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EASYPol Series 129

Value Chain Analysis for Policy Making

Methodological Guidelines and country cases for a Quantitative Approach

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About value chain analysis: VCA is the assessment of a portion of an economic system where upstream agents in production and distribution processes are linked to downstream partners by technical, economic, territorial, institutional and social relationships.

The effects of policies targeting specific production processes extend their primary impacts in the economic system according to the same path as the main inputs and outputs. Analyzing impacts of policy options through value chains provides decision makers and other stakeholders with anticipated evidence on likely changes directly induced by policies.

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E-ESBN 978-92-5-107664-4
E-ISSN 2219-9497

Table of contents

1. Introduction 1

2. Value chain analysis for policy making: the approach 3

2.1. Conceptual background 3

2.2. Domains of value chain analysis for policy making 7

2.3. Value Chain Analysis and Policy Making 8

2.4. Limits of the value chain approach 9

3. Some domains of value chain analysis 11

3.1. Socio-economic context of the value chain 11

3.2. Demand for value chain outputs 13

3.3. Analysis of the institutional set up 14

3.4. Analysis of input and output markets 17

3.5. Functional Analysis of the value chain 22

3.5.1. Setting the boundaries of the value chain 22

3.5.2. Identifying activities 23

3.5.3. Identifying agents 23

3.5.4. Quantifying physical flows 28

3.6. Appendix: exercises 31

Exercise 1: Value chain functional analysis 31

Exercise 2: Quantity flows in the paddy rice sub-sector 31

4. Economic analysis: general aspects 34

4.1. Economic Analysis at market prices 35

4.2. Building the production account of an economic activity 36

4.2.1. Total output value 37

4.2.2. Intermediate input costs 38

4.2.3. Consumption of fixed capital 39

4.3. A two-side production account 40

4.4. Building the income account of an economic activity 40

4.4.1. Calculating the interest cost on fixed capital 43

4.4.2. Choosing the appropriate discount rate 47

4.4.3. Pricing the consumption of non-man-made fixed assets 47

4.5. Agents accounts and value chain accounts 48

4.6. Consolidating accounts at value chain level 50

4.7. Appendix to chapter 4 54

4.7.1. Data requirements and data sources to implement a value chain analysis 54

4.7.2. Loss of value of an asset in a given period 57

4.7.3. Equivalent Annual Cost 58

4.7.4. Averaging interest costs across periods 59

4.7.5. Exercise: Cost-Benefit Analysis of policy options for Rice Value chain in Burkina Faso. 62

5. Policy impacts in VCA: scenarios for counterfactual analysis 65

5.1. Counterfactual analysis for policy impacts 65

5.2. Impact models 66

5.3. Building scenarios in the VCA framework 68

5.4. VCA for monitoring value chain performances 77
5.5. Appendix 79
5.5.1. Cost-Benefit Analysis of policy options for Rice Value chain in Burkina Faso 79
6. Decision making in an open-economy setting 82
6.1. Computing parity prices..........83
6.1.1. Parity price of an output as import substitute 84
6.1.2. Parity price of a domestic output as export 86
6.1.3. Parity prices of importable and exportable inputs..........88
6.2. Appendix: exercises 94
6.2.1. Exercise 1: Calculating rice parity price 94
6.2.2. Exercise 2: Calculating milk parity price..........94
6.2.3. Exercise 3: Calculating cattle parity price..........94
7. Decision making from an economy-wide (societal) perspective 97
7.1. Social values versus market prices..........97
7.2. Market Failures..........98
7.2.1. Missing policies..........103
7.2.2. Policy failures 103
7.2.3. Social values and reference prices..........104
7.3. Choosing the numeraire for reference prices 105
8. Computing reference prices..........107
8.1. Calculating reference prices of tradable goods 107
8.1.1. Share of taxes as transfer..........108
8.1.2. Exchange rate 110
8.1.3. Externalities..........116
8.2. Calculating reference prices of non-tradable goods and services 115
8.3. Reference prices applied: analysis of organic bananas in Ecuador 122
8.4. Exercise: computing reference prices with externalities 126
9. Profitability, competitiveness and protection indicators 128
9.1. Structure of the Policy Analysis Matrix (PAM) 129
9.2. Impact analysis of policy options and PAMs..........133
9.3. Profitability and value added indicators at market prices..........135
9.4. Profitability and value added indicators at reference prices..........139
9.5. Protection indicators 142
9.6. Other protection indicators..........147
9.7. A synoptic view of PAM indicators for policy impact analysis..........150
9.8. Assessing policy impacts with PAMs. A real-case example from Burkina Faso .154
9.9. Expanded PAMs 157
9.10. How to deal with protection pass-through between agents 160
10. Glossary to the guide 164
11. References..........167

Acknowledgements

These guidelines are based on the material used and experience gained in recent years by the author and other colleagues at FAO, in carrying out value chain analyses for policy making in various countries. The final version of these guidelines benefited from contributions by different sources. Substantial contributions come from Nathalie Guilbert, FAO consultant, who worked on a first set of slides and contributed to selected country cases in Burkina Faso. Eleonora Gentilucci, FAO consultant, provided interesting references to prepare the conceptual background. Piera Tortora, FAO consultant, assembled the first sparse material on this topic and substantially contributed to the first draft of chapters 6, 7 and 9. Important hints and suggestions came from Carlo Cappi and Materne Maetz, former FAO policy officers. Comments and suggestions also came from many partners involved in the FAO-policy assistance activities, including Moussa Kaboré and his team at the Ministry of Agriculture of Burkina Faso, who stimulated the authors to deepen and clarify various aspects of the proposed methods. Lucia Battaglia, Fabrizio Moscatelli and Ilaria Tedesco, FAO consultants, contributed to finalize the document with extensive revisions and drafts of various country examples and boxes. Paola Landolfi, FAO, carried out the editing and formatting of the various versions of the document.

These guidelines have been funded to a large extent by FAO's regular programme and contribute to the achievement of FAO's strategic objectives. Indirect and direct contributions were also provided by the FAO Norway cooperation programme (FNOP). The author would like to acknowledge and sincerely thank all the above mentioned contributors.

Acronyms

CIF	Cost, Insurance, Freight included (Import price)
CIRAD	French Agricultural Research Centre for International Development
CBA	Cost-Benefit Analysis
CRR	Cost-Revenue Ratio
DOFAR	Domestic Factor Ratio
DRC	Domestic Resource Cost Ratio
EPC	Effective Protection Coefficient
EPPF	Export Parity Price at production level
EXR	Exchange Rate
FOB	Free on Board (Export price)
GDP	gross domestic product
GHG	Greenhouse gases
GGF	Groupements de Gestion Forestières (in Burkina Faso)
GVA	Gross Value Added
GVC	Global Value Chains
INRA	French National Institute for Agriculture Research
NPCI	Nominal protection coefficient on tradable inputs
NPCO	Nominal protection coefficient on outputs
MC	Marginal production cost
MR	Marginal revenue
MU	Monetary unit
NVA	Net value added
PAM	Policy analysis matrix
PCR	Private cost ratio
PREM	Foreign exchange premium
PVAR	Private value added ratio
SADC	Southern African Development Community
SER	Shadow exchange rate
SNA	System of national accounts
SRP	Subsidy ratio to producers
SUA	Supply utilization accounts
SURPA	Subsidy ratio to private agents
SVAR	Social value added ratio
VA	Value Added
VCA	Value Chain Analysis
WiP	With Policy
WoP	Without Policy

1. INTRODUCTION

Objectives: These guidelines provide users with the key notions required to carry out analyses of policy impacts by means of a value chain approach and show how to do it by making use of relevant approaches and tools. In particular, users will find this material useful to identify the main features of a given value chain, build consistent value chain accounting frameworks, building alternative scenarios reflecting changes that given policy measures are likely to introduce in value chains, measure in monetary terms shifts in physical production, value added, and income accruing to the various agent involved and provide relevant information to decision makers and other stakeholders involved in policy making processes. For instance, the user will be driven to identify the basic units operating in a given value chain and the activities they undertake, quantify revenue, value added and profits of every agent, build different scenarios for selected policy options, calculate value added and other margins, compute protection and competitiveness indicators,

Structure: This document is organized in nine chapters, supported by a number of real country cases, examples, and exercises, complemented by spreadsheets and other electronic material. Selected files to be used with the FAO VCA-Tool Software for value chain analysis are also provided to ease the execution of exercises. Some country cases are illustrated in several parts of the guidelines and create a continuum linking the different chapters (for instance, the case of firewood value chain in Burkina Faso). Other country cases are referred to as examples and applications of specific conceptual and/or methodological aspects.

At the beginning of these guidelines, the conceptual background of value chain analysis for policy making is provided (chapter 2), highlighting the historical and literature background of value chains and general aspects of value chain analysis for policy making. Chapter 3 highlights the importance of analyzing the context in which value chains develop through different lenses, before engaging in quantitative economic analysis. This chapter provides also references to other resources that address the qualitative analysis of different dimensions of value chains.

From chapter 4 onward, the focus is put on how to build the accounting framework of a value chain and how to use it for socio-economic impact analysis of policy options. More specifically, chapter 4 illustrates how to build the accounts of different agents in the value chain and to consolidate them to obtain a consistent accounting framework. Chapter 5 addresses the issue of using the value chain accounting framework to building scenarios for policy impact analysis and for value chain performance monitoring. Chapter 6 introduces the analysis of value chains for policy making from a social perspective, highlighting how this may differ in many instance from the analysis referred to the perspective of private agents involved in the value chain. Chapters 7 and 8 illustrate how to calculate prices that better reflect social values than market prices. More specifically, chapter 7 provides guidance on how to calculate parity prices, i.e. prices that reflect values of goods and services in an economic system open to international trade, while chapter 8 illustrates how to adjust parity prices to better reflect social values.

Chapter 9 presents some modalities to consolidate relevant information for policy making provided by the value chain analysis. In particular, the so called Policy Analysis Matrix (PAM) and related profitability, competitiveness and protection indicators such as the Nominal Protection Coefficient (NPC), the Effective Protection Coefficient (EPC), Domestic Resource Cost (DRC) etc., are illustrated and real country cases are presented.

Target audience and required background: Staff of ministries, policy makers, researchers and anyone who has a role and interest in assessing the socio-economic effects of policy measures for a given value chain can use this material[1]. It can be used for personal knowledge development, as a professional and operational reference, as well as a set of ready-to-use capacity development group sessions[2].

[1] To fully benefit from this material, users should have some notion of economics. However, most of the content is accessible to people without such background.

[2] Users can follow links included in the text to other EASYPol material or references. EASYPol hyperlinks are shown in blue, as follows: Resource packages are shown in **underlined bold font;** other EASYPol material is in ***bold underlined italics***; links to the glossary are in **bold**; and external links are in *italics*. These guidelines are part of the EASYPol Resource Package: **VCA software and manuals**

2. VALUE CHAIN ANALYSIS FOR POLICY MAKING: THE APPROACH

The term **value chain** refers both to a set of interdependent economic activities and to a group of vertically linked economic agents, depending on the scope of the study the focus of the analysis can be on the activities or on the agents. A value chain starts with the production of a primary commodity, ends with the consumption of the final product and it includes all the economic activities undertaken between these phases such as: processing, delivery, wholesaling, retailing.

Analyzing a value chain for policy making implies: a) taking stock of the situation of the value chain looking at its different economic, social and environmental dimensions; b) identifying areas of potential improvement of the value chain that can be introduced by means of public policy measures; and c) assessing the likely economic, social and environmental impacts of the available policy options. Information generated through this analytical work provides insights to stakeholders involved in the policy processes and supports the public policy decision making.

In Value Chain Analysis (VCA) an economic agent is defined as the subject carrying out a set of integrated operations of economic relevance, aimed at producing a given output. Each agent is customer of an upstream agent as well as supplier of a downstream one belonging to the chain. The agent can be a physical person such as a farmer, a trader, a consumer, etc., or a legal entity, for example a firm, an authority, a development organization. Often, in VCA, the term "agent" is intended as the "representative agent" of a group of individuals sharing common characteristics, or the group itself. For instance, the agent "farmer" may refer to all farmers, "trader" to all traders, and the agent "rest of the world" to all economic agents located outside the national borders. Agents directly contribute to the production, processing and delivery of a commodity through the different stages of a production process.

Within a single value chain, "sub-chains" can be identified on the basis of the processing techniques or specific uses of the primary output. For example, within most rice value chains, two different sub-chains can be identified on the basis of the processing technique: on-farm husked rice or industrial processed rice. Whereas, inside most cotton value chains, two main sub-chains can be detected on the basis of the output, such as cotton fiber and cotton seed productions.

2.1. Conceptual background

The systematic study of vertically integrated agents and activities traces its origins in Coase's analysis of the firm (Coase, 1937)[3]. He highlights how firms and markets substitute each other in governing the transactions between two different stages of a production process, according to the relative cost of procuring a given input. If the cost of a given input or service required by a production process[4] is lower when the input or service is generated within the same firm than through market-based contractual arrangements, the firm will produce that input or service internally. This concept, according to Coase, explains the existence of firms, intended as sets of integrated activities as well as the limits to their growth.
Oliver Williamson (1971)[5], one of the fathers of the "*New Institutional Economics*" (or Transaction Cost Economics - TCE), deepened Coase's work on vertical integration by further

[3] Coase R., 1937. The Nature of the Firm, *Economica 4 pp.386-405.*
[4] It includes both production and transaction costs
[5] Williamson, O. E., 1971. The Vertical Integration of Production: Market Failure considerations. *American Economic Review 61: 112-23.*

exploring the internal organization of production processes and its relationship with the functioning of the markets. He highlighted how, on the one hand, vertical integration (intra-firm relationships) can be generated by market failures such as imperfect information, excessive bargaining costs or low mutual trust between contracting agents. On the other hand, reliance on (well functioning) markets (inter-firm relationships) may be preferred whenever internal supply processes generate excessive internal bureaucracy or other organizational costs. In addition, vertical integration is seen as a solution for situations where "incomplete" contracts, i.e., contracts among upstream and downstream agents which avoid regulating ex-ante all the possible implications of future contingencies for the two parties, prevent to achieve optimal investment levels (Grossman 1986)[6].

Joskow (2005) [7] provides a compendium of the research carried out from the seventies in the framework of the TCE, highlighting the governance specificities and efficiency implications of vertical integration between "*upstream*" and "*downstream*" agents versus inter-firm (market-based) contractual arrangements.

Porter (1990)[8] also emphasize the role of nations as integrated systems and related governments as factors affecting the competitiveness of firms and businesses with respect to foreign competitors, Acquiring a competitive advantage may not imply, at least in principle, the optimal use of firm's own endowments, but only "outperforming" with respect to others. However in this framework, it is assumed that the firm seeks to maintain the competitive advantage as long as possible. Therefore, looking for the most efficient use of its endowments (know-how, equipments, etc) may be part of the strategy to maintain the advantage over competitors.

Although developed in a different environment, the concept of competitive advantage for a firm has some similarities with the concept of "*comparative advantage*", originally introduced by Ricardo (1817)[9] and later developed by countless international trade economists. According to this concept, a country (but this could also apply to firms) should specialize in those products which are produced at the lowest opportunity costs and trade with the others to procure goods and services which are relatively cheaper (in terms of forgone output) in other countries, generating mutual advantages. Both concepts are based on the idea of specialization and both should guide each economic agent to obtain larger benefits from their activities. However, between these two concepts there are also some differences. The comparative advantage is based on the opportunity cost of factor use, therefore explicitly considering the best alternative use of endowments for both agents, while the competitive advantage is based on the direct comparison of production costs (for the same output) with competitors. In addition, the comparative advantage underlines the concept of specialization for partnership (trade), from

[6] Grossman, S. J. and Hart, O. D., 1986. The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration, *The Journal of Political Economy, 1986, 94(4), p.691*

[7].Joskow P.L. (2005) Vertical Integration, in handbook of New Institutional Economics 319 (C. Menard & M. Shirley eds., Springer 2005);

[8] Porter, M.E., 1990. *The Competitive Advantage of Nations*, Harvard, Business Review.

[9]Ricardo D., 1817. *On the Principles of Political Economy and Taxation* *http://www.econlib.org/library/Ricardo/ricP.html.* Country A is said to have a comparative advantage with respect to country B to produce a given good or service, if the opportunity cost of producing it, valued in terms of the output forgone by not using the available production factors in their best alternative use, is lower in country A than in country B.

which gains are generated for both partners, while the competitive advantage underlines the concept of outperforming of one with respect to the other agent. *De facto*, these concepts are often interchangeably used. In value chain analysis for policy making however, the existence of competitive advantage is associated to positive private profitability, i.e., the outcome of economic activities as enjoyed by the private agent. The existence of comparative advantage instead is associated to the concept of social profitability, i.e. the economic outcome of an activity enjoyed by the society (the economic system) as a whole[10].

An important stream of literature has been developed by research institutions such as the French National Institute for Agriculture Research (INRA) and the French Agricultural Research Centre for International Development (CIRAD), the so called *approche filière*. Early studies in this strand mainly provided a description of existing agricultural commodity chains through the quantitative analysis of inputs and outputs, prices and value added, summarized in agents' accounts. Later, works increasingly complemented technical quantitative relationships with a policy dimension, by appraising the role of public institutions in the development of domestic commodity chains.

In the mid 90's, the increasing fragmentation of production processes at the international level lead to the development of a literature on global value chains (GVC) initiated by the work of Gereffi (1994)[11]. This literature incorporated an explicit international dimension to the analysis of value chains and focused on the power relations and the rule-setting mechanisms (governance) along the value chain in a global perspective. A pivotal concept is of the one of *lead firms*, defined as firms controlling the access to resources, such as new technologies, generating in turn the highest returns in the industry. Lead firms shape the overall structure of the value chain and determine its performance by controlling the production technology, deciding the location of production plants, designing the products, their time and pace of delivery, etc. However value chains exhibit a variety of governance patterns which impact on how the chain functions and how it might change over time. In "buyer-driven" value chains merchandisers (large retailers) play a key role in controlling the whole system, as opposed to "producer-driven" value chains, where large producers set the rules for the functioning of the system.

Within FAO, the value chain approach is one of the analytical frameworks adopted both to carry out rapid appraisals of value chains, as in e.g. Da Silva and de Souza (2007)[12], as well as to assess on quantitative grounds the impacts of policy options by means of value chain scenarios. FAO has performed analyses in a number of countries and developed related capacity development material. In 1994, the Policy Analysis Division of FAO published a methodological note on value chain analysis for economic analysis of policies (Fabre, 1994)[13] including the descriptive analysis of various economic agents, a structural analysis of physical flows, a financial analysis of transfers and effectiveness, and an economic analysis. An

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[10] The distinction between the concept of competitive advantage and comparative advantage is adopted in VCA to build the Policy Analysis Matrix. Monke and Pearson, 1989. *The Policy Analysis Matrix for Agriculture Development*, Cornell University Press), presented in the next sections of these guidelines.

[11] Gereffi G., 1994. *The Organization of Buyer-Driven Global Commodity Chains: How U. S. Retailers Shape Overseas Production Networks*, in G. Gereffi and M. Korzeniewicz (eds.), Commodity Chains and Global Capitalism, London: Praeger.

[12] Da Silva C.A. and de Souza Fihlo H.M., 2007: Guidelines for rapid appraisals of agrifeed chain performance in developing countries. Agricultural Management, Marketing and Finance Occasional Paper, FAO UN- Rome

[13] Fabre P., 1994. *Note de méthodologie générale sur l'analyse de filière pour l'analyse économique des politiques*. Cappa, Documents de formation pour la planification agricole n. 35. FAO UN, Rome.

associated document (Bockel et al, 1994)[14] presented a possible application of these methods for an export oriented value chain in Africa. This material has been further elaborated and published by FAO's Policy Support Service of FAO, (Bockel and Tallec, 2005)[15].

The Value Chain Analysis (VCA) approach for policy analysis, as currently applied by FAO, borrows from different strands of economic analysis and related literature. These include book-keeping for economic activities and farm management (income statements, crop and farm budgets), industrial economics (production coefficients and vertical integration) national accounts (value added analysis, generation and distribution through classical distributional channels, such as wages, interest, rents and profits), Cost-Benefit Analysis (CBA)[16] for investments (counterfactual scenario analysis, discounted annual-equivalent investment costs), welfare economics (social optimum benchmarking), international trade (competitiveness and protection), contract and game theory (negotiations, strategic behaviour of agents along the chain). Due to the multiple dimensions embodied, the VCA framework naturally lends itself to extensions and cross-linkages with other complementary analytical approaches, including qualitative ones.

As VCA is a very data-calculation intensive exercise, FAO developed the "FAO VCA-Tool software" (Bellù et al. 2006, Bellù and Cappi 2010) [17,18], a tool for carrying out VCA analyses for policy making.
The FAO VCA-Tool software is currently extensively applied in different countries to analyze policies and their socio-economic impacts. This tool has shown to be very effective for the assessment of policies' impacts such as the profitability of the different activities, the effects on the different agents involved, the creation and distribution of value added and the competitiveness and protection of the system under different policies and institutional set-up scenario (see for instance Direction Générale des Prévisions et des Statistiques Agricoles (DGPSA) 2007a,b,c,d)[19].

Over the time, the value chain approach has been integrated with other approaches for policy analysis, such as Computable General Equilibrium models (CGE) and poverty-inequality analysis with household-level data, as for instance in the project developed in Burkina Faso by

[14] Bockel L, Fabre P., & Mansouri M.,1994. *Analyse de filière: application à l'analyse d'une filière d'exportation de coton. Cappa, Documents de formation pour la planification agricole n. 36.* FAO UN, Rome.
[15] Bockel L. and Tallec F., 2005. *Value chain analysis: functional financial and economic analysis.* EASYPol series 044, 045 and 046. FAO-Rome www.fao.org/easypol
[16] The Cost Benefit Analysis (CBA) is defined as the process by which are weighted expected costs against expected benefits to determine the most profitable action
[17] Bellù L.G. and Cappi C., 2010. *FAO-VCA-tool software 3.1.* EASYPol series n. 073 FAO-Rome www.fao.org/easypol.
The FAO-VCA-tool software guides the user through basic standard steps in economic analysis of value chains, facilitates the systematic storage of information, calculates standard margins and indicators at different levels of the chain, such as value added and profits, provides guidance and tools for calculating reference prices for tradable and non-tradable goods and services, provides Policy Analysis Matrices (PAMs), nominal and effective protection coefficients (NPCs, EPCs) competitiveness and comparative advantage indicators, such as Domestic Resource Cost (DRC) ratios; etc.
[18] Bellù L.G (2013) FAO-VCA-tool software manual. EASYPol series n. 074. FAO-Rome www.fao.org/easypol
[19].DGPSA, 2007a. *Analyse de la filière Bois de Feu (Firewood) au Burkina Faso*. Ouagadougou, Burkina Faso.
DGPSA, 2007b. *Analyse de la filière pèche (CaptureFisheries) au Burkina Faso*. Ouagadougou, Burkina Faso.
DGPSA, 2007c. *Analyse de la filière bétail-viande (Livestock) au Burkina Faso*. Ouagadougou, Burkina Faso.
DGPSA, 2007d. Analyse de la filière maraîchage (*Vegetables*) au Burkina Faso. Ouagadougou, Burkina Faso.

the DGPSA of Burkina Faso (DGPSA, 2007e)[20]. Complementing VCA with other approaches for policy analysis enables analysts to overcome some intrinsic limitations of the VCA approach, notably missing modelling of behavioural aspects and its *partial* approach. As a matter of fact, VCA normally analyses portions of economic systems, rather than economic systems as a whole.

2.2. Domains of value chain analysis for policy making

Value chains are complex sets of interrelated elements (public and private agents, domestic and foreign markets, inputs, outputs, production factors, institutions, environment and natural resources, etc) (Kaplinsky and Morris, 2000)[21]. This implies that VCA for policy making has to look at value chains from different, albeit correlated, perspectives. It allows analysts to identify issues (constraints, opportunities, strengths and weaknesses) to be addressed by policies. Analyses to be carried out cover the following domains:

a) **Socio-economic context of the value chain**. This analytical domain identifies and outlines the key elements of the context, such as the geo-strategic, macro-economic and social situation of the country(ies) in which the value chain develops, explains how these elements influence the value chain and vice-versa.

b) **Demand for value chain outputs**. It is important to investigate the consumer side of a value chain. The current and potential demand of the various final output(s), their various destinations and related price trends have to be considered. This allows analysts to identify threats and opportunities related to the destination of the value chain outputs to be addressed by means of appropriate policies.

c) **Analysis of the institutional set-up**. The identification and appraisal of the institutional set-up, i.e., set of interactions taking place among agents and the formal and/or informal rules governing them is a key aspect when designing policies aimed at fixing issues related to the value chain governance.

d) **Analysis of input and output markets**. A specific focus on markets allows analysts to understand agents' behaviour and to further explore the institutions governing the value chain because there are close relationships among markets' set-up, rules and agents' choices. The degree of competitiveness, the existence of monopolies, monopsonies, oligopolies, market segmentation etc. strongly contribute to determine the value chain's performances. Policies have to be shaped considering the existing and desired market structure.

e) **Functional analysis of the value chain**. The functional analysis provides a detailed profile of the industry structure and production technology by identifying, describing and quantifying in physical terms the sequence of operations concerning commodity production, processing, marketing and final consumption and related agents carrying them out.

f) **Economic analysis of the value chain**. This analytical domain assesses in quantitative terms the value added creation and distribution processes. The economic analysis allows analysts to determining for instance, the value added created by the overall value chain, the

[20] DGPSA, 2007e. *Analyse des impacts des politiques de développement agricole et rural et des filières Agro-sylvo-pastorales sur la pauvreté et la sécurité alimentaire: résultats synthétiques*. Direction Générale des Prévisions et Statistiques Agricoles. Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques. Ouagadougou, Burkina Faso.

[21] Kaplinsky R.and M. Morris, 2000. A Handbook for Value Chain Research, IDRC.

value added and margins for each economic agent at each stage of the chain, the value added distribution among factors (capital: profits, labour: wages, other assets: rents). Pretty much as most Cost-Benefit Analyses (CBAs), the economic analysis of a value chain is carried out both from the perspective of private agents, using market prices, and from the perspective of the society as a whole, using the so-called “reference prices”.

The above mentioned analytical domains are explored in the next sections of the guidelines.

2.3. Value Chain Analysis and Policy Making

The Value Chain Analysis can provide answers to prominent policy concerns, such as: Is a value chain creating value added? Who is creating value within the value chain? What is the relation between value added creation and profit earning? What is the income distribution within the value chain?

The answers to these questions can guide policy interventions towards the reallocation of resources and support programmes for the benefit of the most vulnerable groups within the chain.

Moreover, value chain analysis is a valuable tool to investigate the role that value chains can play in achieving specific policy objectives, such as poverty alleviation, sustained growth and inequality reduction. For example, major investments in infrastructures that are crucial for a staple value chain can be planned on the basis of the recognition of the importance of that staple for food security.

Different policy options can be represented by different scenarios and their socio-economic impacts can be assessed through their comparisons in a counterfactual context (Bellù and Pansini, 2009)[22]. The logical process goes through the construction of a base scenario stylised the description of the value chain «**WITHOUT**» policy intervention (WoP), i.e., a state of the value chain which is assumed to represent the situation where the policy measure is not implemented. This will be the reference scenario, also called benchmark or baseline, for the impact analysis of policies.

The reference scenario is described using some **indicators**, chosen on the basis of the type of policy analysed. If, for example, the policy measure aims at poverty alleviation and food security, the poverty and food security indicators, like the poverty headcount rate, the poverty gap, the *per capita* intake of calories and proteins or their distribution will be the most appropriate.

[22] For more details on the counterfactual analysis of policy impacts, see: Bellù L.G. and Pansini R.V., 2009: *Quantitative Socio-Economic Policy Impact Analysis: A Methodological Introduction*. EASYPol series n. 068. FAO UN, Rome. *www.fao.org/easypol* pp.11-1

These indicators calculated for the reference scenario are used as reference indicators.

After building and describing the reference scenario, the analysis focuses on the construction of one scenario integrating the socio-economic impacts of the policy option. This is the scenario «**WITH**» policy (WiP). If more than one policy option is to be analysed, analysts can build different scenarios "with" policy. The same set of indicators as for the reference scenario is then calculated for each scenario.

Ceteris paribus, the comparisons among the different sets of indicators highlight changes from one scenario to the other for what concerns[23]:

- Economic performance of agents.
- Interrelations among agents.
- Upstream and downstream (indirect) changes in the chain.
- Opportunity costs of goods and factors.
- Regional and international comparative and competitive advantages.
- Macroeconomic aspects.

All in all, conducting a value chain analysis allows analysts to:

- Identify bottlenecks that deserve priority attention from the government.
- Identify target groups.
- Trace the effects of a policy along the chain of commodities.
- Understand how value added creation and profit earning will change for each agent and the value chain as a whole.
- Identify "winners" and "losers" of a policy measure.

2.4. Limits of the value chain approach

Value chain analysis mostly relies on the build-up of agents accounts to describe technical relations and it allows for distributional and impact assessments, as well as for competitiveness and protection appraisals. Hence, it can be considered as an **accounting framework** and not a behavioural model, since no particular assumptions are made on agents' behaviour. As a consequence, agents' reactions to shocks cannot be anticipated and taken into account, unless causal relations are borrowed from theory.

Another feature of value chain analysis lies in its lack of a time dimension. Despite being usually carried out with reference to a specific accounting period (i.e., a given year), it does not explicitly considers the impact of time on the variables considered. Hence, we call it a "static" framework.

Moreover, value chain analysis is not a stylized representation of the whole economy, but an in-depth description of a specific segment of it giving only a partial vision of the economy and requiring a large amount of data.

Finally, a word of caution is needed regarding mechanical applications of the various steps of the value chain analysis in identifying upstream and down-stream agents and in the

[23] The comparison between WoP and WiP considers the policy as the only changes in the economic system. Indirect/side effects of policy (i.e. that does not enter in the value chain) or change in other aspects are not taken into account (see par. 1.5)

quantification of related flows of costs and incomes. Following Joskow (2010)[24]: "it is not particularly useful to think of there being a sharp dichotomy between internal organization (e.g., vertical integration) and market transactions. Rather, the appropriate conceptual framework recognizes a continuum of governance arrangements between spot market transactions and internal organization, including combinations of both (e.g., dual sourcing)". This implies that quantitative analyses of value chains have to be associated to a full understanding of the mechanisms, contracts and/or agreements which constitute and regulate the relationships between upstream and downstream agents.

