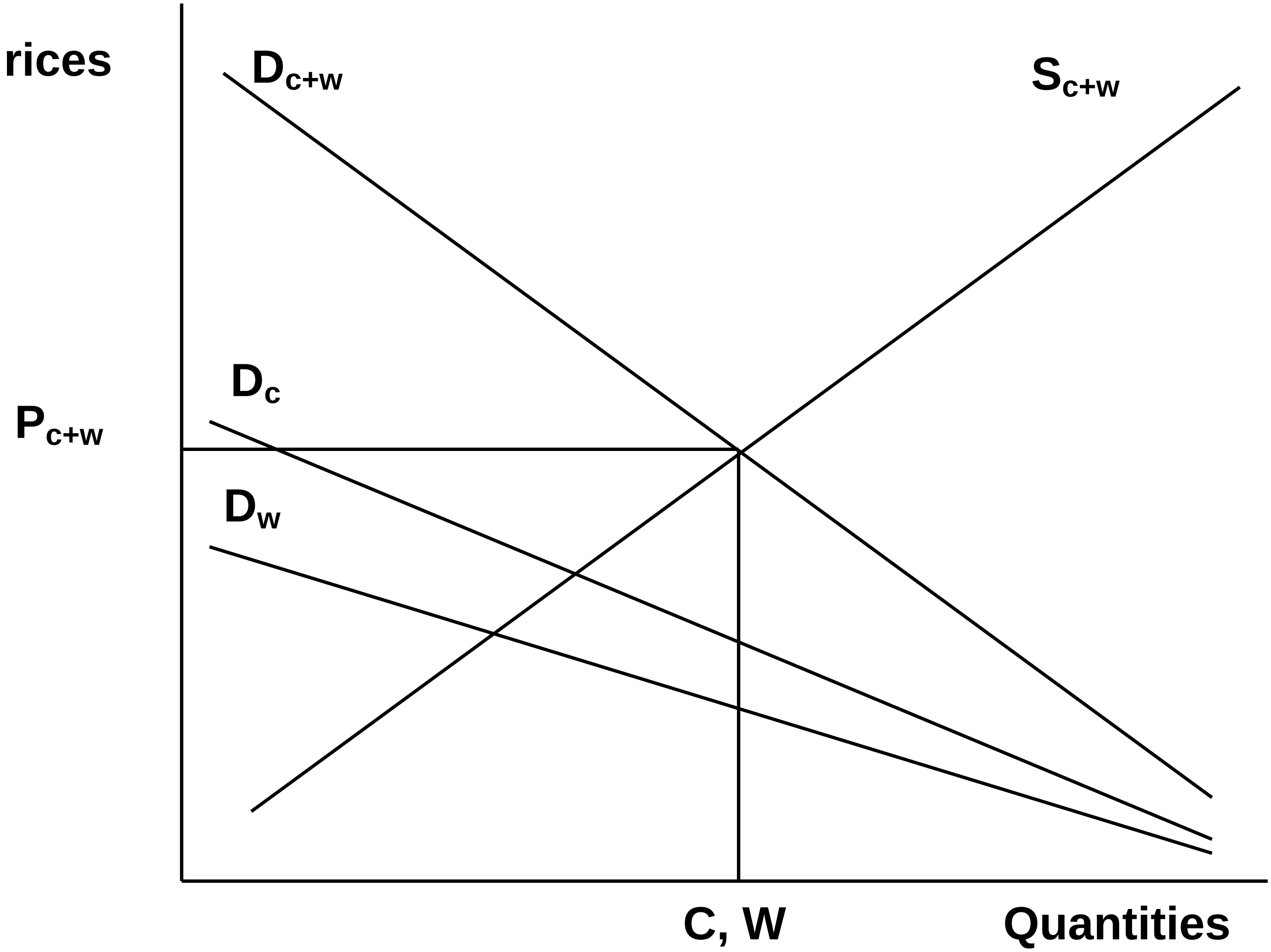


Fig. 1b. Separable production, open economy



ig. 1c. Fixed proportions joint production, closed economy

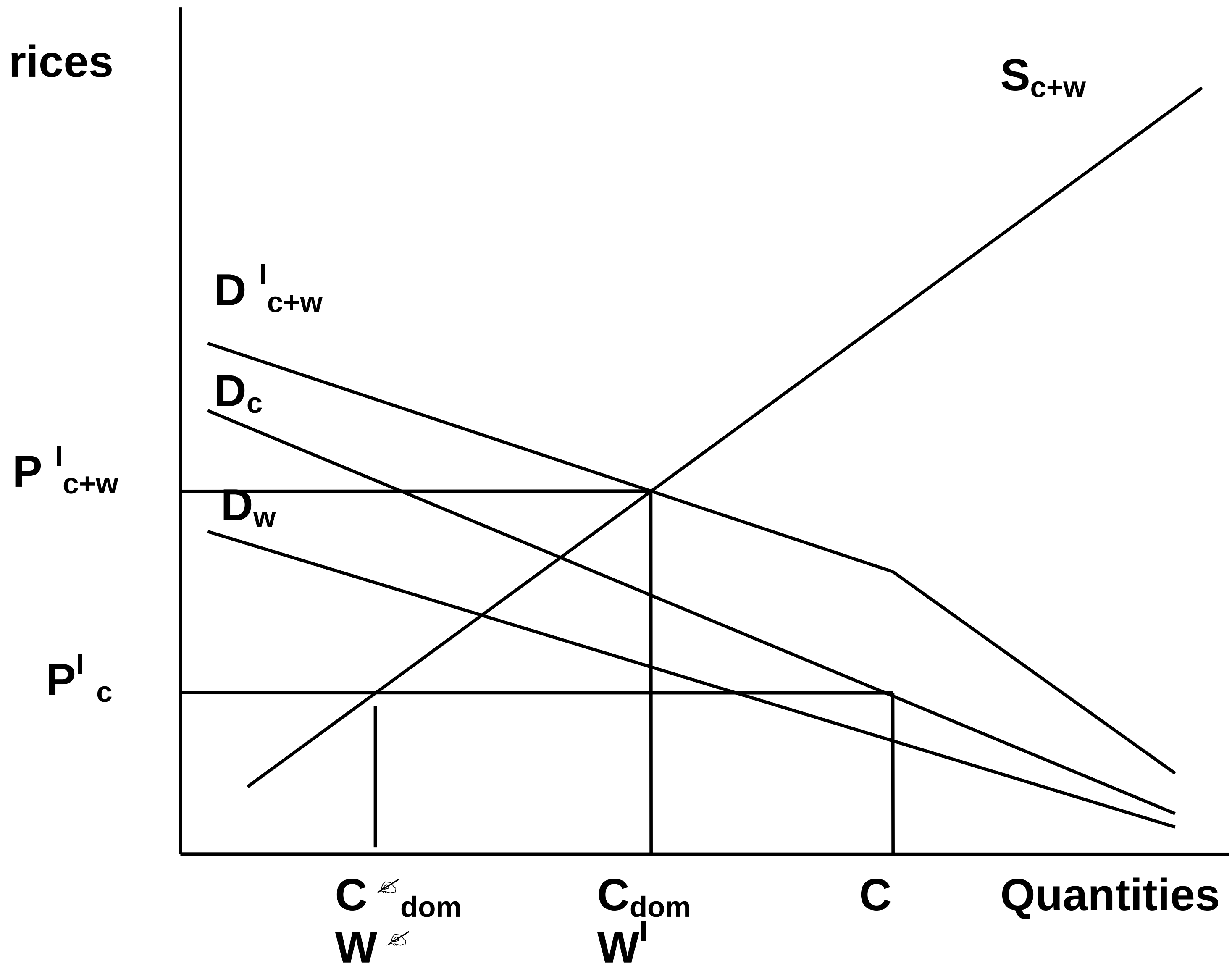


Fig. 1d. Fixed proportions joint production, open economy

Endnotes

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[1] It is traditional in these kinds of analyses to upper-bound commodity supply at the world price, but this practice turns out to over-complicate the analysis of the fixed-proportions joint production case. My strategy of upper-bounding commodity demand serves the same analytical purpose.

[2] One may quibble with whether all of the items on this list are subject to market failure, as would be implied by an effort to green-price each. It could be argued that market failures pertaining to food safety and food quality might be resolved via labeling, food security might be assured via storage strategies rather than by subsidizing domestic agricultural production, and the values associated with rural settlement should be confined to aesthetic values associated with settlement patterns in order to avoid falling into the "secondary benefits" trap. Even if all of these objections were granted, there is nevertheless a rich and lengthy list of legitimate market failures attending multifunctional agriculture.

[3] For making policy judgments (for example, in a benefit cost context), some critics object to unweighted interpersonal aggregation. Individuals with greater income and wealth are likely (other things being equal) to have greater WTP (or WTA, as the case may be), and the simple aggregation procedure makes no attempt to ✌correct✍ for this or to place extra weight on things that benefit the disadvantaged.

[4] There is no claim that total economic value, however, captures the totality of value: there are many different ways of valuing. Total economic value, then, represents a

comprehensive application of the economic way of valuing.

[5] For example, charitable contributions intended for the families of victims of the September 11 attack on the World Trade Center quickly exceeded the amount required for “reasonable” compensation of those families, precipitating a chain of events that ultimately cost the president of the American Red Cross her job.

[6] There is a substantial literature addressing aspects of the green benefits of European agriculture. Drake (1992), Hanley *et al*. (1999), and several of the papers in Willis *et al*. (1999) provide examples.

[7] For example, the Costanza (1998) value estimates for the world’s ecosystem services are based on separate studies of the value of small components. It is clear from the way that Costanza team constructed their estimates that their work does, in fact, suffer from the independent piecewise valuation problem.

[8] To limit excess supply of green products, virtual prices must reflect actual demand. To use an American example, I suspect that under current conservation policies there is excess supply of conservation in southwestern Iowa, where farmers are efficient producers of conservation and public expenditures for conservation are targeted to reflect soil characteristics but not demand for conservation services.

[9] I thank Tim Haab for conversations that increased my optimism about this strategy.