[24] Joskow P., 2010. *Symposium in Honor of Oliver Williamson,* Antitrust Bulletin, p.3. forthcoming 2010.

3. Some domains of value chain analysis

3.1. Socio-economic context of the value chain

This analytical component identifies and outlines the key elements of the context in which the value chain develops, explains how these elements influence the value chain and vice-versa. The following elements are considered:

a) Geo-strategic positioning of the country, including membership in regional organizations etc.

b) Macro-economic and social situation of the country(ies) in which the value chain develops.

c) Contribution of the value chain or the sector(s) to which it belongs to the economy (output, value added, employment, balance of trade, competition in use of natural resources and environmental issues, etc).

d) Contribution of the value chain to the socio-economic situation, including income, expenditure and other social wellbeing implications for various social groups of interest to the value chain.

e) Geographic location of the value chain and implications for territorial set-up and development (rural-urban relationships, synergies with other activities, role in local production systems etc.).

f) Current policies and strategies affecting the value chain, including price, factor and natural resource policies, specific incentives or disincentives to producers and consumers, macro-economic policies affecting exchange rates and interest rates, credit policies and international trade policies.

For instance, the importance of the socio-economic context to determine the performances and perspectives of the maize value chain in Zimbabwe is evident. This value chain fits in a country context where the grains sub-sector plays a strategic role for achieving food security. For this reason, public policies aimed at supporting the sub-sector have been implemented in an attempt to exploit the ample import substitution potential, as illustrated in box 3.1.

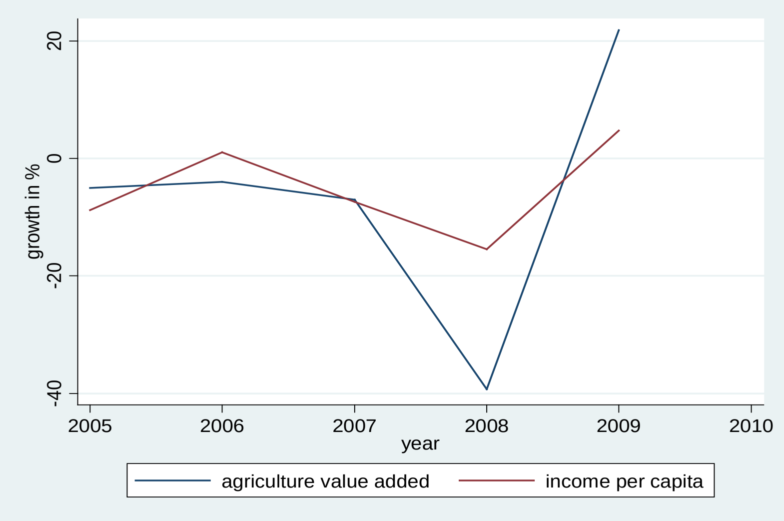
Box 3.1: Case study: Socio-economic context of the maize value chain in Zimbabwe[25]

Zimbabwe is characterized by a poor and unstable socio-economic environment, in which the role of agriculture and grain sectors is strategic in achieving food security's goals. The socio-economic context, in which the maize value chain develops, is analyzed. After a period of stagnating or downward sloping growth, from 2008 the Gross Domestic Product (GDP) per capita in Zimbabwe started to rise, driven also by the agricultural sector (see Figure 3.1). Despite recent progress however, the whole economic structure remains fragile, due to scarce capital sources, uncertainties arising from the policy framework, poor infrastructure, obsolete technologies, and power and water shortages. The fiscal revenues remain severely constrained by the lack of commitment and transparency - limiting in this way the public budget possibilities to a few policy priorities.

[25] Adapted from: *Tinashe Kapuya et al (2010):"The grain industry value chain in Zimbabwe", prepared by Tinashe Kapuya, Davison Saruchera, Admire Jongwe Tolbert Mucheri, Kingstone Mujeyi, Lulama Ndibongo Traub, and Ferdinand Meyer for Food and Agriculture Organization of the UN (2010), Rome.*

As regards the social context, improvements in health and schooling have been lately pursued with donor support on humanitarian assistance; however there is not a clear poverty reduction strategy and development targets may be hampered by limited government budget resources[26]. Recently, efforts have been undertaken by the Government to rebuild capacities to manage public policies and improve accountability in the management of public resources.

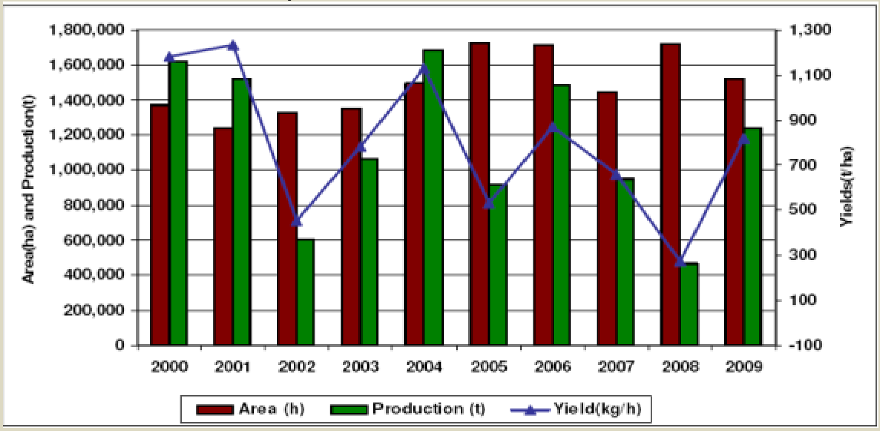
Figure 3.1: Income per capita and agriculture value added growth (2005-2009)



Source: Author's elaboration on Penn World Tables PWT 7.0 and World Development Indicators (WDI), World Bank

Zimbabwe's agricultural sector accounted for more than 16% of GDP in the last decade and over a half of the cultivated land area is devoted to grain crops and food staples. Grain crops are indeed considered strategic in achieving domestic food security. Among the grain crops maize is considered the most important, as it is used for both human and animal consumption. Since 2008 there has been an increasing trend in yields and output production (Figure 3.2), however, the performance of the sector is considered to be low, also due to its poor output quality compared to imports. Major constraints lie in the limited supply of inputs (seeds, fertilizers, electricity and water), the inadequacy of institutional support and the lack of capacity to mobilize capital to improve the production process.

Figure 3.2: Maize Area Harvested, Production and Yields



Source: Tinashe Kapuya et al (2010)

[26] *African Economic Outlook, 2012. Zimbabwe. African Development Bank Group – UNECA, 2012.* http://www.africaneconomicoutlook.org/fileadmin/uploads/PAGES-%20Pocket%20Edition%20AEO2012-EN.pdf .

Since 2000 the country undertook production and trade policy interventions to ameliorate the output of the sector. As a member of the Southern African Development Community (SADC), Zimbabwe was involved for example in the provision of seed and fertilizer through the SADC Agricultural Inputs Support Initiative (2008). Results were however not satisfactory as the variability of the production volumes and yields implied that the country had to heavily rely on food aid and imports from neighbour countries to satisfy internal demand.

There is a need to look at the maize industry as a strategic economic activity for the country, to satisfy domestic demand and to explore options to enhance domestic production and productivity, such as supporting the adoption of sustainable technologies and improving access to credit. However, in the short run the Government may also explore appropriate trade policies to address immediate food security challenges. Overall, the ample import substitution potential could be exploited through substantial improvements of the domestic production system.

3.2. Demand for value chain outputs

Demand analysis looks at the consumer side of a value chain considering the various destinations of the final output(s). Under this component, the following elements are normally considered:

a) Current and potential (future) domestic and foreign demand for the value chain outputs (including trends and/or forecasts).

b) Domestic and/or international output prices and price trends.

c) Socio-economic features of current and potential customers, including spending capacities.

d) Current and potential foreign competitors.

e) Specific features of products, including product diversification to target different types of clients.

f) Current or potential substitutes that influence prices or volume demanded

g) Other issues related to demand, such as dependency from economic cycles or other determinants of demand.

Demand analysis helps identifying whether the capacities to meet different domestic or international requirements have to be improved and/or the extent to which existing or potential demand could absorb possible supply expansion. Also the innovation of products can be demand-driven and demand analysis helps also determining whether the features of the goods or services provide could be diversified to meet other potentially more profitable niches of the market.

For instance, the analysis of firewood demand in Burkina Faso highlights that current and likely future consumption put an excessive pressure on natural resources. Substitute products, such as the butane gas exist, whose promotion could potentially reduce the demand for firewood. However, this substitution process does not show to be straightforward due to the high cost of the substitute and the consumers' behaviour. Despite technical substitutability considerations, households prefer to stick to traditional energy sources. These aspects are discussed with some more detail in Box 3.2.

Box 3.2: Case study: demand analysis of firewood in Burkina Faso[27]

Firewood demand in Burkina Faso is essentially related to energy needs. Firewood represents the main energy source for households, artisans and the industry sector. Because of the high demand, the need of firewood and charcoal in the country is elevated (MECV, 2004) [28]. According to the Ministry of Energy,[29] in 2004 the firewood value chain accounted for around 8 million tons, corresponding to an estimated value of 18 billion FCFA of sales (US$36 million). It has been estimated that the annual consumption of firewood in the capital city of Ouagadougou only is more than 300,000 tons (Ouedraogo, 2002)[30]. Indeed, the products deriving from the exploitation of the forests are mainly devoted to the energy sector while only a marginal part of wood is used in the construction of houses and warehouses.

The massive exploitation of forestry resources in the country has severe negative impacts on the preservation of the forests. Since in Burkina Faso the forested land corresponds only to 21% of the country[31], the Government aims to protect forested land by diversifying the production of energy. In recent years, the energy sector has seen the introduction of butane gas as a substitute for firewood. Through the introduction of subsidies for its use, the Government has tried to make this new source of energy more affordable for households.

Despite the efforts of the Government, the rate of substitution of firewood with other sources of energy such as butane gas is not increasing as expected since the traditional source of energy is still considered to be preferred. In addition, as butane is mainly used in urban areas, where wealthier people reside, this subsidy translates into a regressive tax policy, generating evident social disparities and equity concerns. The demand analysis of firewood and of its closest substitute highlight that the pressure on forests is likely to persist in the future and possible solutions to this issue have to be identified on the supply side of the firewood market.

3.3. Analysis of the institutional set up

The identification and appraisal of the institutional set-up, i.e., set of interactions taking place among agents and the formal and/or informal rules governing them is a key aspect when designing policies aimed at developing value chains. This implies looking at:

a) The organization and interactions among the different agents with attention to the functioning of vertical (upstream-downstream) linkages (synergies, actual or potential conflicts etc).
b) The set of rules that allows a value chain to function, be it self-imposed or imposed by an authority.
c) The role of the public sector (public policies, investments) *vis-à-vis* private agents.

In this respect, VCA investigates the role of the state, as well as other institutions, in regulating the value chain and creating the legal environment that ensures its functioning. For example,

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[27] Based on: DGPSA, 2007a : *Analyse des impacts Financiers et économiques de la filière bois-énergie (Firewood) organisée approvisionnant la ville de Ouagadougou*, Burkina Faso. EASYPol series 106.
http://www.fao.org/docs/up/easypol/892/analyse_impcts_financiers_econ_bois-energie_106FR.pdf
[28] Ministère de l'Environnement et du Cadre de Vie, 2004. « *Note d'information sur la filière bois – énergie au Burkina Faso / Ministère de l'Environnement et du Cadre de Vie – Direction des Aménagement Forestiers* », MECV.
[29] Ministère des Mines, des Carrières et de l'Energie (MMCE), 2007. « *Stratégie Nationale de la filière commerciale bois – énergie à l'horizon 2015 (version provisoire)* » Ministère des Mines, des Carrières et de l'Energie – Ministère de l'Environnement et du Cadre de Vie ; p. 46.
[30] Ouedraogo, B. (2002) « *Eléments économiques pour la gestion de l'offre et de la demande du bois – énergie dans la région de Ouagadougou /Thèse pour le Doctorat ès Sciences Economiques* » Universités de Ouagadougou et de Montesquieu – Bordeaux IV (France)
[31] FAO, 2010. Global Forest Resources Assesment 2010 – Main report, *FAO Forestry Paper no.163*

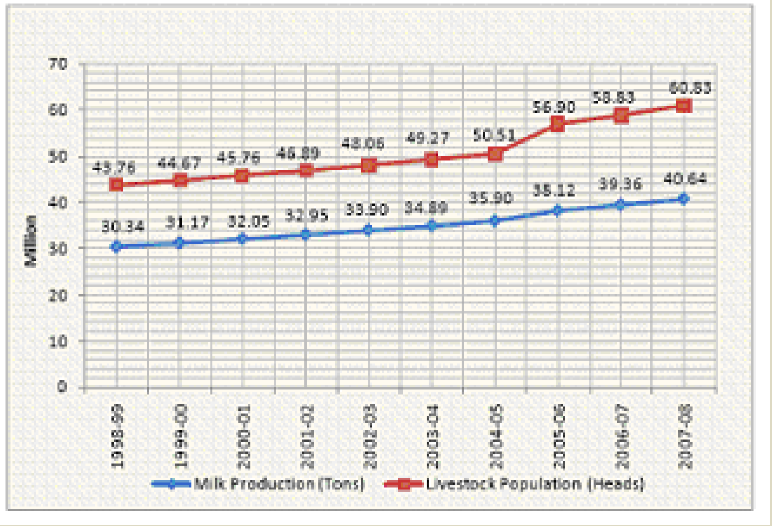
merchandisers inside the value chain can set standards for suppliers in relation to timely deliveries, frequency of deliveries and quality, while other standards, for example regarding environmental and child labour, can be set by external chain agents, for instance by national legislation, international agreements or NGOs. Institutional set-up and governance are key determinants of the level of efficiency and other specific features of a value chain, as discussed in box 3.3, where the institutional set-up of the dairy value chain in Pakistan is discussed.

Box 3.3: Case study: Institutional set-up of the dairy value chain in Pakistan[32]

Pakistan's institutional framework for the dairy value chain is characterized by poor regulation and law enforcement by the Government and lack of coordination among agents (Government, private sector and other development agencies). These weaknesses are harming the development of the sector.

Pakistan is one of the world's top milk producers. Since 2000, milk production amounted to more than 30 million tons with an average annual increase around 3% over the last ten years (see Figure 3.3). The milk *per capita* production was around 230 kg in 2003, more than twice India's production and about 70% the one of United States[33]. Milk and dairy products are mainly domestically consumed, accounting to the 30% of household expenditure on food items (ACIAR, 2006)[34].

Figure 3.3: Annual milk production and livestock population



Source: Umm e Zia et al. (2011)

The sector is fragmented and characterised by subsistence smallholder farmers: the herd size for most of them ranges between 1 and 4 heads (see Table 3.1). They are not organized and the production and marketing are in general poorly managed. Smallholder market-oriented farmers sell milk through various channels (direct sales, sales to intermediaries or the procurement agents of dairy processing corporations). Almost 95% of Pakistan's milk is marketed raw through informal mechanisms while the remaining 5% is processed and marketed through dairy factories. However a more structured production and processing occurs in proximity of major urban areas. Given the perishable nature of milk, the distances between sites, the inefficient marketing infrastructures and the large number of intermediaries, harm the quality of the product.

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[32] Based on: Umm e Zia, T. Mahmood and M.R. Ali 2011. Dairy development in Pakistan, Food and Agriculture Organization of the UN, Rome.
[33] Sheeraz Ahmad, G. Hinch, J. Prior, P. Thomas and D. Burrell (2012), "The Role of Extension in Changing the Dairy Industry in Pakistan: A Review", International Workshop on Dairy Science Park, Peshawar, Pakistan
[34] ACIAR (2006). *Report on dairy mission to Pakistan*, by P. Wynn, D. Harris, R. Moss, B. Clem, R. Sutton & P. Doyle, Australian Centre for International Agricultural Research.

Table 3.1: Production size (livestock quantity)

Contribution of different production scales		
Herd size	% of total producers	% of total animal
1 to 4	83	51
5 to 10	14	28
> 10	3	21

Source: Umm e Zia et al. (2011)

The marketing chain is exclusively in the hands of the private sector; the dairy industry overall, is highly unregulated and the few existing rules are weakly enforced. For this reason, livestock activities have significant negative impacts on the environment, often neglected and poorly understood by all the main stakeholders.

In an attempt to develop the dairy value chain, on the one hand the Government, international development partners and NGOs have often designed and implemented projects focusing on smallholders' subsistence production, with an aim to achieve poverty alleviation targets. On the other hand, the three big processors created their own network of suppliers leaving the rest of producers with no or limited access to processing facilities.

Overall, lack of organization, poor interaction and missing coordination result in a lower exploitation of the potentials of the dairy chain in Pakistan. To improve the dairy value chain functioning, the public sector could act to strengthen its regulatory and coordinating role; in this respect, quality standards and environmental regulations could be key determinants to improve the chain's efficiency. Moreover, it could provide more infrastructure and incentives to both large and small farmers, for example, by connecting isolated areas and or providing credit facilities and training to set up small scale processing plants.

3.4. Analysis of input and output markets

Analyzing domestic and international markets for inputs and outputs provides important insights on the way a value chain works and on possible policies to improve its performances. A specific focus on markets allows analysts also to understand agents' behaviour and the institutions governing the value chain because there are close relationships among markets' set-up, rules and agents' choices. The degree of competitiveness, the existence monopolies, monopsonies, oligopolies, market segmentation, the possibility of discriminating some categories of consumers by applying different prices for the same goods etc., are features that contribute to determine the quantity and quality of outputs, the value added generated and its allocation among the different segments of the chain, the remuneration of production factors, their implications for value added generation and distribution processes, domestic tax revenues, earnings transfers across countries, expatriation of profits, etc.

A market is a place (physical or virtual) where sellers and buyers meet to exchange goods and services. Along a value chain there are a variable number of markets for a main commodity that may differ according to their specific features, such as:

a) Number of agents.
b) Level of information available to sellers and buyers.
c) Entry/exit barriers for sellers and buyers.
d) Control binding the supply.

e) Control over prices.
f) Nature of product.

Different market structures also correspond to different efficiency levels and pricing mechanisms. Main theoretical market structures include:

a) Perfect Competition.
b) Monopoly (only one seller).
c) Oligopoly (few sellers).
d) Monopsony (only one buyer).
e) Oligopsony (few buyers).
f) Other, depending on the degree of competition.

In economics, "perfect competition" constitutes the useful theoretical benchmark defined by the simultaneous occurrence of a number of conditions. In a perfectly competitive market there is a large number (virtually infinite) of economic agents (buyers/sellers) trading small quantities of goods and services, who thus have no power to set the price of the service/commodity traded.

They are defined as price takers agents. In a perfect competition, the price is determined by the interaction of total demand and total supply of a good/service and it reflects information about both supply and demand sides, such as scarcity and consumers' preferences. Other features of a competitive market are the homogeneity of products traded and the absence of costs associated to the entry or exit from the market and to the transactions.

The neo-classical theory assesses that perfect competition equilibrium implies the efficient allocations of resources among alternative uses, zero profits in the long run and market prices reflecting resources scarcity and consumers' preferences.

On the contrary, the other market structures entail a sub-optimal allocation of resources. For example, the theory predicts for oligopoly higher prices and lower consumer welfare.

Along agricultural value chains, imperfect competition is thought to be widespread in food processing and retailing, while more competitive markets usually characterize the upstream stages of the chain, namely the primary commodities production. However, producers, and more specifically smallholders, in many circumstances, have little means to sell their products due, for example, to the lack of transport facilities. Those constraints lead them to rely on middlemen who have the power to impose unduly lower prices if compared with the ones that they could get if they had direct access to the market. This is for instance the situation faced by mango producers in Kenya, as illustrated in Box 3.4 here below.

When analyzing input markets, a particular focus should also be put on financing institutions which determine the financing mechanisms through which agents in a value chain fund their activities. The interactions between the value chain organization, the institutional set-up and the structure of the financial sector contributes to determine the extent which agents are able to obtain financial resources both for investment and working capital requirements[35].

[35] Miller C. And Jones L.2010. *Agricultural value chain finance: tools and lessons*. FAO UN and Practical Action Publishing. http://www.fao.org/docrep/017/i0846e/i0846e.pdf

Box 3.4: Case study: The mango market in Kenya

The mango value chain in Kenya is characterized by a large number of producers and few middlemen. Middlemen benefit from more information regarding market prices and opportunities than mango producers. Those features characterize the mango market at the production level as an **oligopsony**.

In 2008, the overall production of mangoes in Kenya amounted to around 450,000 metric tons from around 25,000 hectares of harvested area, i.e. around 15% of land devoted to fruit production. In terms of quantity and harvested area, mangos are the second fruit produced after bananas. Mango producers in the country are about 20,000 and most of them are small scale producers. Often, when selling their produce to middlemen, they are unaware of consumers' prices for mango on the main markets. Indeed, the majority of them do not operate under contractual arrangements with middlemen since the transactions are personalised. In addition, there are usually only a few middlemen buying from a large number of producers, thus each producer has limited options regarding who to sell to. Therefore, producers tend to accept the price proposed by middlemen.

The economic theory of oligopsony highlights that oligopsonists enjoy positive extra-profits, i.e. profits above the normal remuneration of capital, while sellers are earning less than they would have if they acted in a perfect competition setting. Moreover, the output is lower than the socially optimal level, because producers do not enjoy the full value of they produce, therefore facing disincentives to expand their output. If this holds true for the specific case of mango market at production level, policy makers should identify possible remedies through appropriate policy measures.

Source: FAO, 2008. Draft report on mango value chain policy analysis in Kenya (unpublished). FAO of the UN, Rome. Data on production and area harvested are from FAOSTAT.

Monopsonies may arise also because there are close technical ties between primary production and processing. This is the case for instance of sugarcane, which needs to be processed within few hours form cutting, otherwise it loses its sugar content. The sugarcane producer and the processing plant need to be close, to minimize transport time. In addition, the bulkiness of the primary product does not allow for alternative destinations, due to the large incidence of transport costs. This implies that the producer has no choice than selling the sugarcane to the nearest sugar plant. In these situations, very often producers and processors engage in some sort of contractual arrangements to ensure the possibility for the farmer to sell its produce and for the processor to procure enough raw material to feed the processing plant.

In other cases, monopsonies at the processing level may be legally constituted, i.e. created and enforced by laws and/or public regulations, with an aim of achieving a better organization of the value chain, as for instance, in the case of the cotton value chain in Burkina Faso (see box 3.5 below. However, in such cases, logistics and pricing arrangements must be set to achieve mutual advantages for both upstream and downstream agents, ensuring an equitable sharing of value added.

Box 3.5: Case study: collecting and ginning cotton in Burkina Faso[36]

Cotton is Burkina Faso's main export crop and it covered between 50% and 70% of export revenues from 2000 to 2005. This value chain is characterized by three main stages: Primary production (seed cotton), ginning (cotton fibre) and trading (cotton bales).

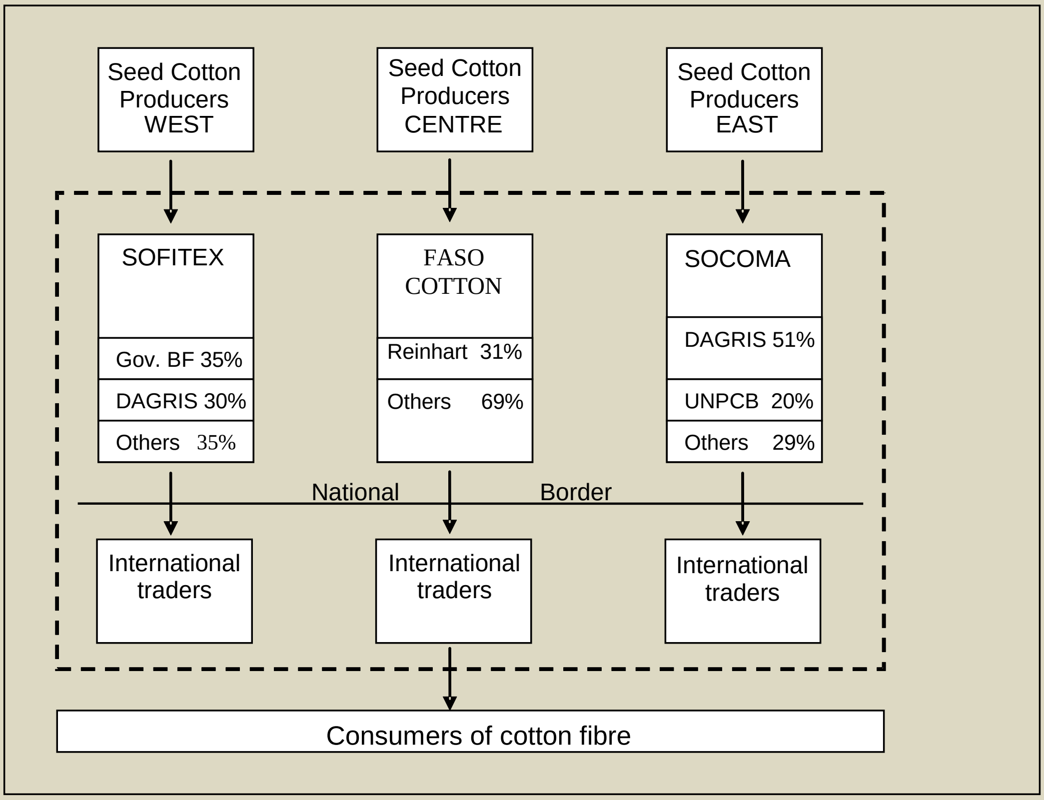
Collecting and ginning activities are organized as **legally established regional monopsonies**. Three companies have the control of these activities in the three regions of the country and handle the relationships with the international markets. In 2004, a national law attributed to three companies the control of the collection and ginning of the cotton: SOFITEX, FASO COTTON and SOCOMA, respectively cover the western, central and eastern areas of the country. SOFITEX is controlled by a joint venture of the Government of Burkina Faso with the partially state-owned French company DAGRIS[37]. FASOCOTON is controlled by the Swiss multinational company REINHART, one of the major cotton traders world-wide, while SOCOMA is controlled by DAGRIS and by the Union Nationale des Producteurs de Coton du Burkina Faso-UNPCB (national association of the cotton producer in Burkina Faso). These companies buy the seed cotton and, after the ginning and pressing process, sell cotton bales on the international market (Figure 3.4).

The price paid to farmers is set through a two-stage pricing mechanism. At the beginning of each campaign, the three companies announce a floor price (*ex-ante* price) for the seed cotton which is 95% of the so-called "pivot price". The pivot price is a reference price based on the average international price of the cotton fibre of a given quality in the last five years taking into account a technical conversion factor between seed cotton and cotton fibre and some standard processing costs. The average international price corresponds to the "*Cotlook A*" Index, which is calculated as the average of the cheapest five quotations from a selection (at present numbering nineteen) of the principal upland types of cotton traded internationally[38].

When the seed cotton is delivered, farmers are paid at the floor price net of the cost of the inputs they received at the beginning of the campaign and related interest. At the end of the campaign, the "*ex-post*" price of seed cotton is calculated using the same criteria applied for the pivot price. If the "*Ex-post*" price is lower than the floor price, the companies receive a compensating payment from a stabilization fund ("*fond de lissage*"). If the price is comprised between the "floor price" and 101% of the "pivot" price, the companies pay farmers the difference between the "*Ex-post*" price and the "floor" price. If the "*Ex-post* price exceeds 101% of the "pivot" price, the part up to the 101% goes to farmers, whereas the part exceeding 101% goes partly to the "stabilization" fund, partly to the companies and partly to the farmers.

[36] Based on: Bellù (2010): ‚*Incentives-disincentives in Transnational Value Chains: the Example of Burkina Faso*, unpublished document. FAO, December 2010.
[37] APE (2008): Agence des Participations de l'Etat: French State as a Shareholder. Ministère de l'Économie, de l'Industrie et de l'Emploi. Report 2008.
[38] For more information on the Cotlook A Index, see www.cotlook.com

Figure 3.4: Structure of cotton value chain in Burkina Faso



By construction, the Cotlook A index is an underestimate of the actual average market price because it is based on the five cheapest daily transactions. By way of consequence, a pricing mechanism based on the Cotlook A index tends to underestimate the actual market price and may act as a systematic "disincentive" to cotton producers.

In addition, in situations where the domestic processing companies are directly or indirectly controlled by the international traders the price paid to domestic companies by international traders may be lower than the value of cotton (net of a "normal" trade commission) that they enjoy on international markets. Domestic companies and international traders may be in actual facts two sides of the same economic subject that, in absence of a binding and enforceable domestic legal framework for international transactions, may apply "internal transfer prices" i.e. prices of goods that are sold within the same group that are lower than actual values, with the aim of expatriating profits (Brealey and Myers,1991)[39].

Furthermore, in situations where producers' supply curve is rigid, a lower price might translate almost exclusively in a reduction of producers' income. Rigidities may arise because in concrete situations it is difficult for producers to shift production factors to other uses. This phenomenon could be the result of both technical as well as institutional factors, such as the influence of processing companies on farmers *via* agricultural input availability, "informal" social or political pressure etc.

[39] Brealey R.A. and Myers S.C: (1991) Principles of corporate Finance, Fourth Edition (p. 880) Mc Graw Hill.

3.5. Functional Analysis of the value chain

The functional analysis provides a detailed profile of the industry structure through the identification, description and quantification in physical terms of the sequence of operations concerning commodity production, processing, marketing and final consumption.

More specifically, it examines:

a) Technical operations required from primary production to final consumption.
b) Inputs used and intermediate outputs produced at each stage of the chain.
c) Economic agents involved at the different stages and related functions.
d) Physical flows of the commodity among the different agents.
e) Bottlenecks (e.g. inputs availability, logistical issues, etc).

A first step in analyzing the functions of a value chain implies setting the boundaries of the value chain, i.e., defining the portion of the economic system analysts want to analyse[40]. Once the contours of the value chain are clearly defined, three more steps are required to complete a functional analysis: identifying activities, identifying agents, quantifying physical flows and describing market structures. These steps are summarized in Figure 3.5.

Figure 3.5: Steps of a Functional Analysis

I. Setting the boundaries
II. Identifying the activities
III. Identifying the agents
IV. Quantifying the physical flows

3.5.1. Setting the boundaries of the value chain

Different criteria can be employed to frame a value chain. Agricultural value chains are usually identified on the basis of the primary commodity used (for example maize chain, cotton chain, etc). Then, we follow the basic commodity downstream along:

a) All the processing stages up to the final commodity.
b) Market intermediaries.
c) Various by-products and/or joint products.

When analyzing a national value chain, country borders are usually taken also as the borders of the chain. However, the analysis can be extended well beyond the borders of a single country, whenever the commodity is traded abroad and analysts are required to understand the whole processes of generation and distribution of the value. This is particularly relevant when the same agent operates both as a national agent within the country borders and as an agent on international markets (transnational value chains).

[40] Some production processes give rise to a multiplicity of outputs (joint products), therefore it can be difficult to define which product line to follow, or in other words, to identify the "value chain". However, any analytical exercise is driven by the reasons why it is undertaken, which helps analysts include in the analysis what is expected to be relevant and discard what is not expected to matter in relation to the goals of the study.

3.5.2. Identifying activities

Understanding the way a value chain works implies to identifying the main activities undertaken at each stage of the chain, namely the:

a) Primary commodity production, including different technologies.
b) Processing level, including determination of sub-chains due to different processing methods.
c) Transport, handling, storage.
d) Wholesale and retail distribution.
e) Intermediation.

Usually, only the operations directly related to the commodity are considered. However, it may be advisable also to take into account input supplies strategic for the services to the chain, for example farm equipment, agricultural machinery, fertilizers, phytosanitary products, etc, as they may constrain the chain development.

3.5.3. Identifying agents

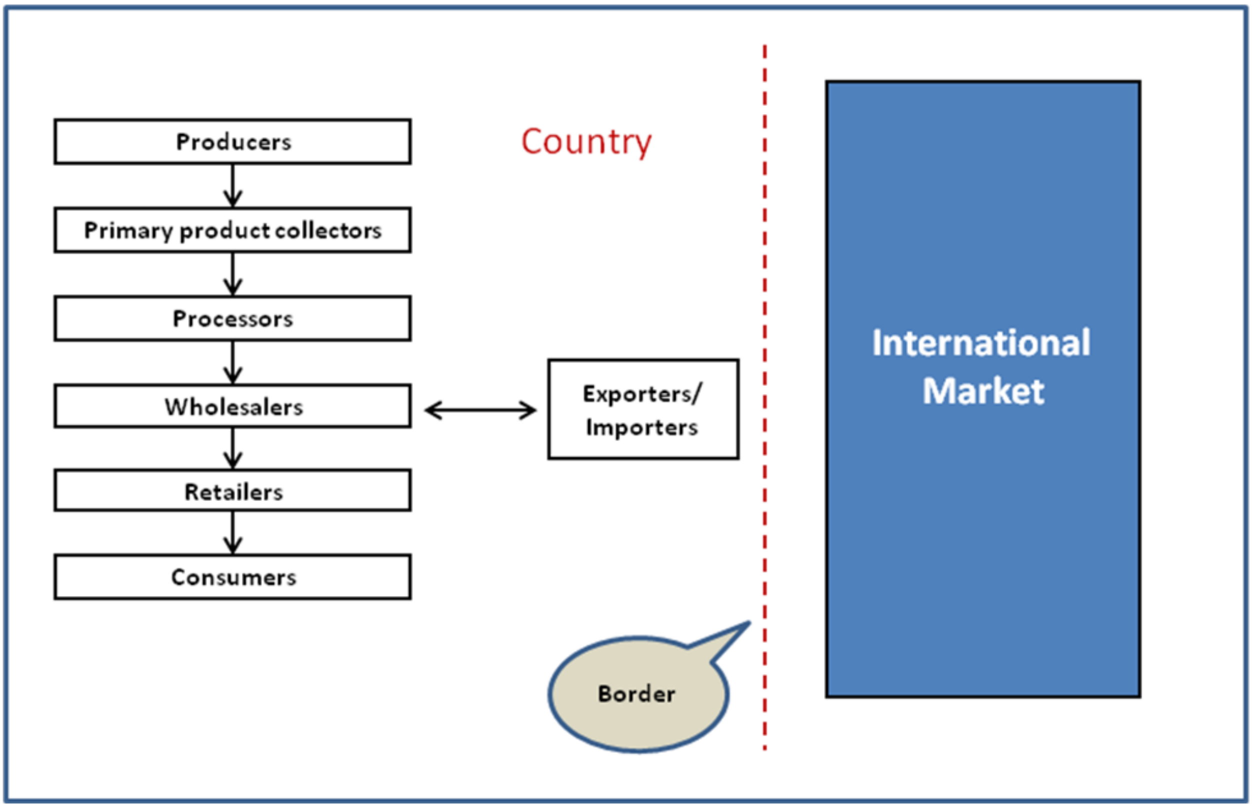
Once the operations undertaken within the value chain have been identified, it is fundamental to understand what types of agents perform them. In other words, activities have to be matched with agents and the roles of the latter have to be examined, considering that some of them might carry out more than one activity. This step entails the classification of agents into homogeneous and relevant categories. How can we choose to aggregate a multitude of individuals into representative categories of agents?

If we take for example the production of rice in Burkina Faso, data reveal the existence of different production systems for rice: the rain-fed, the pumping irrigated intensive and the gravitational irrigated intensive (DGPER, 2009)[41]. Furthermore, rice producers differ by farm size and are located in several areas of the country. These different characteristics are likely to impact on the cost structure of producers and on the yields. Thus, analysts have to make a choice on how to aggregate producers, who potentially exhibit myriad of specificities, into categories that are manageable, clear and detailed enough to be relevant for the purpose of the analysis. A balance between accuracy and simplicity has to be found.

In general, a distinction is often made between small holder producers and large commercial farms. The distinction between these two categories of producing agents is based on the differences in the production techniques used and allows analysts to classify the analysis in terms of different socio-economic features. Once the match between activities and agents is made and once the relevant categories of agents are built for all the value chain, this information can be represented in a **flow chart** (see Figure 3.6).

[41]Direction Générale de la Promotion de l'Economie Rurale (DGPER) 2009 : Analyse de la compétitivité de la filière Riz Local au Burkina Faso. Ministère de l'Agriculture, de l'Hydraulique e des Ressources Halieutiques. Ouagadougou. http://www.fao.org/docs/up/easypol/938/analyse-filiere-riz-local-burkina-faso_131fr.pdf

Figure 3.6: Basic chain flow chart



For the purpose of analytical clarity and as an effective presentation tool, information regarding main activities, agents involved and outputs produced can also be illustrated with a "**functional analysis table**". An example table for the value chain of rice is shown in Table 3.2.

Table 3.2: An example of functional analysis table: rice value chain

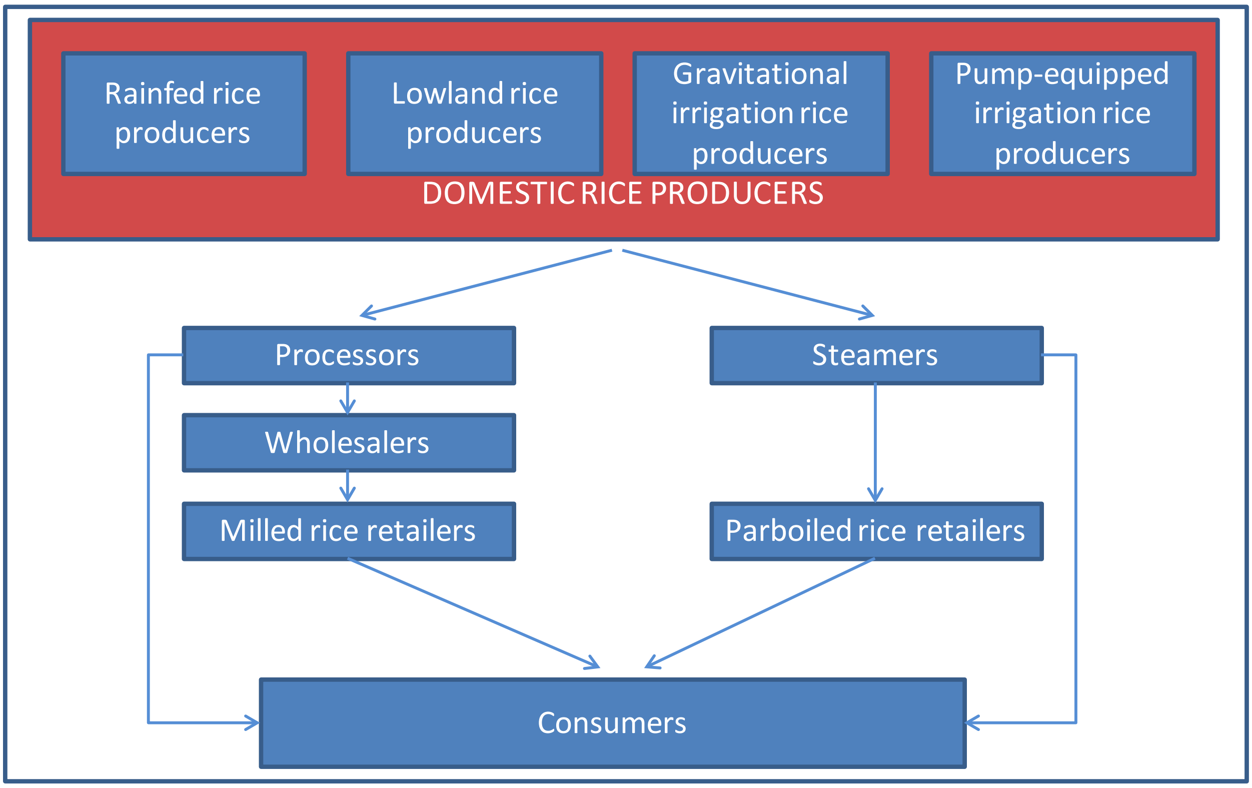
Activity	Agent	Output
Paddy supply	Rainfed rice producers Lowland rice producers Gravitational irrigation rice producers Pump-equipped irrigation rice producers	Paddy rice
Self Consumption	National rice producers	Paddy rice Self-processed rice
Trade (paddy rice)	Village collectors-traders Local merchants Trade Cooperatives	Paddy rice delivered to consumers
Steaming	Steamers	Parboiled rice
Processing	Processors (Huskers,...)	Milled rice Processed rice
Trade (rice) Selling	Wholesalers Milled rice retailers Parboiled rice retailers	Milled rice Parboiled rice

Source: Freely adapted from DEP, 2009 [42] .

In turn, the information included in the functional analysis table (Table 3.2) can be used to draw a flow chart to illustrate the rice value chain, as in Figure 3.7. Figure 3.8 illustrates a flowchart for a cocoa value chain.

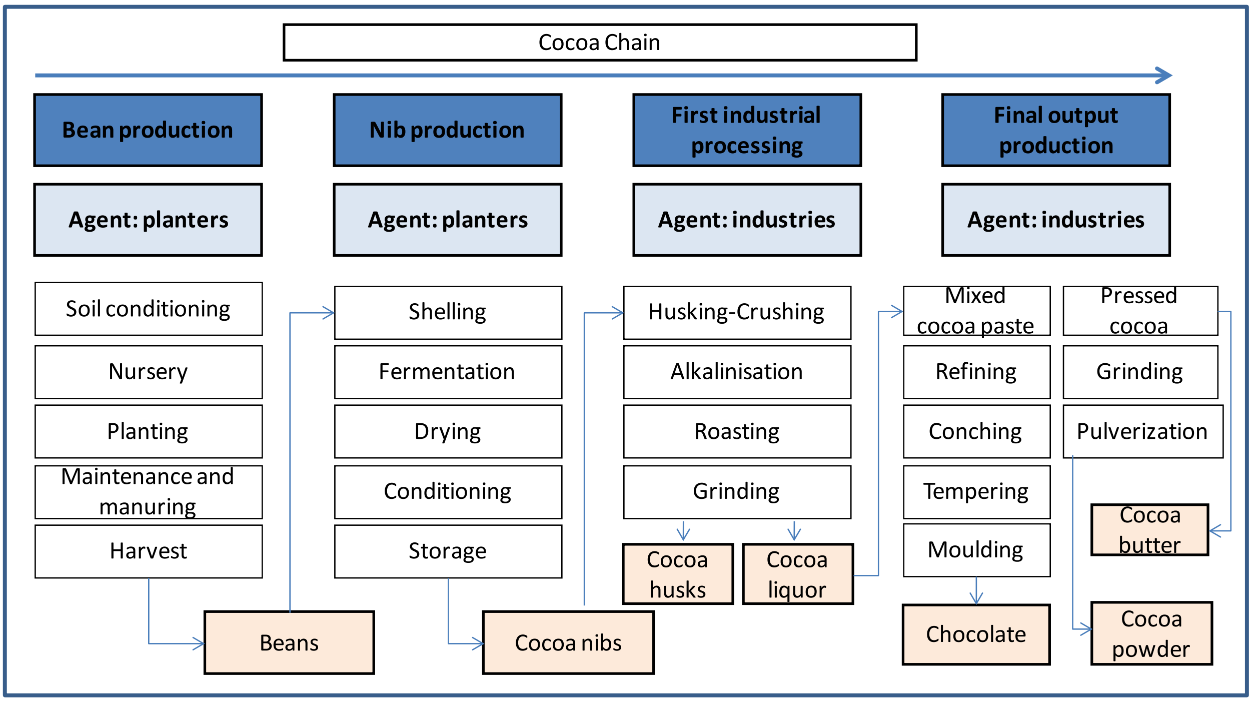
[42] DEP, 2009. *Analyse de la compétitivité de la filière Riz Local au Burkina Faso*. Direction des Etudes et de la Planification, Ministère de l'Agriculture, de l'hydraulique et des ressources halieutiques. EASYPol series 131 FAO, Rome, Italy.

Figure 3.7: A flow chart for the rice value chain in Burkina Faso



Source: freely adapted from DEP 2009.

Figure 3.8: Technical Analysis: the cocoa value chain



Source: elaborated on the basis of: About Cocoa. International Cocoa Organization (ICCO) http://www.icco.org/

Box 3.6: Case study: firewood in Burkina Faso

In Burkina Faso firewood represents the main energy source of households, artisans and the industry sector. Agents in the firewood value chain can be grouped into 3 main groups: firewood producers (woodcutters), firewood wholesalers and firewood retailers. However, the identification and analysis of the agents of the firewood value chain in Burkina Faso is very peculiar because of the presence of two different systems. Indeed, the market of firewood is characterized by the coexistence of a formal and an informal system.

On the one hand, selected firewood producers are organized in a socio-professional association at the town level, the forestry management association (Groupements de Gestion Forestières - GGF). By means of their union (UGGF) they are in charge of the managed forests where they must carry out conservation activities such as the protection of the range of vegetation cover, to making investments needed for forests management, etc. This group of agents includes both producers of firewood and woodcutters.

On the other hand, other firewood producers carry out their activities outside any formal framework. Within this informal system, the production of firewood is not controlled. Several informal woodcutters aim at producing for self-consumption. However, some of them carry out production activities for commercial purposes.

Firewood wholesalers carry out 2 main activities: purchasing firewood and its distribution to retailers. In some cases they are both wholesalers and retailers selling the firewood directly to consumers.

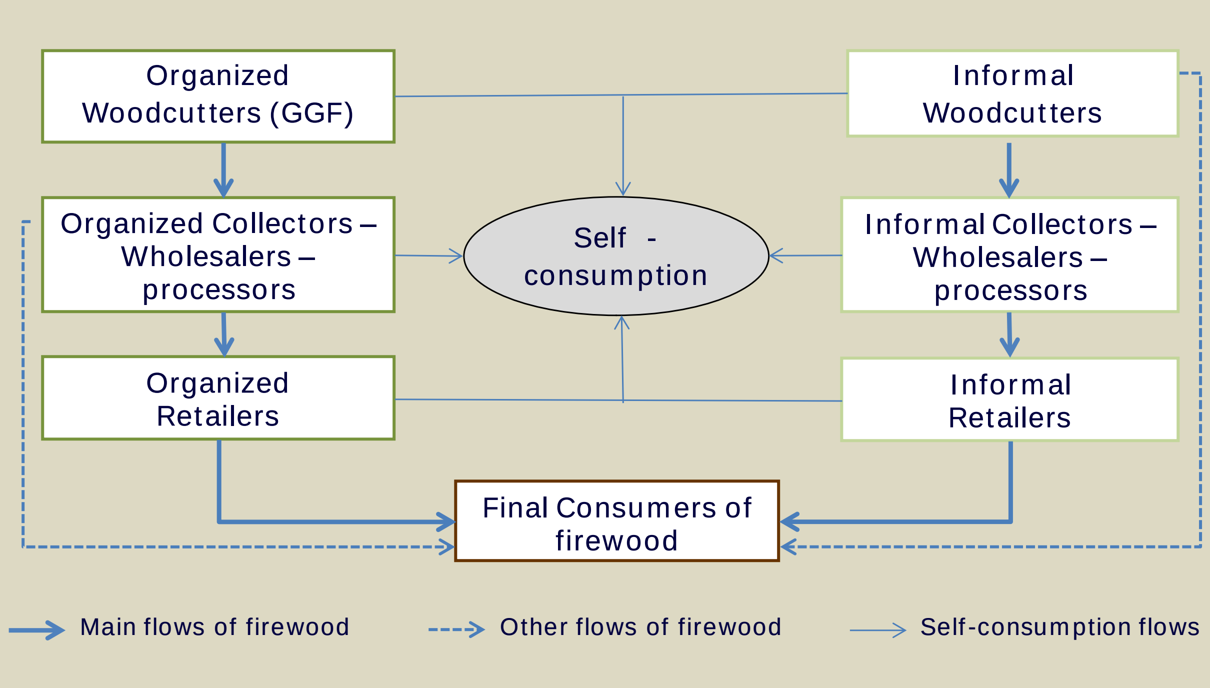
In the formal system, the wood comes from the forests managed according to the technical rules favouring the renewal of the forest and the channels of distribution are mainly represented by the traders organized in associations.

However, the majority of the distribution channels are part of the informal system. This system is fed by firewood coming from unmanaged areas where forestry resources are not protected and the distribution channels are represented by pedestrian, cyclists, carters and truck drivers.

In both systems, firewood retailing is manly managed by women who use wood bark and residue for their needs. In the same way, woodcutters and traders also exploit wood bark and residue for home consumption.

In Figure 3.9 the role of the different agents is shown together with the flows of firewood within the chain. The flow of product from producers to consumers through wholesalers and retailers of firewood since it is the main flow of the value chain. However it is also important to take into account the weaker flows of products generated by the sale of products carried out by the wholesalers.

Figure 3.9: Flows of firewood and linkages between the agents in the value chain



3.5.4. Quantifying physical flows

In value chains, commodities can undergo several stages of collection and processing and eventually reach consumers through different distribution channels; the commodity physical flow streams down the value chain, going from one agent to the next. Figure 3.7 illustrates a typical flow chart containing inputs and outputs of the process as well as activities and agents involved. To better understand the value chain structure and the relative weight of the agents operating within it, commodity's **physical flows** need to be quantified.

Collecting all data needed to quantify flows for a value chain analysis usually requires drawing information from different data sources. The quantification of physical flows occurs through yields per unit of activity (e.g. ha) and the times the number of ha are cultivated.

Good practice wants that data consistency is checked, especially between quantities supplied and quantities used. This can be done through:

a) Input-output matrices of flows among agents.

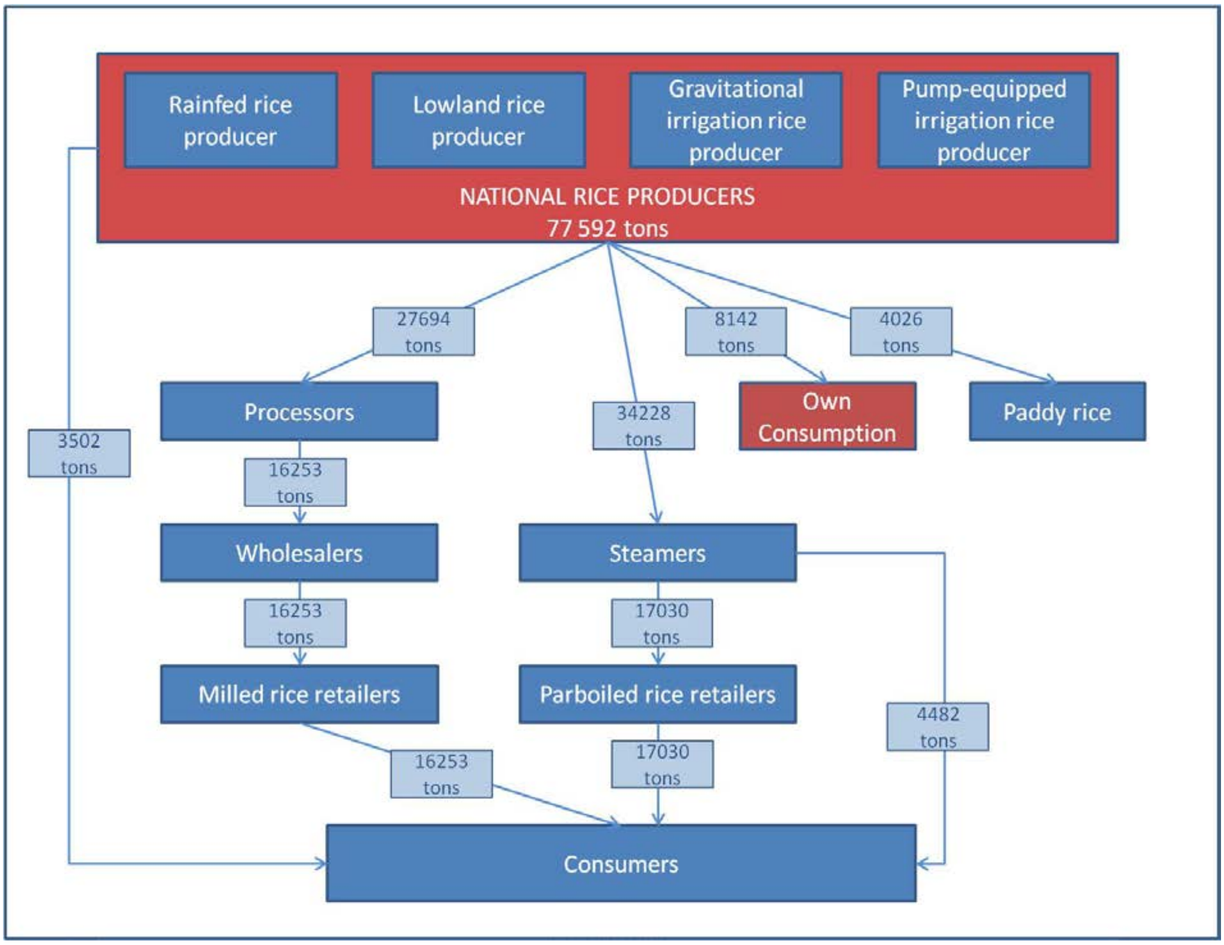
b) Graphical representation of physical flows.

c) Supply Utilization Accounts (SUA).

The *input-output matrices* provide a synoptic view of flow of the physical quantities managed by each agent. In order to be consistent, in the matrices, all the physical flows have to be expressed in commodity equivalents (e.g., flour expressed in terms of grain required). However in practical terms this often makes use of input-output matrices cumbersome and not effective.

The *value chain flow charts* are useful to host and report information regarding physical flows of the commodity at different stages of the chain. Figure 3.10 duplicates Figure 3.7 but also includes quantities to the process. This graph helps analysts to visually check the consistency of their data. However, as value chains become more and more complex, graphical representations become increasingly complicated and less effective.

Figure 3.10: Quantification of physical flows: an example of rice value chain



Source: Freely adapted from DEP 2009

To overcome these practical difficulties analysts widely use SUA, consisting in a double-entry accounts that allows analysts to check consistency, at each stage of the chain, between the quantities of the commodity supplied by upstream agents and the quantities absorbed by the downstream ones. In SUA, the overall quantities used correspond to overall quantities supplied. Analysts can build as many SUAs as the number of stages of the chain, implying that each of them is a physical balance of the commodity at a different stage of transformation process (e.g., wheat, flour, bread etc). Therefore, no calculated balances in commodity equivalents are needed, as in the case of physical input-output matrices. The consistency check is particularly useful when statistical data come from different sources.

However, internal consistency between inputs and outputs within each agent has still to be verified using technical coefficients.

As the calculation and adjustment of SUA is often quite cumbersome, dedicated software packages allow analysts to carry out these consistency checks[43].

Figure 3.11: An example of Supply Utilization Account (rice sub-sector)

	Supply items		Utilization Items	
	National rice production of paddy	77,592	Processed	27,694
			Steamed	34,228
			Own consumption	8,142
			Traded	3,502
			Other use	4,026
Total		**77,592**		**77,592**

Source: Freely adapted from DEP 2009

[43] For instance, the FAO-VCA-Tool software allows analysts to perform data adjustments, and quantity consistency checks.

3.6. Appendix: exercises

Exercise 1: Value chain functional analysis

a) Choose a value chain for which you have or can easily obtain relevant information.
b) Identify and list all relevant activities and agents in the chain.
c) Set up the functional table (see Table 3.2).
d) Set up the flow chart (see Figure 3.6).
e) Identify physical flows (see Figure 3.10).
f) Prepare a 5 minute presentation.

Exercise 2: Quantity flows in the paddy rice sub-sector

In the current period, in country X, around 150,000 farmers produce paddy rice. Almost all of them are smallholders presenting similar socio-economic features and applying similar technologies. Therefore, they can be described by means of a "representative producer" profile, i.e., an "average" small scale producer.

This representative producer is endowed with 0.4 hectares (ha) of land and uses three inputs and factors: seeds, fertilizer and labour, applying the technology described in Figure 3.10. Using this information, calculate the quantities of inputs and outputs used at farm level and at paddy sub-sector level, by filling in the flow chart in Figure 3.10. To this end, assume that the representative farmer applies the technology by proportionally adapting inputs and factors to available land and obtains a proportional quantity of output.

Figure 3.12: Exercise 2-Paddy production technology

Activity: cultivating 1 ha of paddy rice		
Input quantities per ha		
	Unit	*Quantity*
Labour	Person/month	4.00
Manure	Ton	0.60
Seeds	Ton	0.03
Output quantity per ha		
Paddy rice	Ton	1.30

Figure 3.13: Exercise 2-Physical flows of inputs and outputs

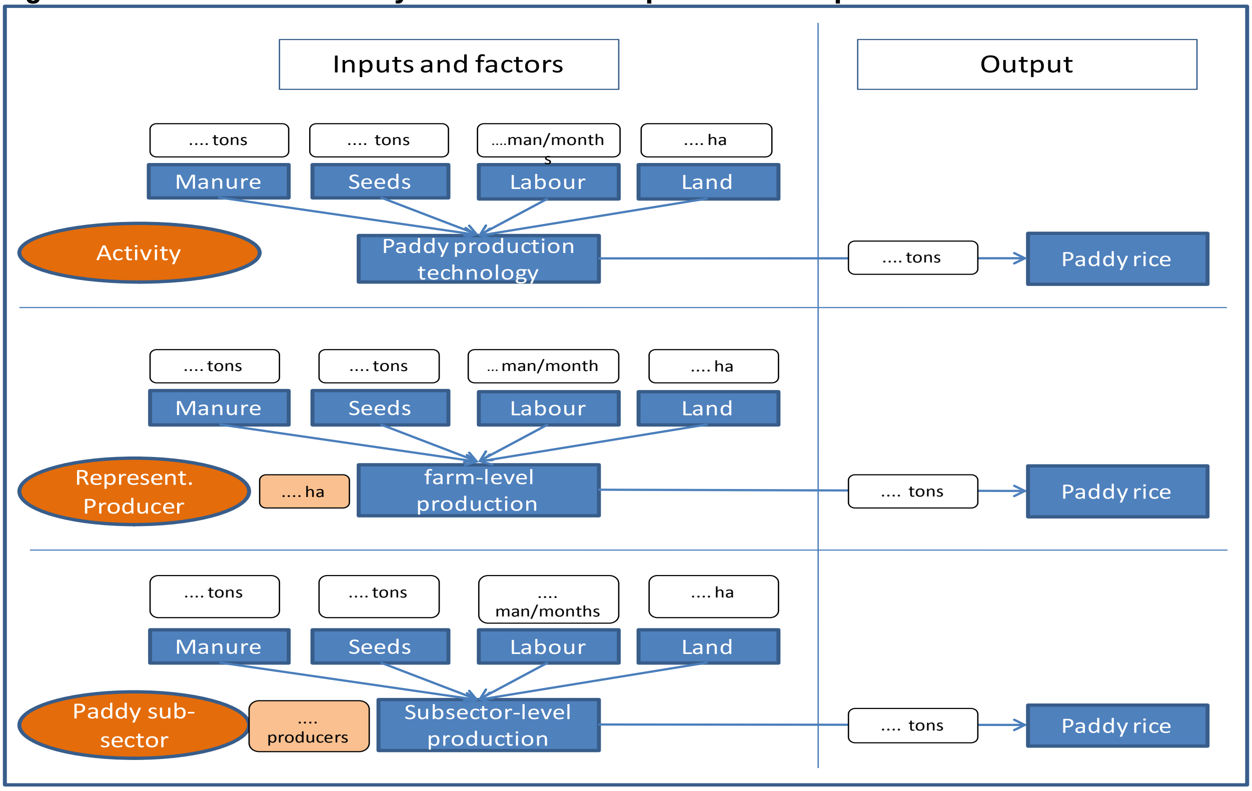
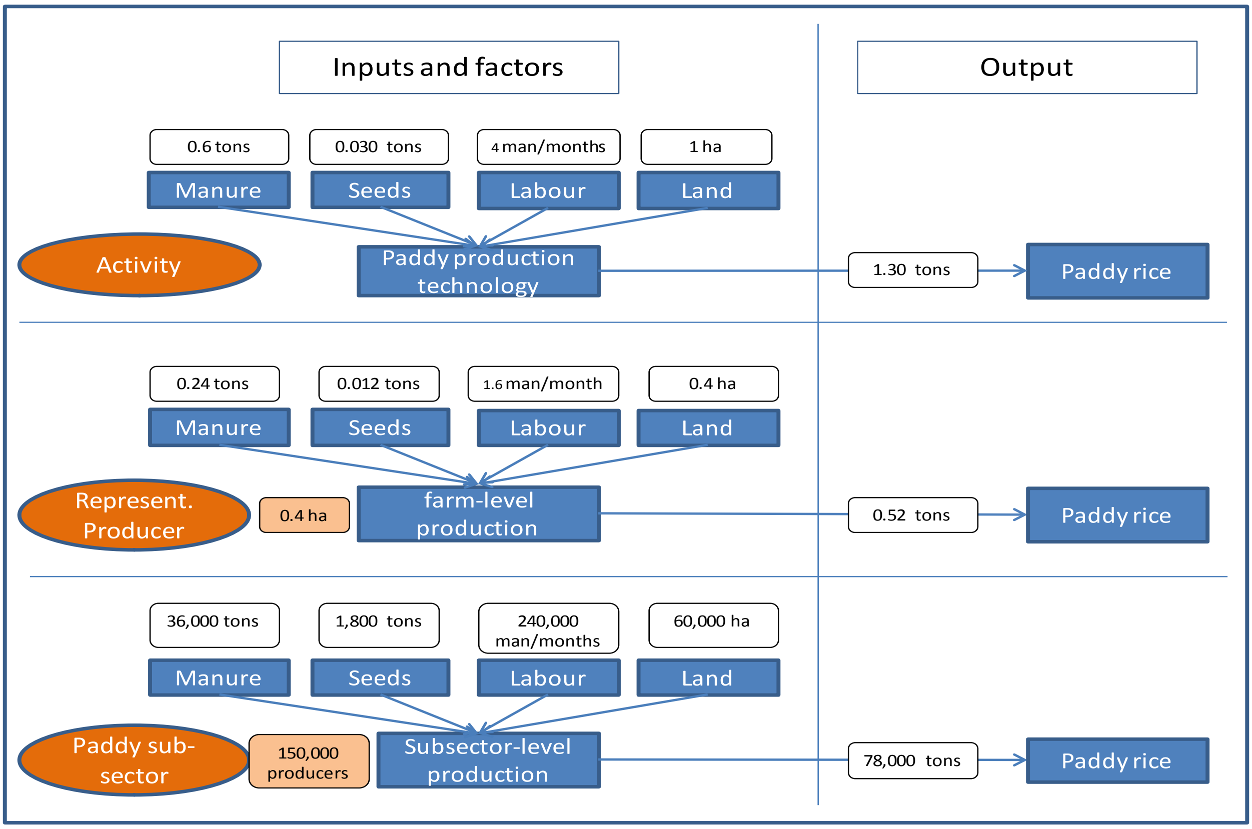


Figure 3.14: Exercise 2-Solution



4. ECONOMIC ANALYSIS: GENERAL ASPECTS

The "*Economic Analysis*" of a value chain assesses in quantitative terms the creation of "*Value Added*" and its distribution to the various agents involved. The Value Added is a measure of wealth created in an economic system by a production process, net of the resources consumed by the process itself.

More specifically, the economic analysis allows the analyst to determine:

a) The value added created by the overall value chain.
b) The value added and margins for each economic agent at each stage of the chain.
c) The allocation of value added among production factors (capital labour, other assets) and the public budget, through the respective distributive variables: (profits, wages, rents and taxes).

On the one hand, the gross domestic product (GDP) of a country is actually an aggregate measure of the value added (gross of depreciation) produced by all the economic activities in different sectors. Therefore the assessment of the value added created by the overall value chain is useful to investigate the extent to which a value chain contributes to the GDP. On the other hand, how value added is shared among factors is key information which allows analysts to assess the social importance of the value chain activities and changes in the income levels and household expenditure likely to be induced by policy measures affecting the value chain. How to compute value added and margins in the value chain framework will be presented in the next section.

The economic analysis builds essentially on the functional analysis described in Chapter 2, because it requires that analysts identify the key elements of the value chain (i.e., the economic agents and their activities) and the quantification of the physical flows of the main commodity among agents.

The economic analysis of a value chain, pretty much as most Cost-Benefit Analyses (CBAs), is carried out both from the perspective of private agents and from the perspective of the society as a whole. The relevance of this "double" analysis is due to the fact that, on the one hand, it is important to investigate the revenues, costs and related margins that agents actually face, as they act as incentives (or disincentives) for each agent to engage or stay engaged after a shock or a policy-induced change, in its specific economic activity. To this end, physical flows of inputs and outputs are assessed in monetary terms using the so-called "*market prices*" (or "*private*" prices), i.e., prices actually faced by the agents. On the other hand, it is also important to investigate whether the society as a whole benefits or loses from a given activity. In this case, "*reference prices*" (or "*social*" prices) are adopted, as they are calculated in such a way to approximate the actual value of goods and services of the society[44]. "*Reference"* prices are often directly or indirectly based on international market prices of internationally traded goods and services. Chapters 7and 8 explain how to calculate the different sets of prices. For each agent, as well as for whole value chains, information on revenues, costs and margins calculated both at "*market*" and "*reference*" prices can be summarized in the so-called "*Policy Analysis*

[44] Divergences between "*market*" and "*reference*" prices emerge due to market failures and/or policy interventions..

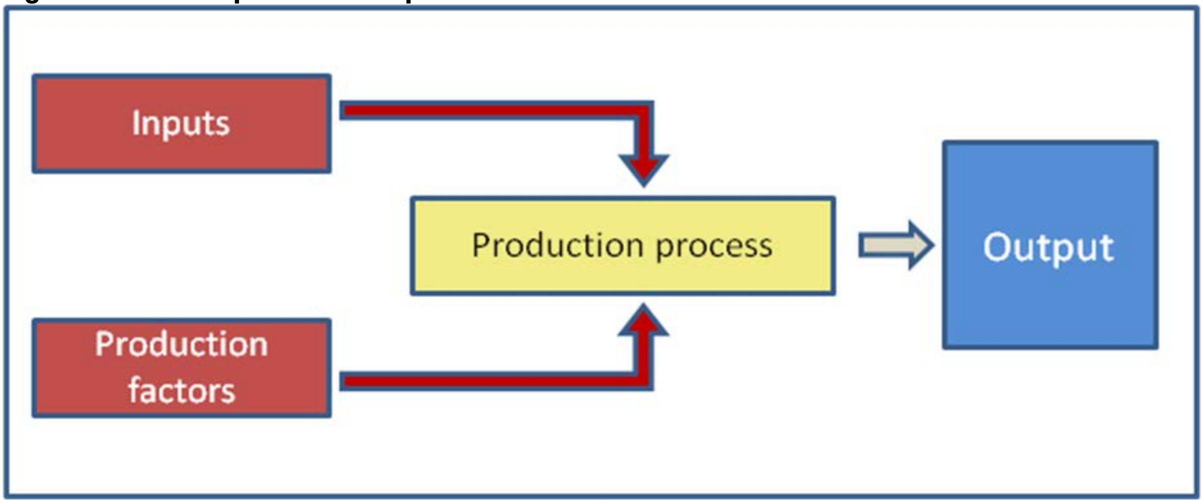
Matrix" (PAM). Competitiveness and protection indicators are then calculated on the basis of PAMs (see chapter 9 for more details).

4.1. Economic Analysis at market prices

The purpose of the economic analysis of a value chain at market prices is to appraise revenues, costs and margins (value added and net benefits) of each activity, each agent, segments of the value chain and the whole value chain, on the basis of prices actually paid and received by economic agents[45].

Within a production process, inputs and production factors are combined together with the purpose of obtaining one or several outputs (Figure 4.1). Production refers to a process entailing human involvement and not being a purely natural process. In this context, for example, the unmanaged tree growth is not production, whereas collecting berries is part of a production process. The agent is the institutional unit that takes responsibility for the production process and owns any goods produced as outputs. How inputs are combined in order to obtain given outputs is defined by the *production technology*. The output of the production process can be either goods or services.

Figure 4.1: The production process



Fundamental tools for the economic analysis are the "*Production account*" and the "*Income account*" for a given period[46]:

a) the **Production Account** of a production process determines the **Value Added** (VA), as the balancing item of revenues minus the value of the inputs required to obtain that output[47] (see Section 4.2);

[45] Information and data requirements to build an economic analysis at market prices and to be adapted to specific cases is listed in Annex 1 to this Chapter.

[46] To the maximum extent possible, the criteria and terminology adopted here adhere to the standards defined by: United Nations, Statistical Division- UNSTATS (2008): System of National Accounts (SNA), available at: http://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf .

[47] "*The balancing item of the production account is value added, so called because it measures the value created by production. Value added is of analytical interest because when the value of taxes on products (less subsidies on products) is added, the sum of value added for all resident units gives the value of gross domestic product (GDP)*". (SNA, 2008, p 103, par 6.7)

b) the **Income Account** determines how the value added is distributed among the actors participating in the production process through the supply of production factors such as labour, capital, land, other natural resources, entrepreneurial capacities, etc.

In VCA, these accounts are built for each activity, following accounting standards, the application of which ensures consistency and comparability of results within and across value chains, and also between different countries.

Building production and income accounts entails taking into account revenues and costs of an agent over a given time period, also imputing costs and revenues not yet materialized or materialized on a different time span but attaining to that period. The economic analysis at market prices looks at the costs or benefits of an agent from the viewpoint of her/his *opportunity costs* (see Section 4.2). This implies assessing net benefits deriving from running an activity, by factoring the cost of foregone revenues accruing from alternative uses of inputs/factors of production and the benefits stemming from producing rather than buying the same products[48].

4.2. Building the production account of an economic activity

The production account of a production process in a given period allows analysts to calculate the Value Added. This balance is a measure of the new wealth generated by the production process in that period and available for final uses (final consumption and savings) The income corresponding to the Value Added "*allows one agent to consume the goods and services produced by another agent or to acquire goods and services for later consumption*" (UNSTATS, 2008)[49].

Value added can be calculated either before or after deducting the consumption of capital goods used in the production process, the so called "*consumption of fixed capital*". This gives rise to the following balances:

- **Gross Value Added (GVA):** the value of output net of the value of intermediate consumption.
- **Net Value Added (NVA)**: the value of output net of the values of both intermediate consumption and consumption of fixed capital.

The consumption of fixed capital is not always straightforward to measure. Indeed, very often, only the mere depreciation of items based on unadjusted historical purchase prices of assets is available in business accounts. For this reason, the gross value added is easier to estimate and tends to be more plausible. However, net value added is more relevant for analytical purposes.

An example of a production account is reported in Table 4.1.

[48] The economic analysis at market prices should not be confused with the "cash flow" analysis. The latter assesses solely items that imply monetary inflows and outflows of a business in a given period. Thus, in the economic analysis, the profit that is computed as the balance of the income account does not reflect the amount of money that ends up in the pockets of an agent in a given period, which is the result of the cash flow analysis.

[49] UNSTATS 2008, p.2 par 1.6.

Table 4.1: An example of a production account

D= A+B+C	**Total Output Value**			**1110**
	A. Sales Revenues		1,000	
	B. Own Final Consumption		100	
	C. Change in Inventories		10	
	C1. stock end of period (+)	50		
	C2. stock beginning of period (-)	40		
E	**Intermediate Inputs (II)**			**500**
F= D-E	**Gross Value Added (GVA)**			**610**
G	Consumption of Fixed Capital		90	
H= F-G	**Net Value Added (NVA)**			**520**

Therefore, to work out the production account and its balance it is necessary to compute the following three items:

a) Total output value.
b) Intermediate inputs costs.
c) Consumption of fixed capital.

The items of a production account are described with more detail here below.

4.2.1. Total output value

The goods and services produced as outputs can be:

a) Sold on the market.
b) Used for own final consumption.
c) Stocked for future sale or use (changes in inventories).

Thus, when analysts build a production account for a given period, they calculate the total output value by adding up the value of the product *sold* in that period, the value of the product destined to own final use and the value of the stock of the product (inventory) at the end of the period net of the stock at the beginning of the period[50]. This item is added because the relevant quantity of output to be accounted for is the amount actually produced a given period, not necessarily corresponding to the sales of the output in that period.

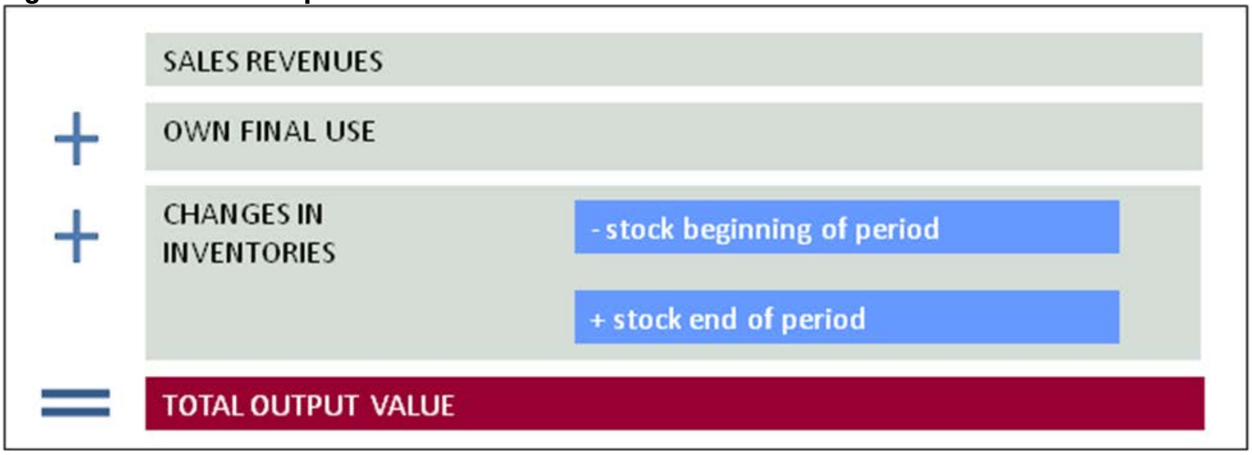
All quantities computed are priced at market prices. In particular, own final consumption should be valued at the price at which it could have been sold on the market.

The share of product retained for final use by producers should be classified as such only when it could have been sold on the market. This, by convention, excludes outputs of domestic and personal services produced by household members such as cleaning or repairing the house,

[50] The balance between the stock at the end of the period and the stock at the beginning of the period gives the changes of inventories.

preparing and serving meals, etc., because they are directly related to the intra-household management, not to the production activity[51]. The calculations to obtain the total output value are illustrated in Figure 4.2.

Figure 4.2: Total output value



4.2.2. Intermediate input costs

In the production account, the goods entering the production process and totally consumed during a production period are recorded as "*intermediate inputs*". The cost of intermediate inputs is obtained by pricing items at their purchase prices that prevailed when they enter the process of production[52]. For intermediate inputs the relevant quantity is the amount actually consumed to produce the output imputed to a given period, not necessarily corresponding to the purchases of the input in that period. Therefore, the "*changes in input inventories*" should be added to the purchases of the period.

In value chain analysis, a fundamental distinction is made between *Intermediate Inputs produced Inside the value Chain (IIIC)* and *Intermediate Inputs produced Outside the value Chain (IIOC)*. This distinction is made because the inputs within the chain are the elements which link one segment of the value chain with the preceding one. For example, in the case of the sugar value chain, sugarcane is an intermediate input produced inside the value chain whereas fertilizers, pesticides, seeds, etc., are intermediate inputs from outside the value chain. Through the price of intermediate inputs produced inside the value chain paid by the downstream agent to the upstream one, the value added is distributed along the value chain. Changes of prices of these inputs affect the way the Value Added is distributed. The balance of powers between agents in the two segments, negotiating capacities, market functioning (or malfunctioning) and other institutional factors contribute to define the price of IIICs and, by way of consequence the value added distribution along the value chain.

[51] However, the value of domestic services provided by family members that should otherwise be bought on the market, may contribute to assess the opportunity cost of family labour (see Section 3.3).
[52] The prevailing price when they enter the production process has to be used instead of the price at which they were purchased, to better reflect the actual value of the items.

4.2.3. Consumption of fixed capital

While some goods are thoroughly consumed during one single production period like intermediate inputs, some others, such as vehicles, machinery and equipment, can be used over several production periods. These inputs are defined as *fixed assets* and the stock of fixed assets is defined as fixed capital. Although fixed assets produce services for several periods, their value *P* normally declines over time, due to physical deterioration, obsolescence (i.e., loss of value due to technical progress) or expected accidental damage. The decline in value in one accounting period is defined as the "*Consumption of fixed capital*" in that period (SNA, 2008)[53]. To correctly take into account all the resources consumed to produce a given output the consumption of fixed capital also needs to be imputed into the production process. In this way, the consumption of the asset is correctly imputed to several years rather than just to the year of purchase. Under the assumption that the value of an asset is the sum of future gains obtainable from that asset (discounted with an appropriate discount rate to reflect the opportunity cost of capital)[54], the decline in the value of the asset in a given period, i.e., the cost to be imputed to that period is the gain of that period (see Annex 2 to this chapter).

The reduction in the efficiency of an asset, period after period of its economic life lasting *n* productive periods, is reducing the gains from that asset in each subsequent period. However, since analysts are often interested in analyzing the value chain and related policy impacts in an "average" situation, they may assume that the efficiency of the asset is kept constant during its economic life, by adopting the so-called "*one-hoss shay*" depreciation model (See OECD, 2001)[55]. This implies assuming that the asset provides the same quantity of services in all the periods of its economic life, until it completely wears out. This implies also that the gains from the use of the asset as well as the loss of its value and the related cost *Cf* to be imputed to each period are the same for each period and correspond to the initial value divided by the number of periods of its economic life:

$$Cf = \frac{V}{n}$$

Assuming that for instance the value of an asset *V* is 1,000 Monetary Units (MU), under the assumption of constant efficiency for e.g. *n*=5 years, its loss of value per year Cf is:

1,000 MU / 5 Years = 200 MU/year[56].

Note that the cost of an asset to be imputed to each period should also cover the **interest cost** on the anticipated value of the asset, because the fixed asset needs to be funded with anticipated resources before the gains materialize. However, as the interest cost does not affect the amount of value added produced but only its distribution, this issue will be discussed when dealing with the income account.

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[53] SNA, 2008. paragraph 6.240.

[54] SNA, 2008. paragraphs 6.246-6.251. This assumption is the basis of the so called Perpetual Inventory Method (PIM) to estimate the value of an asset.

[55] For this model and alternative models of capital consumption such as the "double declining balance method" OECD 2001: Measuring Capital. OECD, 2001. *Manual measurement of capital stocks, consumption of fixed capital and capital services* p. 60. Available at: http://www.oecd.org/.

[56] Note that, assuming for instance an opportunity cost of capital of 10%, 1,000 MU is the sum of a discounted constant flow of gains of 239.8 MU occurring for five years and materializing at the beginning of each period, as follows: 1,000 = 239.8 + 218.0 + 198.2 +180.2+ 163.8. The "average" value per year of this flow is MU 200. The analysis of discounted flows is dealt with more detail in the next section.

4.3. A two-side production account

The production account can also be represented as a two-side table, as shown in Table 4.2. The representation is useful to understand how to consolidate the production accounts of different segments of a value chain. The production account represented in a two-side format highlights the Value Added as a "*balancing item*" of the account.

Table 4.2: A two side production account

	COSTS AND VALUE ADDED			REVENUES	
C2	Stock at beginning of period	40	C1	Stocks at end of period	50
E	Intermediate Inputs	500	A	Sales	1,000
G	Consumption of Fixed Capital	90	B	Own Final Consumption	100
J=C2+E+G	Total Costs	630			
H= K-J	Net Value Added (balancing item)	520			
K = D	**Total costs and value added**	**1,150**	**D=C1+A+B**	**Total output value**	**1,150**

4.4. Building the income account of an economic activity

The income account shows how the Net Value Added (NVA), calculated as the balance of the production account, is shared among the factors of production. The NVA constitutes the net wealth available to remunerate the factors involved in the production process, which will be used by recipients for final uses (final consumption or savings).

The types of income deriving from the distribution of NVA are listed below in Figure 4.3.

Figure 4.3: Factor incomes

- **Wages**, for labour;
- **Interests**, for financial resources;
- **Rents**, for land and natural resources;
- **Taxes**, for general public services;
- **Profits**, for entrepreneurial capacity and capital services

Profits = NVA - (Wages + Interests + Rents + Taxes)

In detail, the types of factor income are:

- *Wages*, including payments in cash or in-kind contributions to hired employees and the remuneration of family labour. The value of family labour is estimated at its opportunity cost.
- *Interests*, including the financial charges on the purchase of fixed assets and the charges generated in the short term to finance the working capital, i.e., the funds required to pay for

input costs anticipated with respect to revenues. Interests should not include the cost of financial services provided by banks, such as advice on funding opportunities and current account services (e.g. account keeping, check expenses etc) considered as services to be accounted for intermediate inputs.

– *Rents*, referring to payments received by the owner of natural resources such as land, water or subsoil assets[57]. Rents have to be distinguished from *rentals* which refer to the payments for the use of fixed assets[58], whether equipment or buildings, that are leased from other institutional units under a lease agreement and to the payments for man-made assets, such as buildings, as they are considered intermediate inputs (services purchased by the activity). It is assumed that rentals only partially represent income available for final consumption.

– *Taxes* on production and imports accounted in the generation of the income account. Subsidies to production are recorded in this entry as negative. Taxes do not include social contributions and benefits paid for workers (comprised among the wages as components of the cost of hired labour), current taxes on income and wealth, or any other current transfer to the agent or referring to the household and not specifically to the production activity.

– *Profits* are the balancing item of the income account, which represent the remuneration received by agents carrying out the economic activity for their entrepreneurial skills and business risks. Since profits are calculated residually after subtracting from the NVA the remuneration of the other production factors, they can be either positive or negative.

An example of income account is provided in Table 4.3. Definitions of terms used so far are listed in Box 4.3.

Table 4.3: An example of income account

A	**Net Value Added**		**520**
B	Wages	200	
C	Interests	30	
D	Rents	40	
E	Taxes (or Subsidies)	90	
F=A-B-C-D E	Profit (or Loss)	160	

* Subsidies would appear with a minus in row E of the table above

In some cases, the analyst faces difficulties to classify some costs either as intermediate inputs (i.e. to be subtracted from the revenue to calculate the Value added) or as factors income. This is the case for instance of services purchased by third parties which could be assimilated to services provided by employees. While classifying them as intermediate inputs or factor incomes does not alter the calculation of profits, this alters the calculation of value added. This issue is quite sensitive for public policy making, whenever developmental objectives, including

[57] Rents are defined in *UNSTATs et al. 2009*, Chapter 7, Section E: Property incomes, Par. 5.
[58] *"The rental is the amount payable by the user of a fixed asset to its owner, under an operating lease or similar contract, for the right to use that asset in production for a specified period of time"* (SNA 2008 , Chapter 6, Section H, Par.2).

food security, poverty reduction and income distribution are key elements, as the value added produced by a value chain and its likely changes induced by policies becomes a fundamental variable[59]. Underestimating/overestimating the value added produced by a value chain may lead to non-optimal decisions regarding value chains to promote or specific policy measures to be implemented. In practice, in VCA for development policy making purposes inputs with predominant value added content can be classified as factor income. This applies for instance to selected advisory services where the bulk of the price paid is due to labour services, financial services which embody a large interest or labour component, rental services with a large rent component[60].

In many practical situations, additional problems may arise in building detailed income accounts due to the difficulty to disentangle the different value added components or part of them. This occurs for instance when separating the labour services provided by the entrepreneur (to be virtually valued at the opportunity cost of labour) from the remuneration of entrepreneurial capacity or the remuneration of own capital. In such instances profits become *de facto* a "*mixed income*", i.e. a miscellanea of different factor incomes.

[59] This issue is overcome when carrying out the analysis at reference prices, where the analyst works out also the "*implied value added"* i.e. a configuration of value added which includes, in addition to the value added directly generated by the activities under investigation, also the share of value added embodied in the value of inputs purchased outside the chain.

[60] On this aspect see for instance *UNSTATs et al. 2009*, Chapter 7, Section E, Par.5: "*a farmer may rent a farmhouse, farm buildings, cultivated and grazing farmland in a contract in which only a single payment is required to cover all four. If there is no objective basis on which to split the payment between rent on land and rental on the buildings, it is recommended to treat the whole amount as rent when the value of the grazing land is believed to exceed the value of the buildings and cultivated land, and as a rental otherwise*."

Box 4.1. Some accounting definitions

Sales revenues: Flow of output generated by the production process and sold on the market multiplied by the unit price. Sales are measured before the application of any taxes on the product. Sales exclude all payments received from government unless they are granted to any producers undertaking the same activity.

Own Final Use: Products retained by producers for personal use as final consumption or capital formation.

Changes in inventories: The value of the entries into inventories net of the value of withdrawals and of the value of any losses of goods held in inventories.

Total output value: Sales revenues+ Own Final Use of output + Changes in inventories.

Intermediate inputs: Flow of goods and services entering the production process and totally consumed during a production period.

Fixed capital consumption: The loss of value of an asset in a given period. It can be calculated as the sum of the discounted expected future benefits from using the asset for its remaining service life periods, which is calculated at the beginning of the period net of the sum of discounted expected future benefits at the end of the period.

Interest cost: Either the interest paid on funds borrowed to purchase the asset or the opportunity cost of capital measured as the yield obtainable from investing on the best alternative asset.

Gross Value Added (GVA): The difference between total output value and the cost of intermediate inputs, before fixed capital consumption.

Net Value Added (NVA): The difference between total output value and the cost of intermediate inputs, after deducting fixed capital consumption.

Production factors (PF): Labour, capital, land, general public services, entrepreneurial capacities and all the non-man-made assets the services of which contribute to a production process.

Profits (or losses): NVA net of the remuneration of production factors except entrepreneurial capacities.

Source: UNSTATs et al. 2009: System of National Accounts 2008. European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank, New York, Dec. 2009.

4.4.1. Calculating the interest cost on fixed capital

The way the value added is distributed, and the related income account, are affected by the quantity, quality and efficiency of the assets contributing to the production process. This is due to the fact that the fixed asset needs to be funded with anticipated resources before the gains materialize. Anticipated resources are to be remunerated with interest. Therefore, fixed assets not only influence the amount of value added produced through the consumption of fixed capital, as calculated for the production account (see previous section) but also influence the distribution of income, as the asset cost to be imputed to each period should also cover the **interest cost** on the anticipated value of the asset.

The interest cost on the fixed asset is either the *actual interest* paid on funds borrowed to purchase the asset, and repaid with the gains from the asset (*loan capital* according the terminology of the SNA 2008) or the *opportunity cost of capital*, as missed gains when own funds are used to purchase the asset and not invested in the best alternative lucrative asset (*equity capital*). Both items are conventionally considered a component of the value added (UN SNA 1993)[61].

[61] According to the UN SNA 1993, section 6.178, "*The capital consumption on the fixed assets forms part of gross value added while interest costs, both actual and implicit, have to be met out of the net operating surplus*", i.e. part of the value added.

The amount of interest due to be imputed to each period's fixed assets depends on the value of the asset used in the production process at that time. Therefore, the consumption of fixed capital and the interest to be imputed to each period are closely linked. The assumption on the loss of efficiency adopted to calculate the amount of consumption of fixed capital influences the determination of the interest to be written in the income account in each period. However, in VCA analysts are interested in an "average" period and the interest cost, as well as the consumption of fixed capital which can be reasonably "smoothed, and the "average" interest cost that can be calculated by means of the so-called "Equivalent annual cost", as shown here below.

Under the assumption of existence of well functioning intertemporal markets, the value of an asset at any point in time can be computed as the present value of the future gains generated by using such asset, i.e., the sum of the stream of discounted future gains expected over the remaining periods of the asset's life at a given discount rate[62]. Thus, the loss of value in each period can be measured by the value of the stream of remaining discounted gains at the beginning of the period minus the value of the same stream at the end of the period[63]. Under these assumptions, as shown in Box 4.2, the loss of value of an asset in a given period corresponds to the gain of that period imputed to the asset.

In addition, with reasonably competitive asset markets, the **purchase price** of a fixed asset, adjusted for price dynamics, can be assumed as an estimate of its value[64]. Under these assumptions, knowing the purchasing price P_0, we can calculate the cost C to be imputed to each of the n periods of the economic life of the asset, composed by the consumption of the fixed asset the and the "opportunity cost of capital", at a given "interest rate" r. This composite cost is the so-called "**Equivalent Annual Cost**", (see 4.7.3.):

$$C = P_0 \left[\frac{r(1+r)^{n-1}}{(1+r)^n - 1} \right] \qquad (1)$$

Assuming for instance that the value of an asset is 1,000 Monetary Units (MU), under the assumption of constant efficiency for a given period, e.g. 5 years, its loss of value per year is:

[62] The discount rate is set on the basis of the "opportunity cost of capital" or the borrowing rate of the agent. On the economics of discounting see e.g. Brealey S. and C. Myers, 2003. *Principles of corporate finance.* 7 Edition McGraw-Hill/Irwin.
[63] This definition of consumption of fixed capital refers to the UN statistical division, System of National Accounts 2008, Chapter 10, section C.
[64] Conceptually, the consumption of fixed capital differs from the depreciation as this is an accounting method of imputing *past* expenditures, whereas consumption of fixed capital refers to the loss of value of the asset from the beginning of the period to the end of the period. The two values diverge if there are significant asset price changes over time. All entries of a production account, including the consumption of fixed capital should be valued using the same set of prices, e.g. the set of prices that corresponds to the accounting period. In addition, note that when carrying out a "perspective" analysis of future activities, or when dealing with large complex investment, such as in the case of infrastructures, past asset values may not convey relevant information. In those cases, specific estimations on the cost of the asset and its life span need to be carried out.

$$C = 1{,}000\left[\frac{0.10\,(1+0.10)^{5-1}}{(1+0.10)^{5}-1}\right] = 239.8$$

However we now need to disentangle the fixed capital consumption to be written in the production account from the interest cost to be written in the income account. This implies that, after calculating the annual equivalent cost, the interest component *INT* has to be calculated. As illustrated in Box 4.2 the interest component *INT* results from the following formula:

$$INT = P_0\left[\frac{r(1+r)^{n-1}}{(1+r)^{n}-1} - \frac{1}{n}\right] \qquad (2)$$

In the case of the asset above, for instance, the interest component to be considered in the income account is:

$$1{,}000\left[\frac{0.10(1+0.10)^{5-1}}{(1+1.10)^{5}-1} - \frac{1}{5}\right] = 39.8$$

By way of consequence, the consumption of fixed capital per period results:

$$Cf = C - INT \qquad (3)$$

For instance, in the case of the asset above, *Cf* expressed in Monetary Units (MU) is:

$$239.8 - 39.8 = 200$$

This example is further elaborated in Annex 4 to this chapter, to show how the interest calculated above is an average of the different interest costs for each period.

Box 4.2. Separating consumption of fixed capital from interest cost

Once the *Equivalent annual cost* is calculated as in (1), analysts must separate the consumption of fixed capital, to be subtracted by the Gross Value Added to get the Net Value Added, from the "opportunity cost of capital" to be reflected among the components of the value added.

The "opportunity cost of capital" (interest) component of the equivalent annual cost varies period by period. In the early stages of the life of the asset, the "outstanding" capital, i.e., the part of capital still to be imputed to the economic activity is large, implying that its opportunity cost in financial terms is significant. Therefore, each instalment *C* in the early stages has to cover a relatively larger amount of financial costs. The opposite holds in the late stages of the life of the asset. However, "on average", the opportunity cost of capital per period say, *INT* can be calculated as the difference between the equivalent annual cost at a given discount rate, e.g., $C(r)$ and the annual cost calculated as at a zero discount rate $C(0)$:

$$INT = C(r) - C(0) \qquad (3)$$

It can be easily shown that at a zero discount rate, the equivalent annual cost is equal to the initial cost divided by the number of periods*:

$$C(0) = \frac{P_0}{n} \quad (4)$$

Note that $C(0)$ is the equivalent annual cost calculated ruling out all the financial costs, being the discount rate set to 0. (5)
By replacing the (1) and the (4) into (3), this results**:

$$INT = P_0\left[\frac{r(1+r)^{n-1}}{(1+r)^n - 1} - \frac{1}{n}\right] \quad (6)$$

* This can easily be seen by replacing 0 with r in equation (6) and solving for C.
** The formula (10.a) applies when assuming that the asset cost materializes at the end of each period:

$$INT = P_0\left[\frac{r(1+r)^{n}}{(1+r)^n - 1} - \frac{1}{n}\right] \quad (6a)$$

4.4.2. Choosing the appropriate discount rate

One important practical issue when working out the annual equivalent cost of an asset and the related interest cost is to choose an appropriate **discount rate**. In practice, the discount rate r is set as the real interest rate (i.e., net of inflation) on risk free assets, increased by a "**risk factor**" (premium), to take into account the degree of **risk** of the specific investment. Assume that the real risk free interest rate e, the expected inflation rate f and the risk factor s are composed in a multiplicative way[65]. The nominal risk-adjusted interest rate factor (1+ i) is:

$$(1+i) = (1+e)(1+f)(1+s)$$

The real risk-adjusted interest rate factor (1+r), to be used for calculating the interest cost in VCA can be calculated as the ratio of the nominal risk-adjusted interest rate factor (1+ i) depurated by the inflation component:

$$(1+r) = \frac{(1+i)}{(1+f)} \quad \text{or, analogously:} \quad (1+r) = (1+e)(1+s)$$

If, for instance, the nominal interest rate on risk-free assets[66] is 12%, the risk premium for investments in a specific sector is 9% and the (expected) inflation rate is 5%, the real risk-adjusted discount rate to be used for that specific sector is:

$$r = \frac{(1+0.12)(1+0.09)}{(1+0.05)} - 1 \text{ , that is: } r = 16.27\%$$

4.4.3. Pricing the consumption of non-man-made fixed assets

The cost of fixed assets is computed as shown above only for "man-made" fixed assets, i.e., assets that are obtained as outputs from production processes. Pricing the use of natural resources and their possible depletion (depletion or degradation of land, coal, oil, or natural

[65] Usually, nominal interest rates embody expected inflation, rather that actual inflation as they refer to future periods.
[66] Note that the nominal interest rate on risk-free assets combines the real interest rate on risk-free assets and the expected inflation rate.

gas) follows different criteria. Readers are referred to the literature dealing with environmental cost-benefit analysis, for instance United Nations et al. (2003)[67], where the system of national accounts is extended to embody environmental assets, Markandya et Al (2002), where different pricing methods for environmental assets are illustrated in detail[68], Santopietro (1998) who reviewed and assessed the pricing methods of natural resources[69]. In addition, tools to measure specific environmental assets such as the FAO EX-ACT tool for the assessment of carbon emissions are useful to include in value chain analyses' environmental components[70].

4.5. Agents accounts and value chain accounts

So far the issue of building production and income accounts for a generic production process has been addressed. In practice, in VCA analysts have to build production and income accounts for specific production activities (e.g., banana production, slaughtering, electricity production, paddy processing etc.), for agents carrying out one or more activities in the same period (e.g., combined craft and farming activities, multi-crop farming etc), for homogeneous sets of agents (e.g., all the paddy processors in a country) or for a set of agents carrying out different activities (e.g., a whole value chain including producers of the primary commodity, processors, wholesalers, transporters, retailers etc).

Building production and income accounts for complex sets of activities and agents occurs in different steps.

First, define the accounts of single activities, built on a per unit basis (e.g., one ton of output, one hectare etc) for which basic information is more often readily available, then aggregate them. The quantity of each input entering the activity is expressed by a "*technical coefficient*". The quantity of output(s) is expressed by "*yield coefficients*"[71].

Second, the accounts of a single economic agent are built on the basis of the activities agents undertake, by:

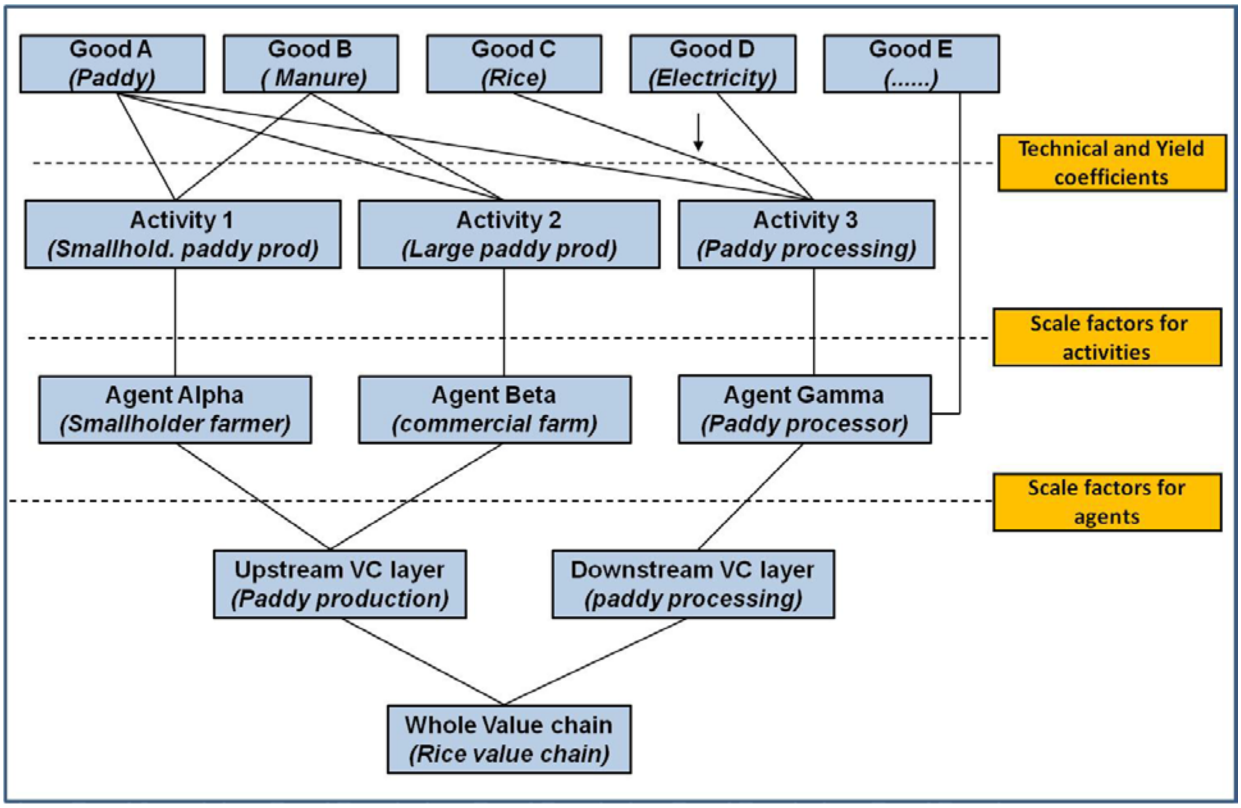
- Scaling up each activity by means of "*scale factors*" for activities to reflect the actual scale of the activity undertaken by the agent (for instance, an activity defined over an hectare is scaled up by multiplying its inputs and outputs by the number of hectares cultivated by the agent).
- Aggregating different activities carried out by the same agent who performs multiple activities). [72]

[67] United Nations et al, 2003. *International handbook of integrated environmental and economic accounting*. http://unstats.un.org/unsd/envaccounting/seea2003.pdf
[68] Markandya, A., Harou, P., Bellù L.G, Cistulli V., 2002: *Environmental Economics for Sustainable Growth. A Handbook for Practitioners*. World Bank - Edward Elgar.
[69] Santopietro G. D., 1998, *Alternative methods for estimating resource rent and depletion cost: the case of Argentina's YPF*, Resources Policy, Volume 24, Issue 1, March 1998, Pages 39-48
[70] FAO, 2009. EXACT Software and guidelines, ***http://www.fao.org/docs/up/easypol/780/ex-act-tech-guidelines_101en.pdf***,
[71] Here "*technical coefficients*" and "*yield coefficients*" are expressed as quantities of inputs and outputs per unit of activity, not per unit of output. as often happens in input-output analysis.
[72] Considering different activities with different outputs in VCA is required for instance when value chains are broadly defined as sets of commodities e.g., "Vegetables" or "Cereals", which implies modelling different

- Adding costs and/or revenues accruing to the agent but not taken into account in any specific activity (e.g. overheads).

Third, following the same logical process above, the accounts of a **group of agents** are built by scaling up the single agent's accounts by the number of the agents in that group ("*scale factors*" for agents). All the agents in a group are assumed to be homogeneous and identical to the "representative" agent modelled for the VCA. In other words, they are assumed to carry out the same activities of the representative agent, at the same activity level. Note that, at this stage, costs and revenues accruing at the level of the group of agents not at the single agent level) can be added, for instance, costs related to research and development of new technologies, costs incurred by producers' associations, environmental damages caused by a whole subsector etc.

Figure 4.4: From activity level to value chain accounts



Fourth, the economic performance of the whole value chain can be examined by aggregating into one single account the accounts of all agents involved. In doing so, several items and balances, such as total output value, total costs, gross value added, net value added and profits are calculated at the aggregate level for the whole value chain. Figure 4.4 illustrates the process of aggregating the accounts from the activity to the value chain level (a simplified example related to a rice value chain is reported in brackets). Note however that while aggregations at the same level of a chain occur essentially by multiplying each input and output for scaling factors and then summing them up, aggregations of different segments of the same chain occur through "*consolidation*" of the accounts of the different segments. Consolidation implies

technologies for different products, or when the same product is obtained with different technologies (e.g. rainfed *versus* irrigated paddy).

cancelling-out transactions occurring between upstream and downstream segments. This issue is discussed in detail in the next section[73].

4.6. Consolidating accounts at value chain level

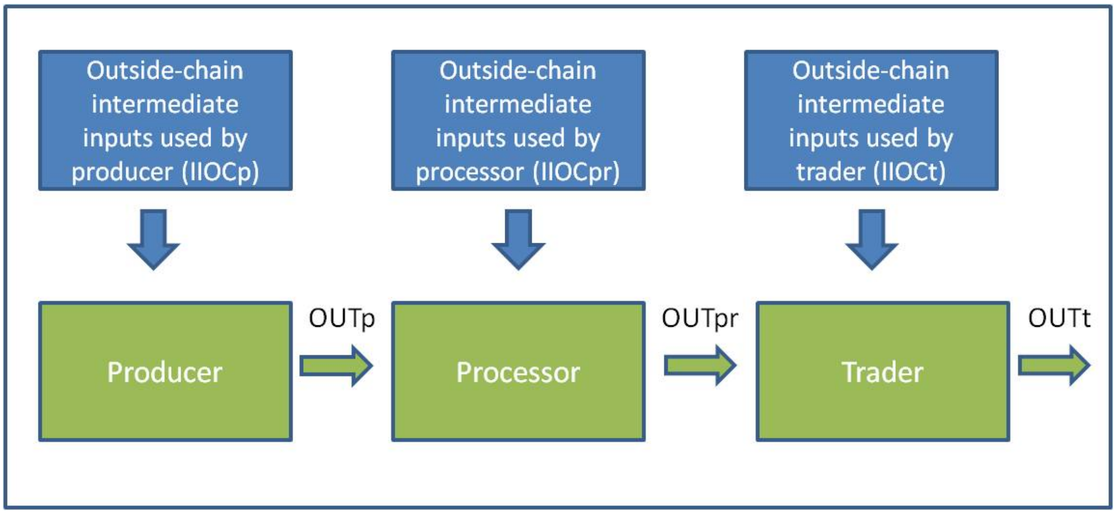
To consolidate the accounts of different agents into value chain accounts, it is worth following these steps[74]:

a) Identify the items **within the chain flows** (arising from transactions between agents of the same chain) and **outside-chain flows** (arising from transactions with the rest of the economy at national and international level).
b) Sum- up the items of the production accounts across agents.
c) Cancel out the within-chain flows since the output of an agent represents the input for its downstream agent.
d) Compute the relevant balances and indicators following the same procedure as described for a single production process.

To illustrate the process, consider a simple three-agent value chain, comprising one producer, one processor, and one trader.

The output of the producer is among the inputs of the processor whose output is among the inputs of the trader. This simple value chain can be represented as follows:

Figure 4.5: Three agent-value chain



Note:
OUTi = Total output value in the account of the agent “i”

[73] In practical VCA studies, building and aggregating production and income accounts occurs with the support of dedicated software, given the large amount of data and calculations to be handled. The FAO-VCA software tool for instance, carries out these calculations.

[74] In the FAO VCA-Tool software, the consolidation of accounts is carried out automatically. For this reason, in order to build the production and income accounts of the whole value chain, the user is requested to build the “plan” of the value chain, i.e. to specify the structure of the value chain, which contains all the “plans” of the different agents properly scaled. Aggregations and consolidation are then carried out automatically.

$IIOC_i$= Intermediate inputs *«from outside the chain»* used by agent i
where ***i****=producer (prod), processor (proc), trader (trad)*

The production accounts of the three agents are shown in Table 4.4 through a "two-side" accounting framework.

Table 4.4: Production accounts of the 3 agents in the value chain

Producer		Processor		Trader	
Inputs	***Output***	***Inputs***	***Output***	***Inputs***	***Outputs***
IIOC prod	OUT prod	IIT proc = OUT prod +IIOC proc	OUT proc	IIT trad = OUT proc + IIOC trad	OUT trad
VA prod		VA proc		VA trad	

Note: **OUT_i** = Total output value in the account of the agent "i"
$IIOC_i$= Intermediate inputs *«from outside the chain»* used by agent i
IIT_i= Total Intermediate Inputs (from outside and inside the chain) used by agent i
VA_i= Value added created by agent i
where ***i****=producer (prod), processor (proc), trader (trad)*

To obtain the consolidated account of the whole value chain analysts need to sum up the accounts of the three agents by summing up the inputs and outputs of all the agents, as displayed in Table 4.5, in the left hand side table.

However, in a value chain, by definition, some inputs for an agent are the output of an upstream agent and, analogously, the output of an agent is an input for the downstream agent. When analysts aggregate accounts items constituting an output for an agent and an input for another one, they cancel out. In our example, this is the case of the output of the producer *OUT prod*, which offsets the input inside the chain of the processor. Analogously, the output of the processor *OUT proc* offsets the input inside the chain of the trader (see Table 4.5, panel b).

Table 4.5: Consolidation of accounts in the a three-agent value chain

Panel A

Producer + Processor + Trader	
Inputs	***Output***
Total inputs =	Total Output =
IIOC prod	OUT prod
+ OUT prod	+ OUT proc
+ IIOC proc	+ OUT trad
+ OUT proc	
+ IIOC trad	
Total VA=	
VA prod	
+ VA proc	
+ VA trad	

Panel B

Producer + Processor + Trader	
Inputs	***Output***
Total inputs =	Total Output =
IIOC prod	~~OUT prod~~
+ ~~OUT prod~~	+ ~~OUT proc~~
+ IIOC proc	+ OUT trad
+ ~~OUT proc~~	
+ IIOC trad	
Total VA=	
VA prod	
+ VA proc	
+ VA trad	

Panel C

Consolidated production account	
Inputs	***Output***
Total inputs =	Total Output =
IIOC prod	OUT trad
+ IIOC proc	
+ IIOC trad	
Total VA=	
VA prod	
+ VA proc	
+ VA trad	

Data marked by «—» cancel out the production account of the whole value chain results as in Table 4.5, panel c. This table shows that:

a) **The consolidated intermediate inputs** of the value chain are only the inputs of each agent coming from outside the chain.

b) **The consolidated output** of the value chain is the output of the most downstream agent.

c) **The consolidated value added** of the value chain is obtained either as the difference between the output of the most downstream agent and the consolidated intermediate inputs, or as the sum of the value added of each agent.

A numerical example of consolidation of accounts in a simplified three-agent value chain is provided in Table 4.6.

Table 4.6: Consolidation of accounts: a numerical example in a simple three-agent value chain (values expressed in monetary units)

Panel A: accounts of single agents

Producer		Processor		Trader	
Inputs	*Output*	*Inputs*	*Output*	*Inputs*	*Outputs*
IIOC prod: 100	OUT prod: 2,000	II proc: 2,000 + 5,000	OUT proc: 27,000	II trad: 27,000 + 3,000	OUT trad: 60,000
VA prod: 1,900		VA proc: 20,000		VA trad: 30,000	

Panel B: aggregated account

Inputs	*Output*
Total inputs = 100 IIOC prod+ ~~2000~~ OUT prod 5,000 IIOC proc ~~27,000~~ OUT proc 3,000 IIOC trad	Total Output = ~~2,000~~ OUT prod ~~27,000~~ OUT proc 60,000 OUT trad
Total VA= 1,900 VA prod 20,000 VA proc 30,000 VA trad	

Panel C: consolidated account

Inputs	*Output*
II consolidated 8,100	OUT consolidated 60,000
VA consolidated 51,900	

Items marked by « ~~ ~~ », cancel out.

In the example, the value added of the whole value chain amounts to 51,900 monetary unit and can be derived from:

a) Output of the most downstream agent – intermediate inputs from outside the chain: 60,000 – (100 + 5,000 + 3,000) = 60,000- 8,100 = 51,900

b) or, equivalently: Sum of agents' VA = 1,900+ 20,000+ 30,000 = 51,900

4.7. Appendix to chapter 4

4.7.1. Data requirements and data sources to implement a value chain analysis

The following is a general (non-exhaustive) list of data most likely required to implement a value chain analysis for a specific commodity:

Output

- Wholesale price at different geographical locations (including international prices CIF-FOB, if any).
- Producer price of the commodity at various locations.
- Consumer price of the commodity at various locations.
- Produced and traded quantities of the commodity.
- Location of the main markets in the region and/or at national level.
- Home consumption and marketed shares of the produced good, if any.
- Numbers of the actual and potential consumers in the relevant destination area.
- Seasonality in prices and quantities of the output.

Primary production process

- Prevailing farming or other production systems in the relevant production area.
- Average farm/firm size or typology of representative farms/firms.
- Number of the representative farms and firms in the relevant area.
- Yield per unit of activity for each representative farms/firms.
- Total production from each farming system type in the relevant area.
- Post-harvest losses.
- Output storage capacity.

Inputs and factors for primary production

- Quantity of each input per unit of output (technical coefficients).
- Purchase prices of input per input type.
- Seasonality in prices and quantities of the main inputs.
- Stocking costs of inputs.
- Packaging and stocking costs of output.
- Transportation costs of inputs from various locations.
- Equipment, required investment, facilities and related depreciation.
- Other Costs.
- Tariffs and taxes.
- Labour wages (agricultural, industrial skilled, non skilled) at various locations.
- Total land in the relevant area.
- Total arable land in the in the relevant area.
- Water resources (types, number, capacity).
- Land, water and other natural resource use rents.

Collection-trade of raw commodity

- Typology of representative trading agents;
- Type of market (competitive, monopsony etc.) and contractual arrangements.

- Facilities available for collection-trade of the raw commodity (Storage capacity, specific infrastructures etc).
- Transportation costs from the production to the processor.
- Other transaction costs (informal taxes, losses etc.).
- Investment costs for collection-trade and related depreciation.
- Commodity purchase price of trader.
- Commodity sale price of trader.
- Trade margins.

Processing
- Typology of representative processing agents.
- Quantity of commodity processed by type of representative processing agent.
- Purchase price of raw commodities.
- Processing-conversion coefficients by type of representative processing agent.
- Other processing inputs and factors by type of representative processing agent (technology).
- Prices of other inputs and factors required in processing.
- Losses due to processing.
- Sale prices of processed commodities.
- Storage capacity of processors.
- Investment costs and related depreciation for processing.

Wholesalers, Exporters and/or Importers of the processed commodity
- Transportation costs.
- Transaction costs.
- Equipment and facilities costs.
- Investment costs and depreciation.
- Purchased quantity.
- Storage capacity.
- Purchase price.
- Sale prices.

General and institutional context
- Economic and social infrastructures available (electricity roads, schools, hospitals, markets, communications, etc).
- Distance from production sites and the closest infrastructure.
- National laws and or international treaties affecting the value chain.
- Market regulations and functioning.
- Producers' organizations acting in support to the value chain.
- NGOs acting in support to the value chain.

The data listed above can be found addressing selected institutions and/or searching for existing censuses, surveys and institutional databases, such as:

Institutions
- Ministry of Economy and Finance, Ministry of Agriculture and other specific Ministries.
- Regulatory bodies or commodity boards, if any, for the specific commodity.

- National Statistical offices and/or statistical branches in various ministries.
- Central Bank, custom services, local institutions.
- Producers' and/or consumers' associations.
- National research centres and institutes.
- International organizations such as: Food and Agriculture Organization (FAO), United Nations (UN), World Bank (WB), International Monetary Fund (IMF).

Surveys and databases

- Agricultural Census.
- Household Budget Survey.
- Small Scale Enterprises Survey.
- Survey of Agricultural Inputs and Outputs.
- Survey of Transport Services.
- Labour Force Survey.
- Institutional databases (e.g. WDI, FAOSTAT, AQUASTAT, etc).

4.7.2. Loss of value of an asset in a given period

Assume that the present value of an asset is V_0 , which results from the sum of a stream of gains G_0, $G_1, G_2, ..., G_{n-1}$ occurring in n periods, discounted at an opportunity cost of capital rate, i.e., the discount rate r: *

$$V_0 = G_0 + \frac{G_1}{(1+r)^1} + \frac{G_2}{(1+r)^2} + \frac{G_3}{(1+r)^3} + ... + \frac{G_{n-1}}{(1+r)^{n-1}} \quad (1)$$

The loss of value of this asset, e.g. in period 2, is given by the value of the asset at the end of period 1, minus the value of the asset at the end of period 2 discounted for one period**. let's call $V_{i,j}$ the value of the asset at the end of period *i* expressed in money available at time *j*. The value of the asset at the end of period 1, expressed in money available at the end of period 1, is the sum of all the gains left at the end of period 1, discounted at the end of period 1:

$$V_{1,1} = G_2 + \frac{G_3}{(1+r)} + ... + \frac{G_{n-1}}{(1+r)^{n-3}} \quad (2)$$

Analogously, the value of the asset at the end of period 2, expressed in money available at that time is:

$$V_{2,2} = G_3 + ... + \frac{G_{n-1}}{(1+r)^{n-4}} \quad (4)$$

Let's call the loss of value of the asset, i.e., the consumption of the asset to be imputed to each period i, expressed in terms of money available at the beginning of the same period $C_{i,i}$. The loss of value in period 2 is:

$$C_{2,2} = \mathrm{V}_{1,1} - \mathrm{V}_{2,1} \quad (6)$$

In order to express the value of the asset at the end of period 2 in terms of money available at the end of period 1, we have to discount $V_{2,2}$ in (4) for one period:

$$V_{2,1} = \frac{V_{2,2}}{(1+r)} \quad (7)$$

therefore, substituting the (4) into the (7):

$$V_{2,1} = \left[G_3 + ... + \frac{G_{n-1}}{(1+r)^{n-4}} \right] \frac{1}{(1+\mathrm{r})} \quad \text{i.e.:} \; V_{2,1} = \frac{G_3}{(1+r)} + ... + \frac{G_{n-1}}{(1+r)^{n-3}} \quad (8)$$

Substituting the (3) and the (8) into the (6) leads to:

$$C_{2,2} = G_2 + \frac{G_3}{(1+r)} + ... + \frac{G_{n-1}}{(1+r)^{n-3}} - \frac{G_3}{(1+\mathrm{r})} - ... - \frac{G_{n-1}}{(1+r)^{n-3}} \quad (9)$$

All the terms on the right hand side of the (9) cancel out except the gain in period 2, so the (9) reduces to:

$$C_{2,2} = G_2 \quad (10)$$

The result of the (10) is easily generalized to any period, so that, given the assumptions made, the consumption to be imputed to each period, expressed in money available at the beginning of the period is the gain of that period:

$$C_i = G_i \quad (11)$$

* We assume that the gains materialize at the beginning of each period, which implies that the gain of the subsequent period, (the gain of period 2 in our example) does not need to be discounted.
** This one-period discounting is required to make the value calculated at the end of each period, expressed in money available at the end of that period, comparable with the value of the asset at the end of preceding, period expressed in money available at the end of the preceding period.

4.7.3. Equivalent Annual Cost

In value chain analysis we have to calculate the cost of a fixed asset, i.e., the loss of its value that we must impute to the accounting period in question.

Assume that the value of the asset is equal to a known amount, e.g., its purchasing price (i.e., the initial cost to the agent): $V_0 = P_0$. On the basis of this assumption the value of the asset to the agent can be written as the discounted sum of a stream of costs imputed to each period *i*, C_i:

$$P_0 = C_0 + \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + ... + \frac{C_{n-1}}{(1+r)^{n-1}} \quad (1)$$

In addition, assume that the cost from using the asset is the same for all the periods of its economic life, i.e. $C_0 = C_1 = ... = C_{n-1} = C$. C is called the "**Equivalent Annual Cost**" for *n* periods of the present value P_0 at the discount rate *r* *. The (12) becomes:

$$P_0 = C + \frac{C}{(1+r)^1} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + ... + \frac{C}{(1+r)^{n-1}} \quad (2)$$

Knowing P_0, *r* and *n*, *C* can be worked out as follows:

$$P_0 = C\left[1 + \frac{1}{1+r} + \frac{1}{(1+r)^2} + ... + \frac{1}{(1+r)^{n-1}}\right] \quad (3)$$

Multiply both sides by $\frac{1}{1+r}$:

$$\frac{1}{1+r}P_0 = C\left[\frac{1}{1+r} + \frac{1}{(1+r)^2} + ... + \frac{1}{(1+r)^n}\right] \quad (4)$$

Subtract (15) from (14):

$$P_0\left[1-\frac{1}{1+r}\right]=C\left[1-\frac{1}{(1+r)^n}\right] \quad (5)$$

Solve for C to get, after some simple algebra:

$$C = P_0\left[\frac{r(1+r)^{n-1}}{(1+r)^n-1}\right] \quad (6)$$

* It is assumed here that, from a financial point of view, the cost materializes at the beginning of each period, as the annual cost of the i^{th} period is discounted with the discount factor $\frac{1}{(1+r)^{i-1}}$, i.e. *i*-1 times. It can be easily shown that if we assume that the cost materializes at the end of each period, the annual equivalent cost is larger and given by:

$$C = P_0\left[\frac{r(1+r)^{n}}{(1+r)^n-1}\right] \quad (6a)$$

4.7.4. Averaging interest costs across periods

Consider the example described in the text, where an asset, which is worth 1,000 Monetary Units (MU) at the beginning of period 1, is used in a production process for five years. Its loss of efficiency is zero for all the periods, until it completely wears out at the end of the fifth year. The annual interest rate is 10%. The incidence of the opportunity cost of capital different.

There are two options: either the asset costs are imputed to the production process at the **beginning** of each period or at the **end**, which amounts to assuming either that the production process is able to generate enough resources to fund the consumption of fixed capital from the beginning of each period or only to the end of each period. This information is summarized in Table 4.7. More specifically, row A provides the initial asset value (1,000 Monetary Units – MU), Row B the periods of life of the asset and row C the rate of the opportunity cost of capital. Rows D and E report the *Equivalent annual costs* calculated with the formulas (6a) and (6) respectively, provided in paragraph 4.7.3, referring to cases with asset costs materializing at the end of each period and at beginning of each period respectively. The two cases give rise to two different equivalent annual costs. Note that the equivalent annual cost calculated assuming that the asset cost is imputed to the production process at the end of each period is higher than the one calculated assuming that the cost is imputed at the beginning of each period (263.8 and 239.8 MU- respectively), because of the longer time the capital is outstanding. The interest component, calculated in the two cases using the formulas (10a) and (11) respectively provided in paragraph 4.7.2, are reported in rows G and H respectively. Panel 1 and panel 2 of Table 4.7 show, given the two configurations of equivalent annual costs respectively, that the average opportunity cost of capital (interest cost) per period averaged across the periods of the economic life of the asset, corresponds to the difference between the Equivalent annual cost and the (constant) consumption of the fixed asset. Focus for instance on panel 2, Table 4.7[75].

[75] The analogous reasoning on panel 2 is up to the reader.

Column (a) reports the fixed capital consumption per period.

Column (b) highlights the residual asset value at the beginning of each period. Note that, given the assumption that the consumption of fixed capital materializes at the beginning of each period, at the beginning of period 1 the residual asset value is the original value of 1,000 MU minus 200 MU for the consumption of the fixed asset imputed to period 1.

Column (c) reports the opportunity cost of capital, calculated on the basis of the opportunity cost rate (row C) and the "residual capital" at the end of previous period reported in column (g). Note however that no opportunity cost of capital arises at the beginning of period 1 because no time has elapsed since the asset has been funded. for instance, at the beginning of period 2, the opportunity cost of capital to be imputed to that period is 10% of the residual capital at the end of period 1, i.e. MU 760.2 x 0.10 = 76.02.

Column (d) reports the total asset cost for each period, calculated as the sum of the capital consumption and the opportunity cost of capital in each period.

Column (e) reports the total asset cost, calculated as the *annual equivalent cost* which includes both the consumption of fixed capital and the interest cost imputed to the production process at the beginning of each period.

Column (g) reports the "residual capital" at the beginning of each period, calculated as the residual capital at the end of the previous period minus the fixed capital consumption of the current period (column b) plus the unaccounted part of the opportunity cost of capital of the current period (column f). For instance, for period 2, the residual capital is the residual capital at the end of period 1 (760.2 MU) minus the consumption of fixed capital in period 2 (200 MU) plus the unaccounted part of the opportunity cost of capital in period 2 (36.2 MU).

Column (f) reports the unaccounted part of the opportunity cost of capital in each period, i.e., the part of the interest that is not imputed to each period, calculated as the total asset cost (column d) for that period minus the *Equivalent annual cost* (column e) imputed at the beginning of each period of the production process. The unaccounted part of the opportunity cost of capital in the preceding period is therefore capitalized and summed to the residual asset value, to be funded in the subsequent period.

The last row of panel 2 averages across periods the fixed capital consumption (MU 200), the opportunity cost of capital, (MU 39.8), the total asset cost and the unaccounted part of the opportunity cost of capital in each period (0.0 MU). Note that the average opportunity cost of capital (MU 39.8), corresponds to the difference between the annual equivalent cost (239.8 MU) and the average fixed capital consumption (MU 200). In addition, on average, no opportunity cost of capital is left unaccounted for when imputing to the production process the annual equivalent cost.

Table 4.7. Averaging interest costs across periods using the annual equivalent cost

A	Initial value of the asset (beginning of period 1)	1,000.0
B	Periods of the asset's economic life	5
C	Rate of opportunity cost of capital per period	10.0%
D	Equivalent Annual Cost (cost materializes at the end of the period)	263.8
E	Equivalent Annual Cost (cost materializes at the beginning of the period)	239.8
F=A/B	Consumption of fixed capital per period	200.0
G=D-F	Opportunity cost of capital component (Interest) (end of period)	63.8
H=E-F	Opportunity cost of capital component (Interest) (beginning of period)	39.8

Panel 1: Cost materializes at the end of the period

Period	Consumption of fixed cap. (a)	Residual Asset value (b=b*-a)	Opportunity cost of cap. (c=g* x C)	Total asset cost (d=a+c)	Annual eqiv.cost (e=D)	Unaccounted cap.opp.cost (f=d-e)	Residual Capital (g=g*-a+f)
1	200.0	800.0	100.0	300.0	263.8	36.2	836.2
2	200.0	600.0	83.6	283.6	263.8	19.8	656.0
3	200.0	400.0	65.6	265.6	263.8	1.8	457.8
4	200.0	200.0	45.8	245.8	263.8	-18.0	239.8
5	200.0	0.0	24.0	224.0	263.8	-39.8	0.0
Average	200.0		63.8	263.8	263.8	0.0	

Panel 2: Cost materializes at the beginning of the period

Period	Consumption of fixed cap. (a)	Residual Asset value (b=b*-a)	Opportunity cost of cap. (c=g* x C)	Total asset cost (d=a+c)	Annual eqiv.cost (e=D)	Unaccounted cap.opp.cost (f=d-e)	Residual Capital (g=g*-a+f)
1	200.0	800.0	0.0	200.0	239.8	-39.8	760.2
2	200.0	600.0	76.0	276.0	239.8	36.2	596.4
3	200.0	400.0	59.6	259.6	239.8	19.8	416.2
4	200.0	200.0	41.6	241.6	239.8	1.8	218.0
5	200.0	0.0	21.8	221.8	239.8	-18.0	0.0

Notes:1) Values are expressed in monetary units. 2) b* in the residual asset value formula and g* in the residual capital formula refer to the previous period residual asset value and residual capital respectively. For period 1 g* refers to the initial asset value in row A.

4.7.5. Exercise: Cost-Benefit Analysis of policy options for Rice Value chain in Burkina Faso.[76]

PART ONE: Production and income accounts

Background information

Let's consider the rice production in Burkina Faso.

We will analyze a portion of the whole rice value chain and focus on two types of agents: the paddy rice producer and the steamer.

In the area under consideration, there are 3,913 paddy rice producers. All the paddy rice producers are smallholders with similar socio-economic features who apply similar technologies. Therefore, they can be described by means of a "representative producer" profile, i.e., an "average" small scale producer. The representative paddy rice producer owns a plot of 0.4 ha. The technology adopted by the representative rice producer is described in Table 4.8.

Table 4.8: Paddy production technology (data per hectare of land)

	Inputs	Unit	Price (FCFA)	Quantity per HA
IIOC	Organic Fertilizer	ton	8,000	2.50
IIOC	NPK Fertilizer*	ton	250,000	0.20
IIOC	Rice seeds	ton	500,000	0.07
VA	Labor for sowing	man/day	1,000	4.00
VA	Labor for harvesting	man/day	2,000	10.00
VA	Labor for threshing and winnowing	man/day	2,000	15.00
*Nitrogen, Phosphorous and Potassium				

	Outputs	Unit	Price	Quantity per ha
O	Paddy rice	ton	115,000	4.500
O	Rice Straw	ton	4,000.00	3.375

Other data	
Hectares per paddy rice producer	0.4
Number of producers in the area	3,913

In the same area, there are 130 steamers. The steamer transforms paddy rice into parboiled rice. The steaming process has a technical conversion coefficient of approximately 0.7: 1 ton

[76] This exercise has been freely adapted and simplified from a real-case study (DGPER, 2009). A spreadsheet for part one is also available. In addition the whole exercise is available on a .VCA file, to be used with the FAO VCA-Tool software. Solutions are provided in the separate booklet

of paddy rice is needed to produce 0.7 ton of parboiled rice. Paddy rice is boiled before husking to facilitate the processing and to increase the nutritional properties of the rice. After steaming the rice is milled and then sold on the market. The list of inputs used in the steaming process with the related quantities and prices is provided in Table 4.9.

Table 4.9: Steaming technology (data per ton of paddy rice to be processed)

	Inputs	Unit	Price	Quantity per ton of paddy rice
VA	Labour for steaming	man/month	50,000	0.25
IIOC	Firewood for drying one ton of paddy rice	cartwheel	3,200	1
IIOC	Water	barrel	200	13
IIOC	Husking a ton of paddy rice	MU	1	10,400
IIOC	Transportation of a ton of parboiled to the wholesaler	MU	1	2,880
IIIC	Paddy rice	ton	115,000	1
VA[77]	Steaming machinery	MU	1	???

	Outputs			
O	parboiled rice	ton	250,000	0.72

Other data	
Tons of paddy rice processed per steamer	54
Steaming machinery (annual equivalent in monetary units)	200,000
Annual opportunity cost of capital at constant prices (Interest rate)	5%
Economic life of the steaming machinery (Number of years)	10
Number of steamers in the area	130

Assignment

Compute for both agents and the respective value chain segments the production and income accounts:

a) revenues, input costs, value added and profits for the representative paddy rice producer and for all the paddy rice producers in the area;

b) revenues, input costs, value added and profits for the representative steamer and for all the steamers in the area.

[77] It is part of the Gross Value Added, a Fixed Capital Consumption item.

Hints [78]

Using the data provided in the tables above, proceed step-by-step as follows:

a. insert the inputs and outputs in a table and calculate the value of each input and output, keeping in mind the surface of the representative producer and the amount of paddy processed by the representative steamer;
b. calculate the consumption of fixed capital and interest costs for the steaming machinery, using the formulas provided in pages 42-43;
c. create the production and income accounts for the two representative agents;
d. aggregate the accounts of the agents in the area for the two segments of the value chain.

PART TWO: Consolidation of accounts

Assignment

Using information provided in part one of the exercise, after checking the consistency of supply and demand of paddy rice, calculate the total revenues, input costs, value added and profits for the entire value chain.

Hints[79]

a. Verify that all paddy produced is used by the steamers. If this does not occur, adjust for instance the quantity of paddy processed by each steamer, until the paddy produced matches the paddy consumed by the steamers.
b. Work out aggregate production and income accounts for the whole value chain.
c. Cancel out the paddy revenue of the paddy producers (part of output of the upstream agents) with the paddy purchased by the steamers (intermediate input inside the chain of the downstream agents), as shown in tables 4.5 and 4.6.
d. Work out the consolidated production and income accounts of the whole value chain.

[78] When using the FAO VCA-Tool software, goods and services have to be inserted in the database by using the "*In-Out good*s" facility. Use the "*Activity*" facility to model the production of paddy rice per hectare and the steaming of one ton of paddy rice. Then, use the "*Plan*" facility to create the production and income accounts of the representative paddy producer and the representative steamer. Use again the "*Plan*" facility to aggregate the representative agents by segment of the value chain.

[79] When using the FAO VCA-Tool software, to check the consistency of the supply and demand of paddy rice, use the "*Calibration*" facility. To consolidate the accounts, use the "*Plan*" facility, to create a plan which embodies both the up-stream and down-stream sector. The FAO VCA-Tool automatically provides consolidated production and income accounts.

5. Policy impacts in VCA: scenarios for counterfactual analysis

5.1. Counterfactual analysis for policy impacts

The analysis of socio-economic impacts of policy options is often carried out in a "*counterfactual*" framework. This applies also when using the VCA framework for policy analysis. After having identified development objectives and related policy options to achieve them, analysts need to determine and "measure" the likely impacts of the different policy options of the socio-economic system. This implies building first a "*base scenario*", which is the stylised description of the socio-economic system «*without*» policy intervention (*WoP*), i.e., a state of the socio-economic system, the value chain in this case, which is assumed to represent the situation if the policy measure is not implemented. This will be the reference scenario, also called benchmark or baseline, for the impact analysis of policies.

The reference scenario is described using the margins (gross and net value added, profits) share of income by factors and other relevant indicators. It is important to note those indicators that reflect the specific policy objectives. If, for example, the policy measure aims at poverty alleviation and food security, analysts would focus on income accruing to poor agents in the value chain, e.g., wage workers, smallholders etc and/or indicators highlighting own consumption[80]. These indicators calculated for the base scenario are used as reference indicators.

After building and describing the reference scenario, the analysis focuses on the construction of one scenario that integrates the expected socio-economic impacts of the policy option. This is the scenario «*with*» policy (*WiP*), i.e. the "*counterfactual*" scenario.

The scenario *WiP* is usually built as a modification of the *WoP* scenario.

In order to go from one scenario to the other, analysts need a **model for socio-economic and environmental impacts** that identifies, describes and quantifies the changes in a socio-economic system, which are most likely induced by a policy measure or an exogenous shock (see next section).

After having constructed the scenario «*with*» policy using the model of impacts, this can be described using the same **indicators** adopted for the description of the reference scenario. As in VCA margins and margin-based indicators are used for the reference scenario; analysts would use the same indicators for the scenario "with" policy, allowing the analyst to compare the two scenarios.

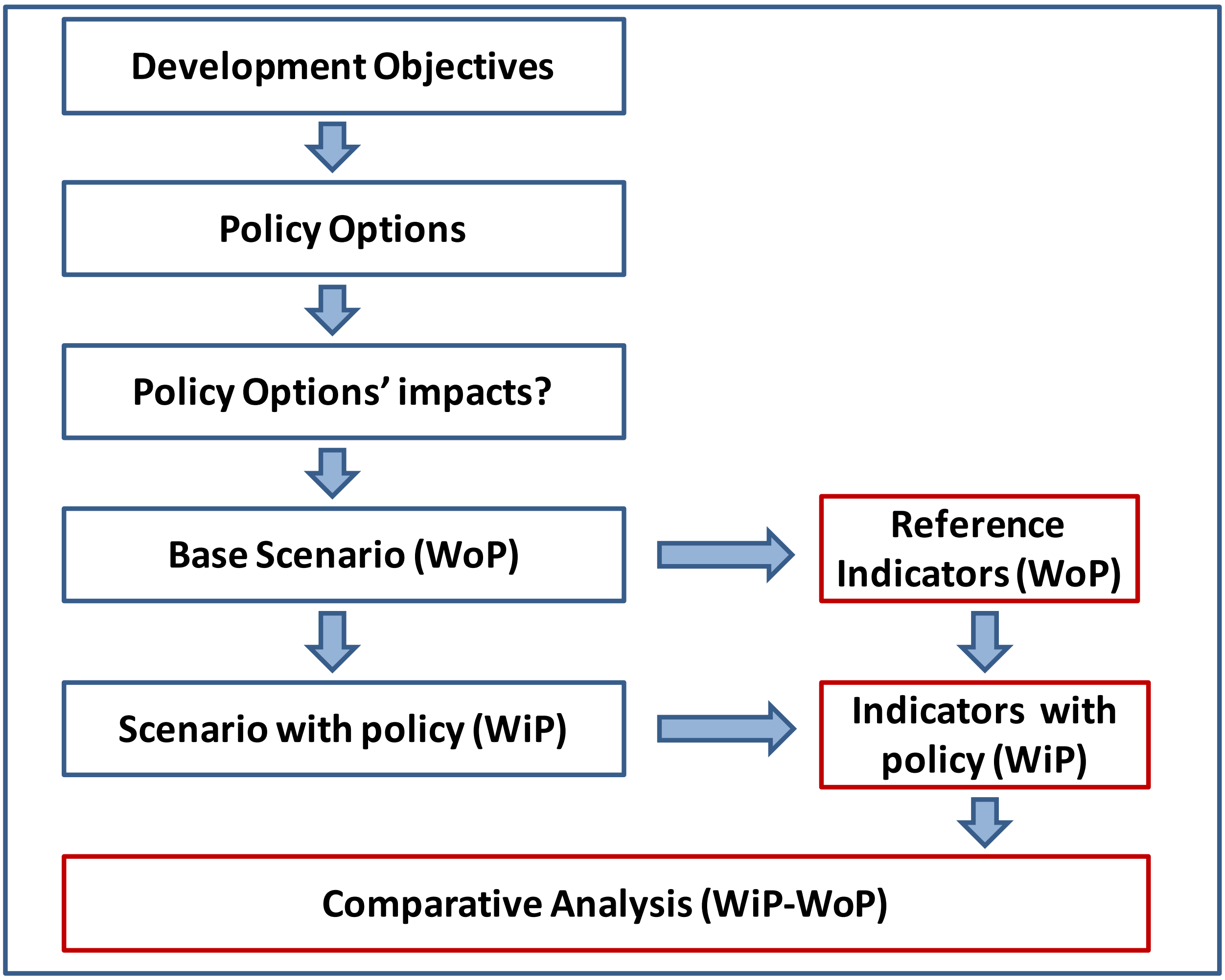
The comparative analysis "*counterfactual*" versus reference scenario, i.e., the comparison of indicators of the scenario WiP with those from the scenario WoP, highlights the changes in the value chain introduced by the policy measure. If more than one policy option has to be

[80] Further indicators of socio-economic impacts can be calculated by complementing the VCA approach with other approaches based e.g. on household or individual data (e.g. Living Standards Measurement Surveys-LSMS). This allows analysts to calculate benchmark poverty and food security indicators, like the poverty headcount rate, the poverty gap, the *per capita* intake of calories and proteins or their distribution (e.g., per different deciles or quintiles of population) and use VCA results to feed e.g. accounting frameworks based on household-level data.

analysed, analysts can build different "with" policy scenarios. Moreover, if analysts construct scenarios for different policy options, they could also compare the different policy options.

The process that analysts follow to build a counterfactual analysis is shown in Figure 5.1.

Figure 5.1: Counterfactual approach for policy impact analysis



5.2. Impact models

A model of impacts highlights causal links, i.e. "**transmission mechanisms**" through a sort of "*cause-effect cascade*", among different socio-economic variables, specifically among the variables directly influenced by a policy intervention, i.e., the "**policy instruments**" and the variables that are directly related to the objectives of the policy intervention i.e. the "**policy objective**". The impact model is therefore a device to simulate the effects of the changes in variables controlled by the policy measure on selected socio-economic variables relevant for the policy objective, as represented in Figure 5.2.

Figure 5.2: Basic structure of an impact model

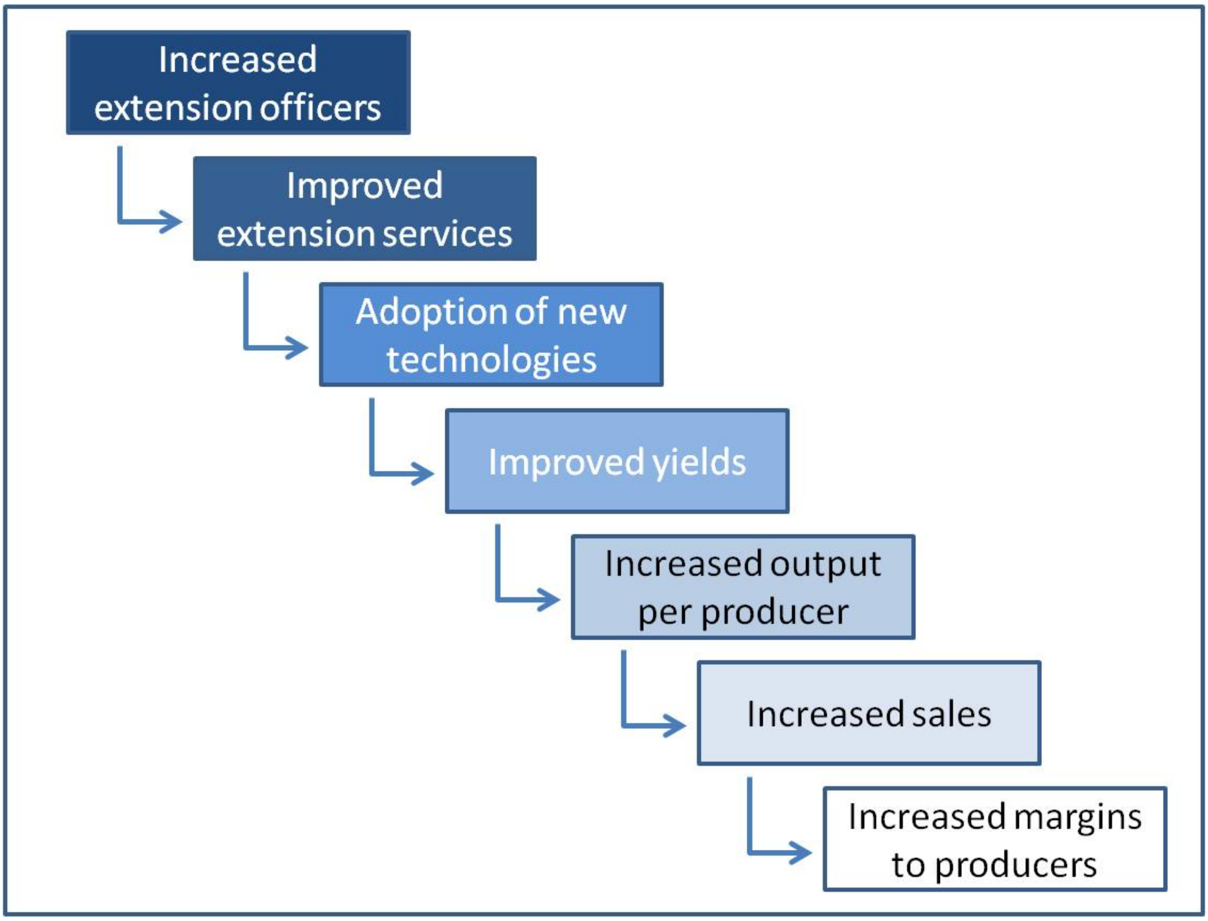
If, for instance, we consider a measure aimed at increasing the revenue of selected groups of producers by means of a technological change induced by an extension policy, the model of impacts must be such that cause-effect links between increased number of extension officers and margins of producers should be: a) spelled out, b) quantified in physical terms; c) converted in monetary terms.

In this case a model of impacts could be graphically represented as in Figure 5.3.

The model of impacts should allow analysts to quantify the changes in yields, quantities of output produced per producer, total quantities produced in the primary production segment of the value chain and in the downstream segments; prevailing prices of the output in the situation with productivity and production changes; additional production costs and margins to producers etc.

Note that in the same model of impacts, the different cause-effect links may involve varying degrees of subjectivity and/or a different mix of qualitative and quantitative information. For instance, the link between increased extension officers and improved extension services can be identified and estimated based on expert consultation or discussion with selected stakeholders, while the link between adoption of new technologies and increased yields could be based on some agro-technical models. From this point on, the VCA accounting framework is then suitable to explore the link between increased yields and output, output and revenue, revenue and value added, value added and margins for each producer, for the primary production segment as well as for the whole value chain.

Figure 5.3: Example of an impact model



In the context of counterfactual policy impact analysis therefore, the VCA framework constitutes a tool which, on the one hand hosts the results of other tools used to identify and quantify cause-effect relationships of policy or exogenous shock-induced changes. On the other hand, it allows analysts to investigate the "*cause-effect cascade*", as the VCA systematically analyses the links between changes in yields, outputs, technical coefficients, prices, revenues, intermediate inputs' quantities and prices, value added, factors' quantities and prices, profits, scale factors and other relevant indicators based on these variables.

5.3. Building scenarios in the VCA framework

As the VCA in this context is based on an accounting framework, margins are the result of algebraic sums of prices of inputs and outputs time related quantities. Figure 5.4 schematically illustrates, by means of a two-segment simplified value chain, how margins are calculated in the base case (WoP) scenario (yellow panel) and in two different policy scenarios, WiP A and WiP B (green and orange panels respectively).

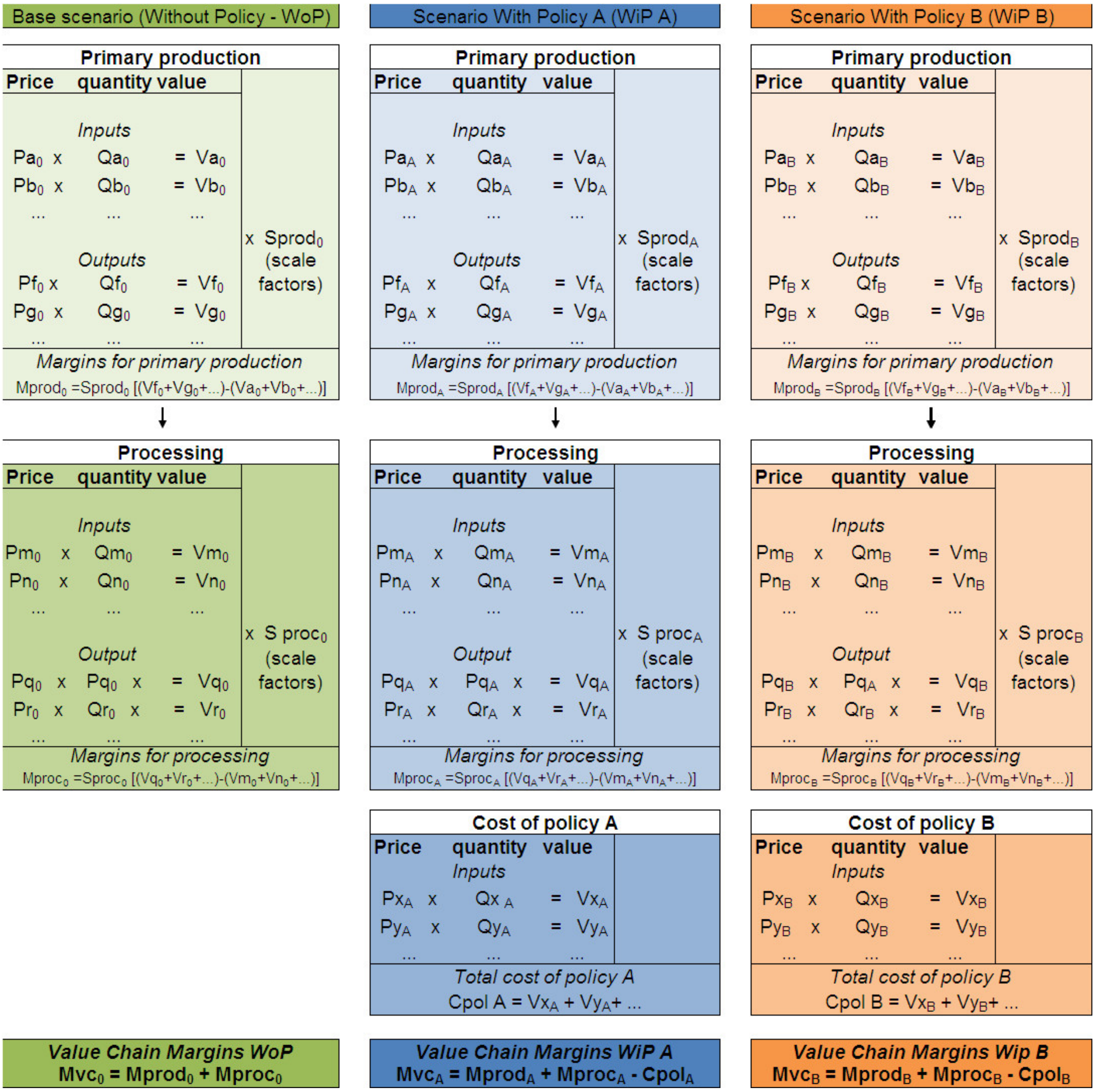
In the base case (labelled with the index 0), the primary production margins *Mprod0* are calculated as the value of outputs minus the value of inputs, adjusted by means of scale factors *Sprod0* for activities and agents, as specified in Chapter 3. The processing margins *Mproc0* are analogously calculated. The margins for the whole value chain *Mvc0* result from the sum of *Mprod0* with *Mproc0.* Policy-induced changes are hosted in the VCA framework by building one or more WiP scenarios. The accounting structure of the WiP scenarios is usually analogous to the WoP one. However, policy-induced changes are accounted for by one or more of the following modifications of the WoP scenario:

a) Modification of prices of inputs/outputs existing in the WoP scenario (e.g., when simulating a policy aimed at reducing the cost of selected inputs or at increasing the output up to a point where market prices may fall to absorb the excess supply).
b) Modification of quantities of inputs and outputs (via modifications of technical and/or yield coefficients) already included in the base scenario (e.g., when simulating a policy aimed at shifting technologies).
c) Inclusion in the WiP scenario of new inputs/outputs and/or deletion of inputs/outputs existing in the WoP scenario (e.g., as in the case above).
d) Modification of scale factors for activities (e.g., for policies aimed at changing the size of agents).
e) Modification of scale factors for agents (e.g., for policies aimed at increasing the number of agents).
f) Inclusion of new activities or deletion of activities existing in the base scenario (e.g., for policies implying relocation of labour, land or other factors to different activities).
g) Inclusion of new representative agents or deletion of representative agents existing in the base scenario (e.g., for policies implying likely socio-economic changes in the profile of actors involved in the value chain or sub-sector activity).
h) Inclusion of the costs related to the implementation of the policy measure. This is reflected for instance in Figure 5.4 for the policy scenarios A and B, where the cost of the policy measures, i.e., overhead costs imputed at the value chain level required to implement the policy measure under simulation *Cpol*, are subtracted by the aggregate margins of the two value chain segments *Mprod* and *Mproc,* in order to calculate the aggregated margins of the value chain *Mcv* (e.g. for the policy measure A:
$Mvc_A = Mprod_A + Mproc_A - Cpol_A$).

The imputation to the value chain of the cost of the policy measure, which is expected to induce the changes modelled in the WiP scenarios, occurs whenever analysts are looking for the economic impact of the policy on the whole value chain net of the costs of implementing the policy itself. Alternatively, the cost of a policy measure could be imputed to one of the segments (e.g., the primary production) or to specific agents within a segment (e.g., large scale producers), by means of the imputation to their income account of specific policy-related taxes. The different imputing options regarding who is going to bear the cost of the policy measure, do not alter the aggregate margins at the value chain level. These options rather modify the distribution of value added within the value chain. The issue on who is paying for what will be addressed in more detail after the discussion of market prices *versus* reference prices, that will be addressed in the next chapter.

Box 5.1 illustrates the case of firewood value chain in Burkina Faso, where the cost of a set of policy measures have been estimated and included in the VCA at the value chain level.

Figure 5.4: Price-Quantity structure of base and policy scenarios



Box 5.1: Example: Firewood value chain in Burkina Faso: Cost Benefit Analysis of policy impacts and imputation of policy costs

Background. Firewood constitutes the main source of energy for Burkina Faso, satisfying more than 80% of the national energy requirements. This value chain also represents a significant contribution to the national economy and to the achievement of poverty reduction objectives: a large number of people involved (especially woodcutters) are in actual fact small-marginal farmers and landless-wage workers whose income is well below the national poverty line, amounting in 2005 at about 96,000 Francs CFA person/year. Thanks to this activity, they gain more than one fourth of their household's annual income. In addition to woodcutters, the other categories of agents involved in the value chain are wholesalers and retailers who contribute to the value added of the entire chain.

Policy measure. Considering the need to increase domestic energy production, reducing extreme poverty and stopping deforestation, in the context of the "Priority Action Programme" (PAP) 2006-2008, the government planned to introduce a new national policy aimed at rehabilitating forests and enhancing their management. A pilot zone where the poverty incidence is 2% higher than in the rest of the country was chosen in the regions of Center-West & Center-South, to implement a policy measure aimed at sustainably enhancing firewood production. The pilot area measures 259,447 ha and is divided in 15 zones of 17,296 ha. While one zone is exploited for one year, the others are left idle to allow the forest to regenerate. In actual fact, in that area, forest management is not optimal and the firewood yields are estimated to be well below their sustainable potential.

More than 800 woodcutters legally operate in that zone. Additional woodcutters could join the sector if forests were properly managed. Most of the potential woodcutters are extremely poor with a large number of children. The revenue from firewood could be an important component of their household livelihood, as is the case for existing woodcutters.

The planned enhanced management involves 4,200 ha per year out of each area of 17,296 ha. It is estimated that, after 15 years from the intervention, i.e., when the forest comes to maturity, sustainable firewood yields can shift from about 5.5 m^3/ha up to 17 m^3/ha. By then, existing woodcutters are expected to increase their profits and to reduce their work per unit of firewood, thanks to the increased forest productivity. The initial enhanced management costs (reforestation, maintenance, surveillance, etc...) were estimated on average at 9,704 Francs CFA per ha. It was also tentatively estimated that, after every second exploitation cycle (i.e. after 30 years from the initial intervention and every thirty years after) a new intervention at the same cost would be required to ensure the sustainability of the enhanced yields.

Cost-Benefit Analysis (CBA). A CBA to assess the profitability of the pilot measure and its impact on poverty has been carried out. Table 5.1 reports a summary of the results, comparing the "*With Policy*" (WiP) and the "*Without Policy*" (WoP) policy scenarios.

Panel A provides data on firewood yields that increase from 5.47 to 8.27 m3/ha (+51%).
Panel B provides information about the number of agents. The number of working days of each woodcutter in the WiP scenario is assumed to be the same as in the WoP scenario, however, they will be able to collect more firewood as they will walk less, thanks to forest's yield intensification. Furthermore, at forest maturity, around 300 additional woodcutters are estimated to join the sector to work in the same area. Regarding wholesalers and retailers, it is assumed that in the WoP scenario both work at full capacity, so in the WiP scenario their number is increased proportionally to the output increase (+51%).

Panel C highlights that woodcutters, wholesalers and retailers present all positive margins in both the WoP and the WiP scenario. It also shows that the policy measure raises the margins for all the segments of the chain. The homogeneity in the margins' increases across the different segments is due to the fact that the policy measure does not alter either the cost structure of the various segments or the price of firewood at the various stages.

Table 5.1: Value Chain margins WiP and WoP

Panel A:Yields

Base scenario (Without Policy - WoP)			Scenario With Policy (WiP)			Comparison (WiP - WoP)	
m3/ha	# ha	m3 total	m3/ha	# ha	m3 total		
5.47	17,296	94,637	5.47	13,096	71,656		
17.00	-	-	17.00	4,200	71,400		
Average m3/ha	# ha	Total m3	Average m3/ha	# ha	Total m3	Var. m3/ha	Var.total m3
5.47	17,296	94,637	8.27	17,296	143,056	2.80	48,419

Panel B: Number of agents in the pilot area

Woodcutters	809	1115	306	37.8%
Wholesalers	41	62	21	51.2%
Retailers	619	935	316	51.1%

Panel C: Value chain margins WiP-WoP (Thousands FCFA)

Profits for woodcutters	104,117	Net Margin for woodcutters	157,372	53,256	51.2%
Profits for wholesalers	367,875	Net margins for wholesalers	555,918	188,043	51.1%
Profits for retailers	154,492	Net margin for retailers	233,674	79,182	51.3%
Cost of the policy measure	-	Cost of the policy measure	- 90,785	- 90,785	-
Value Chain profits	**626,484**	**Value Chain profits**	**856,180**	**229,696**	**36.7%**

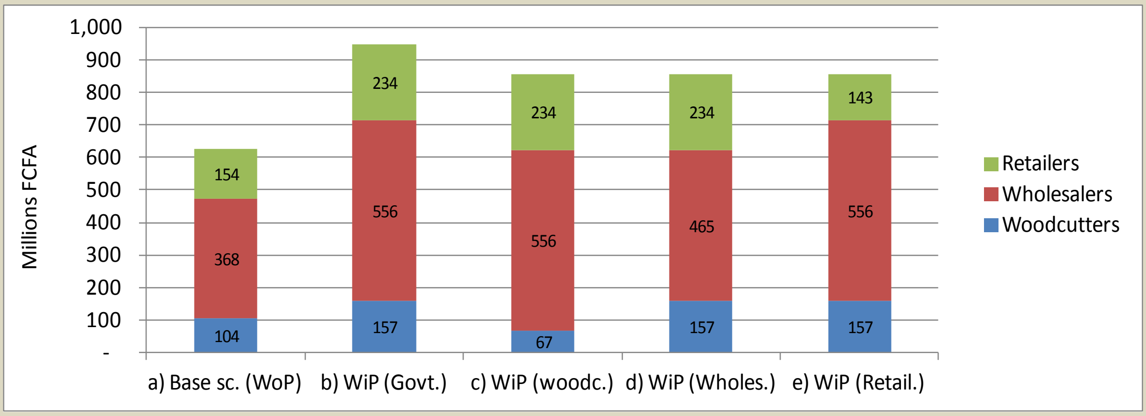
Source: Adapted by the author on the basis of: DGPSA (2007a).[81]

Cost of the policy measure. CBA must also to take into account the cost of the policy measure. Given the fact that this policy measure requires investing in the rehabilitation of the forest before exploiting it, "*annual equivalents*" are calculated to impute a share of investment costs to each exploitation period, taking into account the opportunity cost of capital. In each period the cost of the policy measure results from the sum of a "*Perpetuity*" i.e., an everlasting flow of costs generated by the initial investment for rehabilitating the forest, and an "*Annuity*" on 30 years, generated by the maintenance costs occurring each 30 years. Comparing the value chain profits WiP with those WoP after taking into account the cost of the policy measure (balance of panel C), results show that the policy measure definitely increases the net profitability of the value chain (+ 36.7%).

Imputing the cost of the policy measure. However, the profitability of each segment varies depending on how the cost of the policy measure is imputed. Figure 5.2 shows the profits of the different value chain segments under different assumptions regarding the imputation of this cost, as compared to the WoP scenario: no policy measure cost (hypothesis a). If the cost of the policy measure is borne outside the value chain (e.g. by the government), the profits of all the segments increase proportionally with respect to the WoP scenario (hypothesis b); if the cost is imputed to the Woodcutters' segment, e.g., through an increase of the FAF (Fond d'Aménagement Forestier – Forestry Rehabilitation Fund) woodcutters' profits largely drop below the WoP situation (hypothesis c); if the cost is imputed to the Wholesalers' segment, this segment still enjoys larger profits with respect to the WoP situation (hypothesis d). Finally, if the cost is imputed to the Retailers' segment, retailers' profits drop slightly below their profits in the WoP situation.

[81] Direction Générale des Prévisions et Statistiques Agricoles. Ministère de l'Agriculture, del'Hydraulique et des Ressources Halieutiques (DGPSA), 2007a. *Analyse de la filière Bois de Feu (Firewood) au Burkina Faso*, Ouagadougou, Burkina Faso.

Figure 5.2: Profits for the different segments under alternative policy cost imputation



Alternative policy cost imputations affect also profits of representative agents.

Profits of representative agents. Table 5.2, panel A, shows how the profits of representative agents shift thanks to the policy measure under the assumption that the cost of the policy measure is borne outside the value chain (e.g. by the government). In the WoP scenario Wholesalers earn a disproportionate income, compared to Woodcutters and Retailers. In the WiP scenario, Woodcutters' profits increase by around 10%. Wholesaler and Retailer profits remain unchanged, due to the entry of new agents that absorb the additional profits generated in the respective segments.

Table 5.2, panel B, illustrates that if, for instance, the cost of the policy measure were fully borne by Woodcutters (both current and new), e.g., through an increase of the FAF (Forestry Improvement Fund), the margin of a single Woodcutter would fall by more than 53% with respect to the WoP scenario. If the cost of the policy measure had to be entirely borne by Wholesalers or Retailers, the negative impact on their margins would be -16.4 and -38.8% respectively.

Table 5.2. Representative agents' profits under alternative policy cost imputation

Panel A: profits per agent if the cost of the policy is imputed outside the value chain

Representative Woodcutter	128.7	141.1		12.4	9.7%
Representative Wholesaler	8,972.6	8,966.4	-	6.1	-0.1%
Representative Retailer	249.6	249.9		0.3	0.1%

Panel B: profits per agent if the cost of the policy is imputed to a specific segment

Representative Woodcutter	128.7	59.7	-	69.0	-53.6%
Representative Wholesaler	8,972.6	7,502.2	-	1,470.4	-16.4%
Representarive Retailer	249.6	152.8	-	96.8	-38.8%

Profits enjoyed by representative agents in the various segments under the WiP scenario are also influenced by assumptions regarding the number of new agents expected to join the different segments of the value chain. These assumptions are based on the maximum capacity (maximum activity level) of each agent.

Existing and new agents in the value chain. Figure 5.3 shows how additional profits generated in the WiP scenario are shared among existing and new woodcutters on the basis of assumptions regarding their maximum production capacity. It is assumed that under the WiP scenario the representative woodcutter can expand the output until he/she reaches his/her maximum capacity. This leads to a profit expansion of the existing woodcutters up to 9.7%. However, in order to exploit the full potential of the forest, additional woodcutters (+37.8%) are expected to join the segment, enjoying the same level of profits as the existing ones.

Figure 5.3: Allocation of profits to existing and additional woodcutters under the WiP scenario

Concluding remarks. The CBA reveals that the policy measure is profitable for all actors involved and for the whole value chain. Poverty impacts are two-fold: on the one side, the policy measure increases profits of existing woodcutters; on the other side, additional woodcutters will benefit from the policy measure. However, overall impacts on poverty in the zone need to be assessed through other analytical tools based on household-level surveys, which provide a broader socio-economic picture.

Assuming that all factors at the wholesale level are remunerated at their normal (opportunity) cost, considering the much larger amount of profits enjoyed, this segment appears to be the most appropriate to bear the cost of the policy measure. However, further investigations are required to check the extent to which the government, i.e., the society as a whole, should have an interest in bearing the cost of the policy measure.

Increased profits to agents in the value chain are most likely to generate an increase of local demand. Furthermore, the implementation of the policy measure itself, i.e., the forest rehabilitation, is likely to increase the purchasing power of local people. This may entail multiplier effects for the local economy, to be better investigated through macro-accounting frameworks, such as Social Accounting Matrices (SAMs) or SAM-based General Equilibrium models.

The CBA also highlighted a drawback: the policy measure brings its net benefits after 15 years from the first rehabilitation intervention. Complementary measures to increase the revenues of woodcutters in the short run need to be identified. For instance, policy measures imposing floor prices or breaking possible oligopsonies at the wholesale level, could be advisable, also considering the large profits enjoyed by wholesalers.

Box 5.2: Example: Sugarcane value chain in Kenya[82]

Background. Sugarcane farming in Kenya is primarily carried out on relatively flat regions in the Western, Nyanza, and Coast Provinces. Farmers, who act as outgrowers of sugar cane and sugar companies, who process sugarcane and produce sugar, are the two main agents of the value chain. About 90% of the total sugarcane supply comes from some 200,000 small-scale growers, with the remaining part coming from estates owned by large sugar companies. The country has a handful of major factories with an annual sugar production capacity of between 550,000 and 600,000 tons. By-products from the factories include molasses, mostly for alcohol production, bagasse for power generation and waste used as fertilizer. The sugar sub-sector is the third most important contributor to the agriculture value added, after tea and coffee. It both directly and indirectly supports the livelihood of 6 million Kenyans. However, the sugar industry is facing diverse challenges, such as the low adoption of good agricultural practices, high cost of inputs, also due to high taxation, poor road network, poor management of mills and factories, and delayed payments by factories to farmers. The inefficient factory use capacity translates into delayed harvesting, rising the risks for farmers to lose part of the crop. Inefficiencies of factories, particularly the incapacity to harvest at the right time, also induce farmers not to adopt early maturing cane varieties because they deteriorate faster (KARI, 2010)[83].

In addition to issues related to sugarcane processing, one further issue of the sugar value chain is the under-production of sugarcane at farm level, due to different reasons such as the limited know how of farmers regarding good agricultural practices, missing timely availability of inputs and low yield sugarcane varieties. These problems strongly affect the competitiveness of domestically produced sugar with respect to imported one.

A partial solution to these problems was identified in the development of agricultural practices and the adoption of improved sugarcane varieties, such as the EAK70-97., this sugarcane variety, for instance, is claimed to be pest and disease resistant and adapted to the sugarcane growing conditions in Kenya (Jamoza, 2005)[84].

Policy measure. A policy measure aimed at supporting the introduction of new varieties was scrutinized by the Ministry of Agriculture in 2009. New varieties were expected to lead to higher productivity, increased profitability and enhanced long-term competitiveness. By primarily targeting the rural poor, it was also expected that net incomes of poor sugarcane producers raise, entailing falling poverty rates, increased food security and rural development.

To implement the policy measure a policy instrument had to be identified. On the basis of existing literature (e.g. Birkhaeuser et al, 1991; Bindish and Evenson 1993; Evenson and Mwabu, 1998; Romani 2003) [85], it was reputed that the number and quality of extension agents be a key variable to influence the outreach to farmers and the level of technology adoption. Extension officers' duties comprise farm visits, field and open days, field demonstrations and sometimes seminars, dissemination of pamphlets

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[82] Adapted from: *MOA Kenya-FAO, 2010: Value Chain analysis of the Kenya Sugar Industry in 2008: Selected Policy options.* Unpublished draft document prepared by a National Working Group of experts in the Ministry of Agriculture. FAO Technical Cooperation Programme, November 2010. Data used in the case study regarding harvested Area, yields and production is consistent with FAOSTAT. Data on cost structure and profitability of sugar companies is broadly consistent with info provided in:
GOK, 2007: National Adaptation Strategy for the Sugar Industry, Government of Kenya, February 2007.

[83] KARI, Biennial Scientific Conference, November 2010.

[84] Jamoza J.E, (2005). Sugar Cane Variety Improvement in Kenya. Kenya Sugar Research Foundation (KESREF). Varieties EAK 69-47, EAK 71-402, EAK 70-97 combined to fertilizer rates of 60kg P2 O5/ha and 100kg N/ha for plant crop and 120kg N/ha for ratoon crops have been selected for dissemination amongst sugarcane farmers.

[85] Birkhaeuser, D., R. Evenson and G. Feder. 1991. The economic impact of agricultural extension: a review. Economic Development and Cultural Change 39 (3): 507-521.
Evenson, R. and G. Mwabu, 1998. The effects of Agricultural Extension on Farm Yields in Kenya, *Economic Growth Center Discussion Paper No. 798*. Yale University. New Haven.
Bindlish, Vishva, and Robert E. Evenson. 1993. Evaluation of the Performance of T& V Extension in Kenya. World Bank Technical Paper No. 208, Africa Technical Department Series, World Bank, Washington, D.C.
Romani, M., 2003. *The impact of extension services in times of crisis: Côte d'Ivoire 1997- 2000,* Centre for the Study of African Economies, University of Oxford. CSAE WPS/2003-07.

and bulletins. Therefore, the increasing diffusion of the new varieties was expected be achieved through an increased ratio of extension agents per farmers, notably from 1:1000 to 1:400. This would imply increasing the number of agents from around 200 to 500. Extension agents would be properly trained on agricultural practices regarding the new variety and speaking the same language as the target population. An increased number of extension agents would support in a more effective way the adoption of improved agricultural practices for an efficient planting, growing and harvesting process of the new varieties. However, the adoption of new sugarcane varieties would imply increasing the use of chemical fertilizers, from a current level of around 400 kilograms per hectare to around 650 kilograms, on average.

Cost of the policy measure. The overall annual costs of this policy measure would amount to around 700 millions of Kenyan Shillings (KSh), comprising the salary of the additional extension officers, costs of field visits and fertilizers.

Cost-benefit analysis (CBA). A CBA to assess the expected net benefits of such policy measure was carried out. The estimated impacts of the policy measure on profits of farmers, sugar companies and the whole value chain, are reported in table 5.3, where a comparison between the "With Policy" (WiP) situation and the "Without-Policy" situation (WoP – base scenario) is carried out.

Table 5.3. Cost Benefit Analysis (CBA) of the policy measure: WiP-WoP comparisons of profits

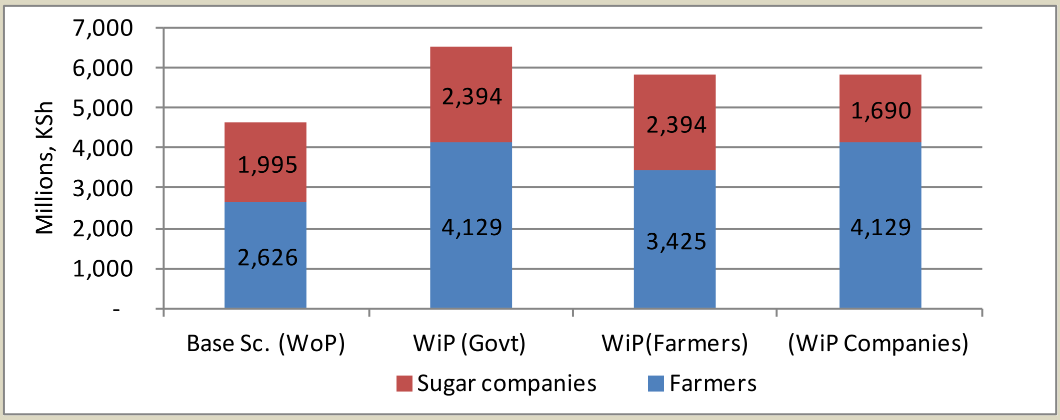
Base scenario (Without Policy - WoP)		**Scenario With Policy (WiP)**		**Comparison (WiP - WoP)**	
	KSh (millions)		KSh (millions)	KSh (millions)	Var.%
Profits of farmers	2,626	Profits for farmers	4,129	1,503	57.2%
Profits of sugar companies	1,995	Profits for companies	2,394	399	20.0%
Cost of the policy measure	-	Cost of the policy measure -	704	- 704	-
Value Chain profits	**4,621**	**Value Chain profits**	**5,819**	**1,198**	**25.9%**

Source: Adapted from *MOA, Kenya - FAO, 2010.*

The policy measure was expected to be profitable for all the categories involved, shifting up profits of farmers and companies of 57% and 20% respectively. Profits of the whole value chain, after accounting for the cost of the policy measure, were expected to increase by 26%.

Imputing the cost of the policy measure. The actual net benefits accruing to each specific segment of the value chain depend on the way policy measure's costs are imputed. Figure 5.4 reports net profits for both farmers and sugar companies under different With-Policy (WiP) scenarios regarding this imputation, compared with profits under the base scenario (WoP). On the one hand, if policy measure's costs were entirely imputed to farmers, they would still enjoy a profit increase w.r.t. the WoP case of around Ksh 800 millions. On the other hand, if policy measure's costs were entirely imputed to sugar companies, they would bear a net profit decrease of around Ksh 300 millions.

Figure 5.4. Imputing the cost of the policy measure: Net profits under different alternatives



Source: Adapted from *MOA, Kenya - FAO, 2010.*

Poverty impact analysis. Since the policy measure under investigation aimed to alleviate poverty, the cost-benefit analysis was complemented by a preliminary investigation on the likely impacts of the policy measure on poverty at the national level. After identifying sugarcane growers in the KHIBS database[86], the Poverty Headcount Ratio (PHR) was calculated under both the WoP and the WiP scenario, to assess possible changes in poverty incidence both in urban and rural areas. The WoP scenario was assumed to be represented by the income levels reported in the KHIBS, while the WiP scenario was built by shifting up the appropriate income component of the sugarcane growers by the percentage reported in table 5.2. The values of the PHR are displayed in Table 5.4.

Table 5.4: Impact of the policy measure on poverty incidence: Comparison WiP - WoP

Item	WoP	WiP	Difference
Headcount ratio - total (%)	37.9 %	37.8%	- 0.1%
Headcount ratio – urban (%)	*26.1%*	*26.1%*	-
Headcount ratio – rural (%)	*41.8%*	*41.6%*	*- 0.2%*

Source: Adapted from *MOA, Kenya - FAO, 2010.*

The policy measure under investigation shows a modest impact on the overall poverty headcount ratio, with no impacts on urban poverty, as expected, but with a slightly more marked impact on rural poverty.

Concluding remarks. On the basis of the elements analyzed, this policy measure appears to be beneficial for the sugar subsector both on economic and social grounds. However, further considerations need to be put forward: 1) Negative environmental impacts of increased use of chemical fertilizers need to be properly assessed and accounted for in further refinements of the cost-benefit analysis. 2) The success of policy measures specifically targeting sugarcane producers heavily depends on the solution of issues related to the overall organization of the value chain, including logistical aspects, timely harvesting and efficient processing of sugarcane; 3) Improvements of the domestic sugar value chain must be strong enough to overcome the competitiveness gap of the sugar sub-sector with respect direct foreign competitors. 4) Competitiveness gaps however would have to be filled not at any cost but with policy measures that contribute to the economic, social and environmental sustainability of the value chain.

5.4. VCA for monitoring value chain performances

The VCA scenario approach proposed above for ex-ante (anticipated) impact analysis of policy options, is also useful for time-wise monitoring of the value chain performances in terms of value added generation and distribution, output production, input use, competitiveness and the overall effect of policies and external shocks, as well as incentives/disincentives received by economic agents. As economic agents are not interested in the value of the output *per se*, but in the margins they get from their economic activity. Margins act as incentives (if positive) or disincentives (if negative) for economic agents. Public policies and/or external shocks are likely to alter incentives/disincentives to producers. For instance, a policy aimed at increasing yields of an activity is likely to stimulate producers to undertake such activity on a larger scale. However the incentives that they receive from the output side may be partially, fully or more than fully offset by disincentives from the input side and *vice-versa*. The implication is that, in order to monitor incentives and disincentives, it is more appropriate to monitor, to the

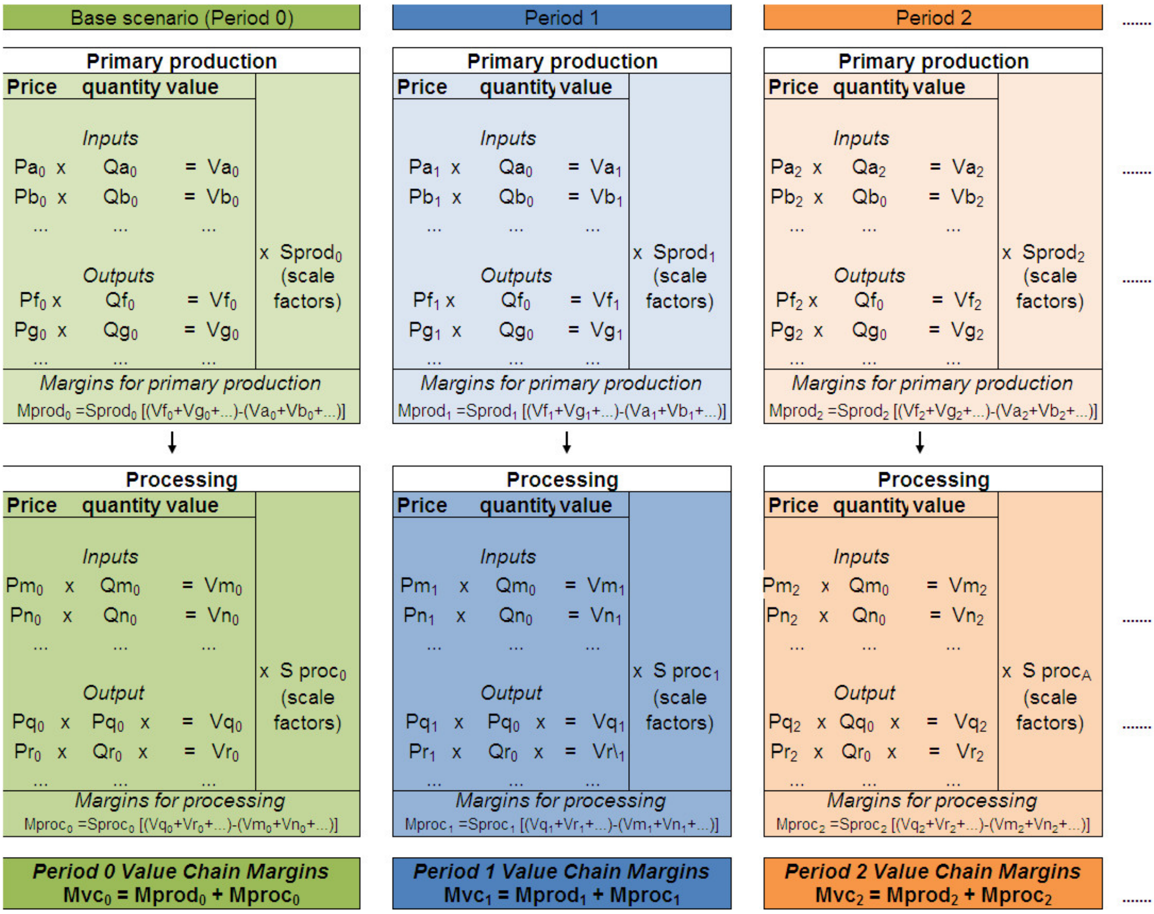
[86] This analysis was based on data from the Kenya Integrated Household Budget Survey (KIHBS) 2004/2005 carried out by the Central Bureau of Statistics (Ministry of Planning and National Development).

maximum extent possible, the margins received by agents as a result of production processes rather than single commodity prices.

Monitoring value chains in the VCA framework implies building, instead of policy or shock-based scenarios as in the case described above, a sequence of VC scenarios referring to different periods. The time dimension is therefore explicitly brought into the analysis. Comparisons of relevant value chain indicators with the benchmark period (period 0) and with each preceding period provide analysts with information on the evolution of the value chain.

Considering that building a value chain framework is quite a data and resource-intensive process, a strategy to more frequently update data likely to significantly change from one year to the next, has to be adopted. Data which are more structural by nature will be less frequently updated. Selected data, such as prices of inputs and outputs require more frequent updating than others, such as quantities per unit of activity, which is essentially data related to the production technology adopted, likely to remain quite stable from one period to the next. Periodic updates may also include activity and agents' scale factors, which must be updated to ensure compatibility with sector-level information (e.g., related to total outputs of commodities produced) and for calibrating supply-demand accounts. This approach provides updated estimates of aggregate data and indicators. Figure 5.5 reports the data structure of a simplified two-segment multi-period value chain monitoring exercise, highlighting data most likely to be updated from one period to the next with different colours .

Figure 5.5: Data structure for a multi-period value chain monitoring



5.5. Appendix

5.5.1. Cost-Benefit Analysis of policy options for Rice Value chain in Burkina Faso

PART THREE: Land rehabilitation and consolidation policy option: cost-benefit analysis

Background information

An accounting framework of the Rice value chain has been elaborated and presented to the government as a base scenario to be used for cost-benefit analysis of various development policy options (part 1 and 2 of this exercise). The policy analysts now want to use such an accounting framework to assess a new policy proposal affecting the rice value chain.

The government wants to implement a land rehabilitation and consolidation policy which would increase the surface used by smallholders producing paddy rice.

The land reform policy aims at increasing the average surface by 25 % (from 0.4 to 0.5 ha per paddy producer).

This policy measure is estimated to cost 180,000,000 monetary units and is expected to extend its benefits over 20 years.

The Opportunity cost of capital at constant prices for this policy measure is assumed to be 5%.

As a substantial share of the cost of this policy measure is directly or indirectly devoted to hire labour (work for land rehabilitation and administrative purposes), the cost of the policy is classified as value added.

In addition, it is assumed that the additional paddy will be processed by existing steamers who in the benchmark present an excess production capacity.

Assignment

Advise the government about the value added generation and the profitability of this policy measure for the various agents involved and for the whole value chain.

Hints

a. Work out the annual equivalent for the cost of the policy measure and separate the "*consumption of fixed capital*" component by the "*interest*" component, as suggested in pages 42-43.
b. Create a "With-Policy" (WiP) Scenario (Scenario n 1) by:
   - Modifying the profile of the representative producer;
   - Checking the consistency of the physical flows between the two segments of the value chain and adjusting the demand side of the paddy market (the steamers) to balance supply and demand of paddy;
   - Appropriately imputing the costs of the policy measure.
c. Compare the balances (value added, profits etc.) of the WiP scenario with those of the benchmark (WoP policy scenario), calculated in part one and two of the exercise.

PART FOUR: Food losses: cost-benefit analysis of a possible policy measure

Background

Part of the paddy rice (10 %) is lost after harvesting due to poor management of post-harvest storage, while the remaining rice is sold to steamers.
In order to reduce the losses, better storing facilities at farm level can be introduced. This solution decreases the losses to 5 % of the crop production, enabling the farmers to gain higher profits from the total output sold.
The cost of a single storing facility is 70,000 FCFA, which lasts for ten years.

	Outputs	Unit	Price	Quantity per ha
O	Paddy rice lost (10% of the yield)	ton	10,000	0.45

Assignment

Carry out the counterfactual cost-benefit analysis by comparing two different scenarios: the Scenario without policy (WoP), which represents the situation without storing facilities and the “With-Policy” Scenario (WiP), which represents the situation with the storing facilities.

What is going to change if we assume that a higher supply of paddy rice will reduce its market price by 2 %?

Hints

Create new scenarios that simulate these cases: scenario n2 with the land consolidation policy and 10% of paddy losses, scenario n3 with the land consolidation policy, the 5% of paddy losses and the cost of storing facilities (calculate the annual equivalent and introduce the good in the dataset), and scenario n4 as scenario n3 but with the new paddy rice price.

6. DECISION MAKING IN AN OPEN-ECONOMY SETTING

In open economies, i.e. in economic system where domestic agents carry out transactions with the Rest of the World (ROW), decisions on how to allocate resources take into consideration the opportunities provided by international markets. Value chain developments which imply transactions for inputs and/or outputs with the ROW, need to be assessed using prices that reflect values of goods and services on international markets. International prices become the benchmark for informing decisions of domestic agents regarding production and consumption decisions. However, when domestic agents will buy or sell goods or services exchanged on international market they will pay a price which, in actual facts, depends on various factors, such as:

- The price of the good or service at the frontier in foreign currency (CIF or FOB, see box 6.1 for definitions)
- The exchange rate;
- Tariffs and taxes applied at the border;
- Domestic transport, handling and/or transformation costs.

In the next sections we explore how to calculate prices of goods and services exchanged on international markets likely to be paid or received by domestic agents, the so called "*Parity Prices*".

Box 6.1: Price configurations [87].

CIF Price (Cost, Insurance and Freight) is the price of a commodity delivered at the frontier of the country importing that commodity. It includes the insurance and freight charges incurred in carrying the good from the exporter's frontier to the importer's one. It can also refer to the price of a service delivered to a resident, before the payment of any import duties or other tax on imports or trade and transport margins within the country. In the balance of payments and in trade statistics, imported goods are always valued at their CIF price

FOB Price (Free On Board) is the price at the border of an exported (and/or an imported) good and it does not include all transportation and insurance costs from the port of departure to the border. It equals to the CIF price net of the costs of transportation and of insurance charges incurred in shipping the good from the customs frontier of the exporting (importing) country to the importing (exporting) country. In the balance of payments and in trade statistics, exported goods are always valued at their FOB price.

Border Price is the import (CIF) or export (FOB) price of a good expressed in national currency.

Import Parity Price is the border price ***plus*** the costs necessary to bring the good/service from the national entry point to the domestic market of reference. Those costs include domestic tariffs, taxes, fees, duties, subsidies, transportation costs, storage costs, etc.

Export Parity Price: it is the border price ***net of*** the costs necessary to bring the good/service from the production site to the national exit point. They include the export taxes, export subsidies, transportation costs, storage costs, etc.

[87] The definitions are taken from United Nations, Statistical Division (2008): System of National Accounts, at: *http://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf* and OECD Glossary of Statistics *http://stats.oecd.org/glossary/*

6.1. Computing parity prices

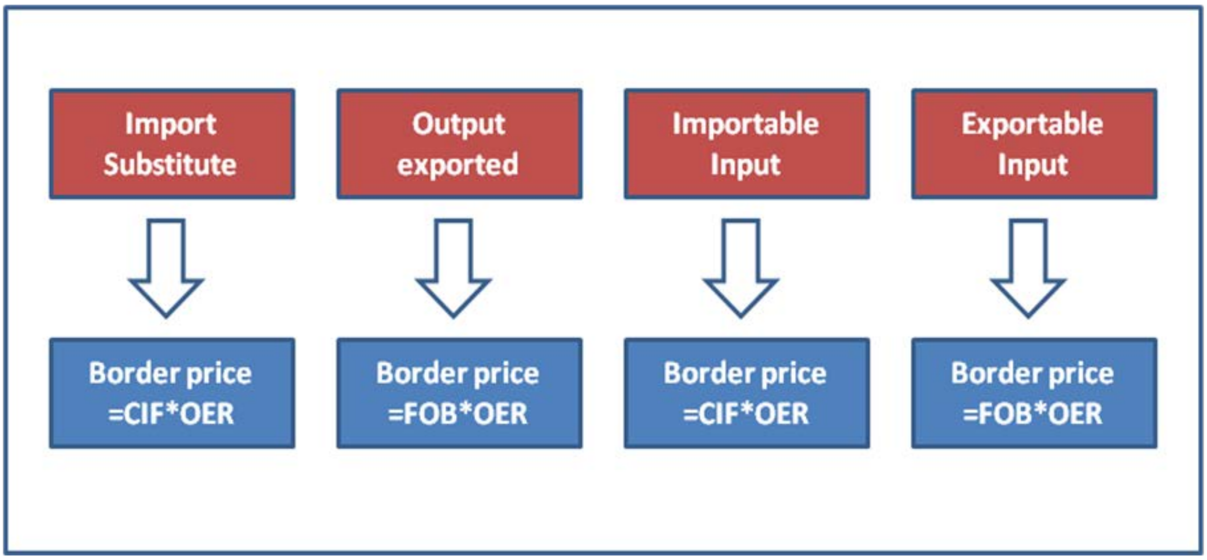
Parity prices are usually calculated for internationally tradable goods and services, i.e. products for which exchange opportunities exist on international markets.

For exportable and exported commodities, both outputs and inputs, the export parity prices is computed using FOB prices as a benchmark for the world prices. In the case of import substitutes, both outputs and inputs, import parity prices are calculated employing CIF prices as world prices (see Figure 7.2). Parity prices for non traded commodities cannot always be computed on the basis of a world price; different solutions to this calculation will be illustrated in paragraph 7.2.

If a commodity traded internationally has more than one entry/exit point in a country, it faces several FOB and CIF prices. Hence, selecting a FOB or CIF price depends on whether the commodity is an exportable/exported or import substitute and on the focus of the analysis.

This also defines the category and the parity price to compute. For example, considering a commodity both imported and exported, analysts can either examine the competitiveness of national producers to export or the potential it exhibits to crowd out importers. The two options require that analysts study two different markets and calculate the parity prices using FOB prices in the first case and CIF prices in the second case. Moreover, calculating an import/export parity price depends on the agent for whom the calculation is made. Hereafter, calculations and examples are carried out by the point of view of the domestic producer. The difference between computing a parity price for an output or for an input depends on the adjustments on the world price. These issues will be addressed, in the next paragraphs. .

Figure 6.2: Calculating parity prices: Categories of goods and services



6.1.1. Parity price of an output as import substitute

The import parity price of a domestic output provides the maximum domestic production costs allowing a commodity to be competitive with the respect to an imported homogenous commodity.

Thus, the import parity price is calculated to assess the potential of a domestically produced commodity to compete with - and eventually to substitute - a commodity taken from abroad and brought to the domestic market.

The **wholesale domestic market** is usually considered the point where domestically produced commodities (the import substitute) compete with the imported ones.

Departing from the border, the imported commodity reaches the domestic wholesale market, with several costs like payment of import tariffs, transport costs, handling and storage costs. In the same way, the domestically produced commodity confronts extra costs to be shipped, like transport costs, handling costs to arrive to the wholesale market, etc.

To compute the **import parity price at wholesale level** (=IPPW) add to the border price (= the relevant CIF price multiplied by the official exchange rate OER) the import tariffs and all the transport, handling, storage and transaction costs incurred from the border to the wholesale market to make the import reach the point of competition. This price is considered to be the benchmark to evaluate the competitiveness of the homogenous domestic commodity produced.

If the domestic commodity has a wholesale price higher than the IPPW, it is clearly not competitive. Under the assumption of homogeneity, consumers would prefer to buy the imported good rather than the domestic one because it is cheaper.

The **import parity price at production level is obtained** by deducting the transport, handling storage and transaction costs incurred to take the domestic commodity from the farm gate (i.e. the point of production) to the wholesale market, from the import parity price at the wholesale level. It can be interpreted as the maximum domestic production costs for which the domestic commodity is competitive with respect to the imported one. This procedure meets the need to compute the domestic commodity price for the wholesale market, i.e., the price covering those costs on top of production costs. The maximum domestic production cost keeping the domestic commodity competitive is therefore obtained by subtracting transport, handling storage and transaction costs incurred to take the commodity from farm gate to the wholesale market from the IPPW.

In a nutshell, to define if the domestic commodity is competitive with respect to a homogenous imported one, it is necessary to compare the **import parity price at production level** with the **domestic production costs.** If the latter is lower than the former, the domestic product is competitive wth respect to the imported one.

Figure 6.3 highlights the mechanisms underlying the calculus of an import parity price for an output, whereas Figure 7.4 and Table 7.1 provide two numerical examples.

Figure 6.3: Parity price of a domestic output as import substitute

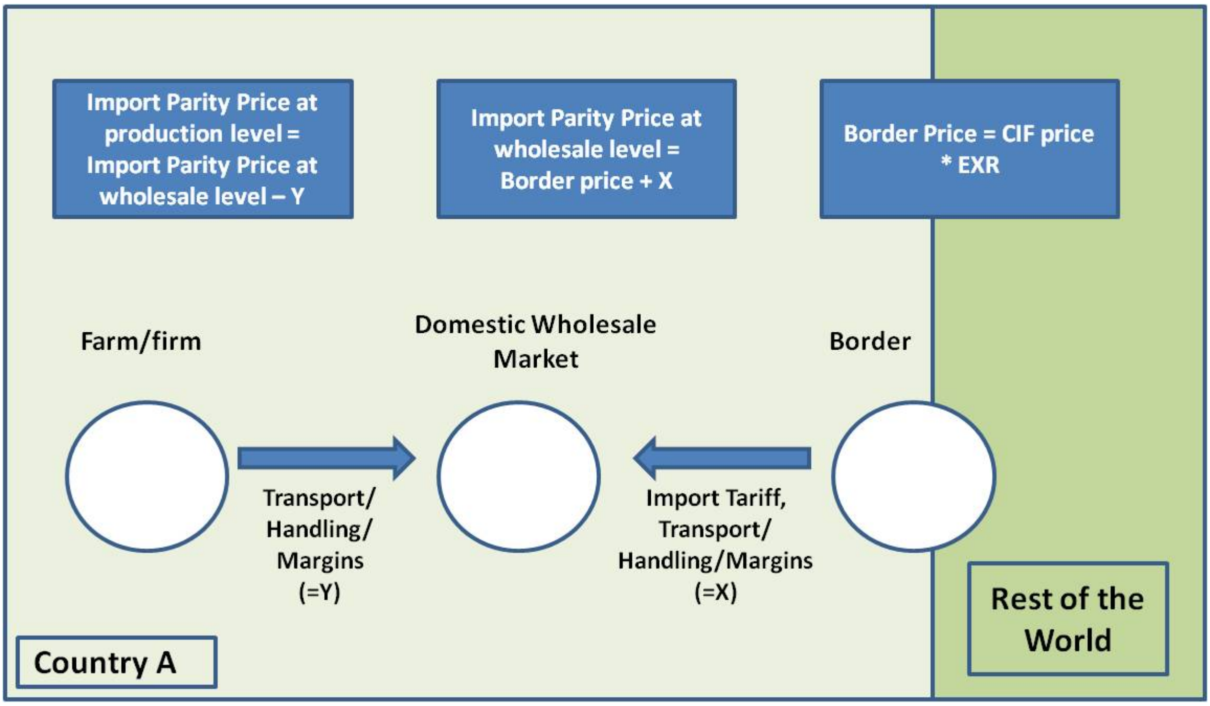


Figure 6.4 provides an example on the computation of the import parity price at the production level. Suppose that the border price of 1kg of rice in domestic currency is 700. To compute the **import parity price at wholesale level** (=IPPW) add to the border price all the costs incurred from the border to the wholesale market. In this case they are represented by the storage costs (30 in domestic currency) and the transportation costs (70 in domestic currency). The import parity price calculated at wholesale level is 800, expressed in domestic currency. The **import parity price at production level** is thus obtained by subtracting from the import parity price at wholesale level all the costs incurred to take the domestic commodity from the production point to the wholesale market. In this example the transport and storage costs are equal to 50. Consequently the import parity price at production level is 750, expressed in domestic currency. This represents the maximum domestic production costs for which the domestic commodity is competitive with the respect to a homogenous import.

In the example of Table 6.1 A, the CIF price of an imported commodity is 1.4 in foreign currency. To compute the border price it needs to be multiplied by the official exchange rate (1 in foreign currency = 500 in domestic currency): the result is a border price equals to 700 units of the domestic currency. To compute the **import parity price at wholesale level** add the border price to all the costs incurred from the border to the wholesale market, including the import tariffs and transport, handling, storage and any other transaction costs. The example shows two types of import tariff: one tariff *ad valorem* (the percentage of the unit price of the commodity imported, in this case 10%) and a single import tariff to be applied as total cost (10) to the border price. The transport, the handling and the storage costs from the border to the wholesale market are respectively 10, 15 and 20. Summing up all the costs incurred, the import parity price at wholesale level is 825, in domestic currency. The **import parity price at production level** is thus obtained by subtracting from the import parity price at wholesale level all the costs incurred to take the domestic commodity from the production point to the wholesale market. In the examples these costs are represented by the transport and the handling, both equal to 5. The import parity price at production level expressed in domestic currency is 815.

Table 6.1: Computing the parity price of an import substitute

a	CIF Price in foreign currency	1.4	f.c.
b	Official Exchange Rate (OER)	500	d.c.
C=a*b	Border Price (CIF price in local currency)	700	d.c.
d	Import tariff (ad valorem %)	10%	
e	Unit import tariff	10	d.c.
F=c*d+e	Total import tariff	80	d.c.
g	Transport Cost from border to domestic market	10	d.c.
h	Handling Cost from border to domestic market	15	d.c.
i	Storage Cost from border to domestic market	20	d.c.
J=C+F+g+h+i	Parity Price at market level (PPML)	825	d.c.
k	Transport Cost from firm/farm to domestic market	5	d.c.
l	Handling Cost from firm/farm to domestic market	5	d.c.
m	Storage Cost from firm/farm to domestic market	0	l.c.
N= J-(k+l+m)	Parity Price at production level (PPPL)	815	d.c.

f.c. and d.c. are respectively foreign currency and domestic currency

6.1.2. Parity price of a domestic output as export

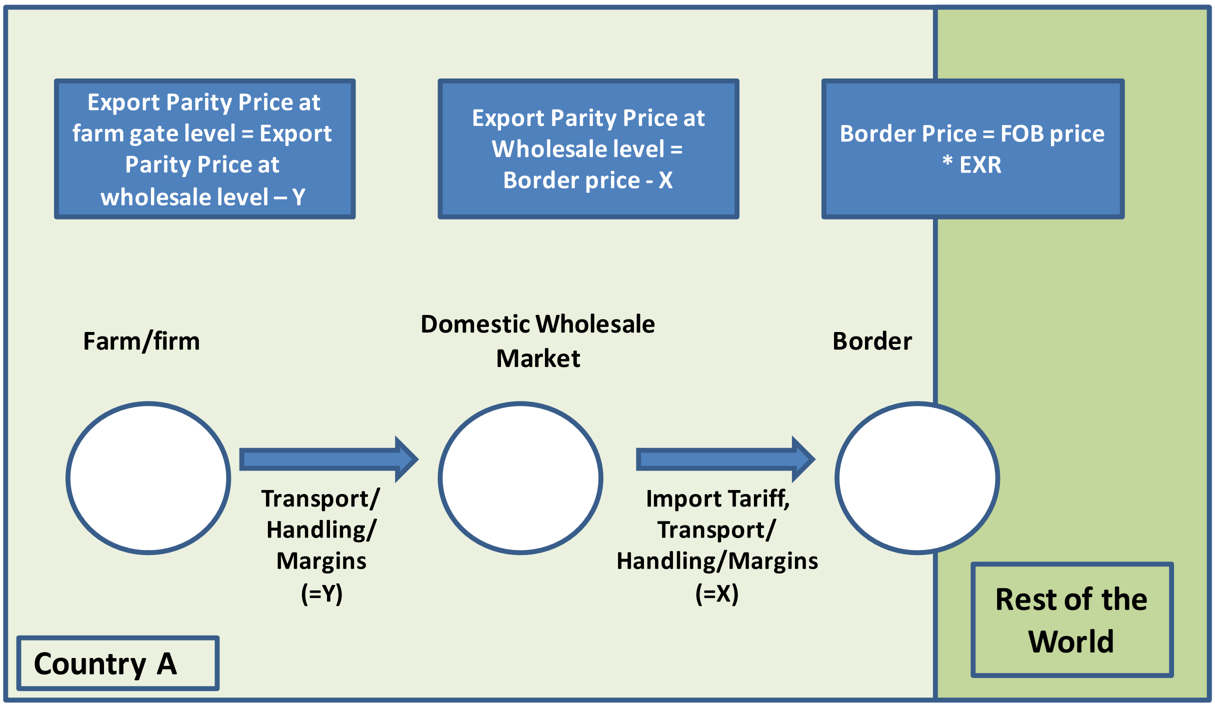
The export parity price at production (or farm) level (EPPF) provides the maximum production costs for a given commodity to be competitive on the international markets. This can be calculated to assess the potential of a domestically produced commodity with the respect to a homogenous commodity traded on the international market. Computing an EPPF for a domestic output implies subtracting from the price obtainable on the international market, converted in domestic currency at the official exchange rate EXR, the costs incurred to bring the domestic good from the production site level to the border.

In the case of an export parity price, *the border is assumed to be the point where the domestic output competes with analogous goods produced abroad*, and not the wholesale market as for the import parity price. The costs incurred from the production level to the border include transport, handling, storage, margins, export tax and all the other transaction costs.

Comparing the export parity prices at the production level with the current domestic production costs will reveal whether domestic producers are competitive on the international market, i.e., when production costs are *lower* or equal to EPPF.

Figure 6.5 describes the reasoning underlying the calculus of an export parity price for an output, whereas Table 7.2 provides a numerical example.

Figure 6.5: Parity price of a domestic output as export



The FOB price of an exported commodity is 0.8 in foreign currency. To compute the border price the FOB price is multiplied by the official exchange rate (1 in foreign currency= 500 in domestic currency): the result is a border price equal to 400, in domestic currency. The **export parity price at wholesale level** is computed by subtracting all the costs incurred to bring the commodity from the production (or farm gate) level to the border, including the export taxes and transport, handling, storage and any other transaction costs.

The example in Table 6.2 shows that these costs are split in costs incurred from the wholesale market to the border and from the production level to the wholesale market. From the wholesale market to the border two types of the exported taxes are computed: one tax ad valorem (as % of the unit price of the commodity exported, equal to 10%) plus a single export tax applied as total cost (1). Transport, handling and storage costs from the wholesale market to the border are respectively 9, 1 and 4. Summing up all the costs incurred and deducting them from the border price, the export parity price at wholesale level is 345, in domestic currency. The **export**

parity price at production level is thus obtained subtracting the export parity price at wholesale level from all the other costs incurred to move the domestic commodity from the production point to the wholesale market. In the examples, these costs are represented by the transport and the handling, respectively equal to 10 and 5. The export parity price at production level expressed in domestic currency is 330.

Table 6.2: Computing the Parity Price of an domestic output as export

a	FOB Price (foreign currency)	0,800	f.c.
b	Official Exchange Rate (OER)	500	d.c.
C=a*b	Border Price (local currency)	400	d.c.
d	Export tax (ad valorem %)	10%	
e	Unit export tax	1	d.c.
F=C*d+e	Total export tax	41	l.c.
g	Transport Cost from wholesale market to border	9	d.c.
h	Handling Cost from wholesale market to border	1	d.c.
i	Storage Cost from wholesale market to border	4	d.c.
J=C-F-(g+h+i)	Parity Price at market level (PPML)	345	d.c.
k	Transport Cost from farm/firm to domestic market	10	d.c.
l	Handling Cost from farm/firm to domestic market	5	d.c.
m	Storage Cost from farm/firm to domestic market	0	d.c.
N= J-(k+l+m)	Parity Price at production level (PPPL)	330	d.c.

f.c. and d.c. are respectively foreign currency and domestic currency

6.1.3. Parity prices of importable and exportable inputs

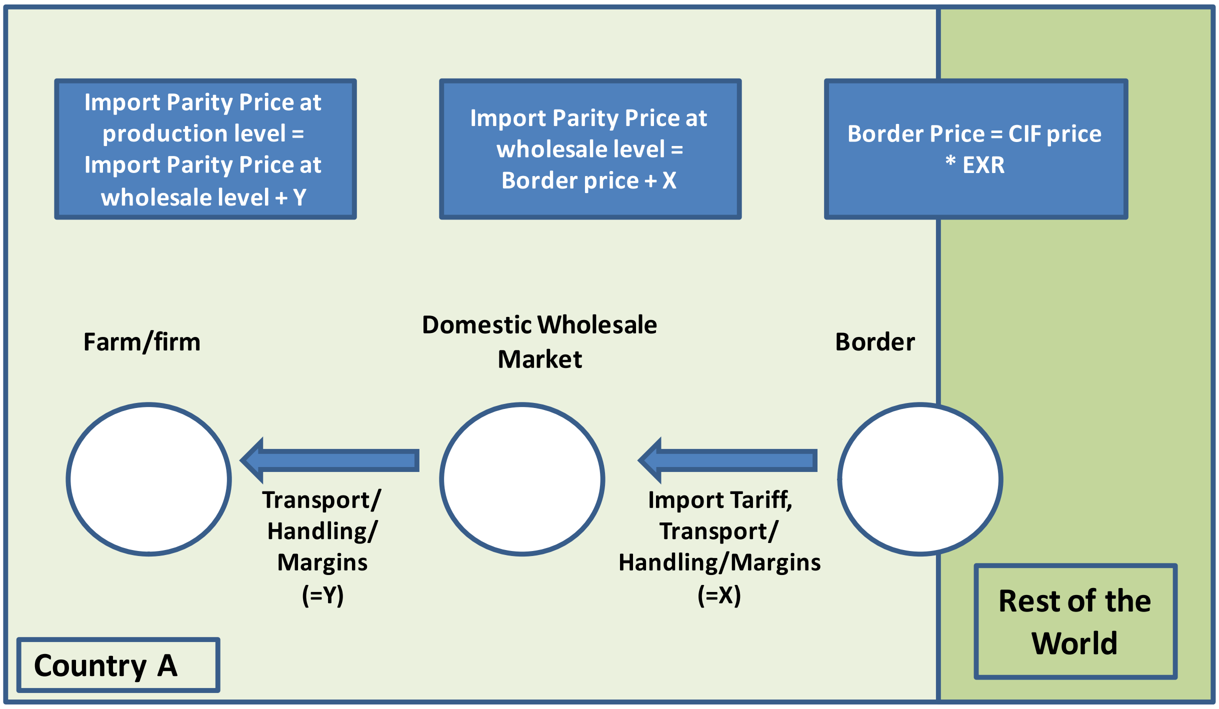
Parity prices can also be calculated for inputs to assess the opportunity cost of using either importable or exportable inputs into domestic production processes.

Considering the producer’s choice to produce his/her own products or to buy the input necessary for the production process, the **importable input parity price** gives the cost of an input not available on the domestic market, to also evaluate the prospective choice of its domestic production. *The production level is assumed to be the point where the domestic input should compete with an analogous imported input.*

Similarly, the information included in the calculation of the **exportable input parity price** answers the question of using or selling- the input, reflecting the cost of domestically using an input that otherwise would be (or is) sold on foreign markets. *The wholesale market is assumed to be the point where the exported input should compete with an analogous input consumed domestically*.

Figure 6.6 illustrates the calculus of an import parity price for an input whereas Table 6.3 provides a numerical example.

Figure 6.6: Parity price of an input to be imported



Consider the example in Table 6.3. A CIF price of an imported input is 0.5 in foreign currency. The border price is obtained by multiplying the CIF price by the usual official exchange rate (1 in foreign currency= 500 in domestic currency). Thus the border price is equal to 250, in domestic currency. To compute the **import parity price of an input at wholesale level** add to the border price all the costs incurred from the border to the wholesale market, including the import tariffs and transport, handling, storage and any other transaction costs. The example shows again two types of the import tariff: one tariff *ad valorem* (as % of the unit price of the commodity imported equal to 10%) plus a single import tariff equal to 5 to be applied to the total cost of the border price. The total costs for tariff amounts to 30. Transport, handling and storage costs from the border to the wholesale market are respectively 10, 2 and 3. The import parity price for an input at the wholesale level obtained is 295 and includes all the costs previously calculated (in domestic currency). The **import parity price of an input at production level** is thus obtained adding to the import parity price at wholesale level all the other costs incurred to take the domestic commodity from the production point to the wholesale market. In the examples of Table 6.3 these costs are represented by transport and handling, both equal to 1. The import parity price of an input at production level is 297 in domestic currency.

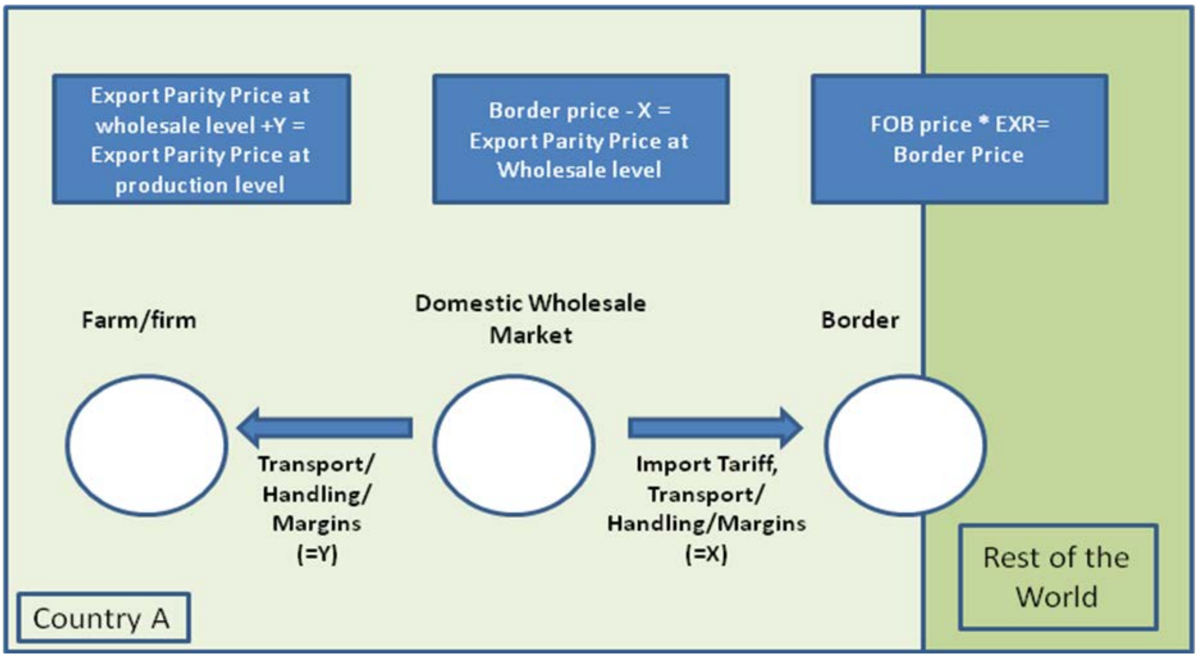
Table 6.3: Computing the parity price of an input to be imported

a	CIF price (foreign currency)	0.5	f.c.
b	Official Exchange Rate	500	d.c.
C=a*b	Border price (local currency)	250	d.c.
d	Import tax (ad valorem %)	10%	
e	Unit import tax	5	d.c.
F=c*d+e	Total import tariff	30	d.c.
g	Transport Cost from border to domestic market	10	d.c.
h	Handling Cost from border to domestic market	2	d.c.
i	Storage Cost from border to domestic market	3	d.c.
J=C+F+g+h+i	Import Parity Price at market level	295	d.c.
k	Transport Cost from domestic market to prod site	1	d.c.
l	Handling Cost from domestic market to prod site	1	d.c.
m	Storage Cost from domestic market to prod site	0	d.c.
N= J+k+l+m	Import Parity Price at Production Level	297	d.c.

f.c. and d.c. are respectively foreign currency and domestic currency

Figure 6.7 illustrates the procedure to calculate the export parity price for an input, whereas Table 6.4 provides a numerical example.

Figure 6.7: Parity price of an input exported



In Table 6.4, the FOB price of an exported input is 0.7 in foreign currency. To obtain the border price in domestic currency, multiply the FOB price by the official exchange rate (1 in foreign currency= 500 in domestic currency): the result is equal to 350. The **export parity price of an input at wholesale level** is computed subtracting from the border price all costs that would have been incurred to bring the commodity from the wholesale market to the border, including the export taxes and transport, handling, storage and any other transaction costs.

From the wholesale market to the border, two types of the exported taxes are computed: one tax *ad valorem* (as % of the unit price of the commodity exported, equal to 20% in this case) plus a single export tax applied as the total cost equal to 5. Transport, handling and storage costs from the wholesale market to the border are respectively 10, 2 and 3. Summing up all costs incurred (75+10+2+3) and deducting from the border price, the export parity price at wholesale level is 260, in domestic currency. The **export parity price at production level** is thus obtained adding all the other costs incurred to the export parity price at wholesale level to move the domestic commodity from the production point to the wholesale market. The examples illustrate that these costs are represented by transport and handling, respectively equal to 20 and 10. The export parity price of an input at production level expressed in domestic currency is 290.

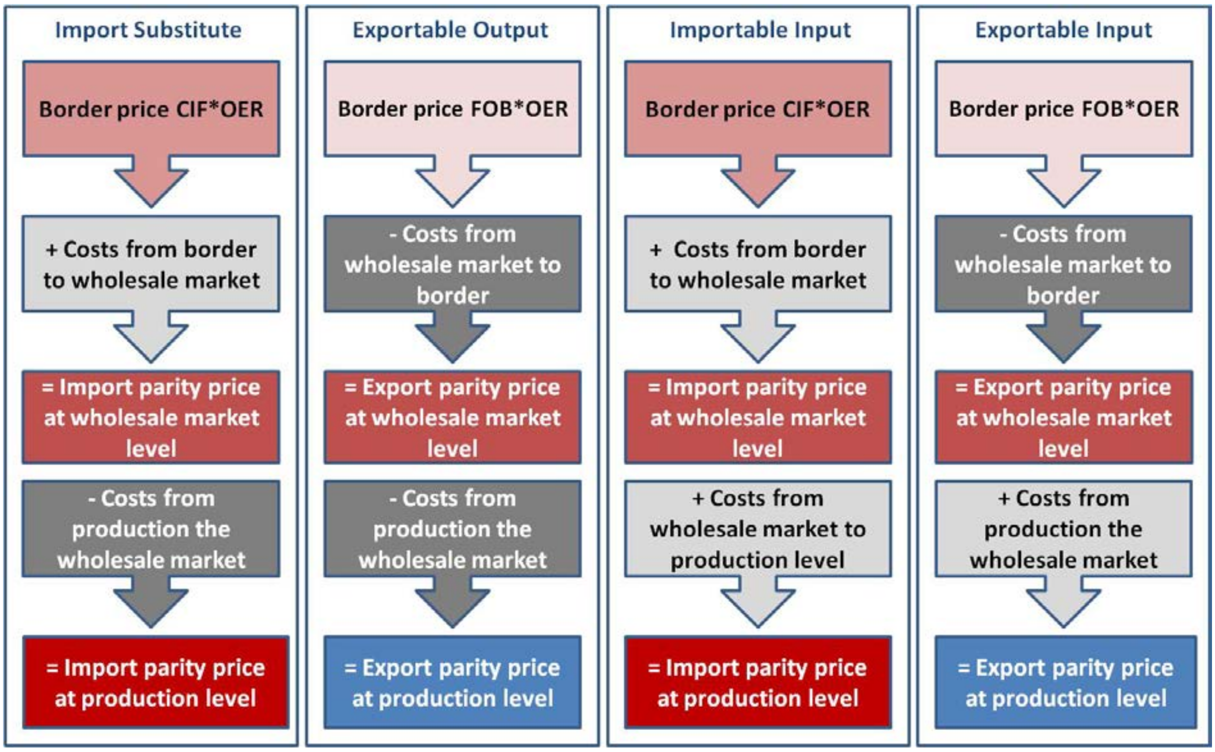
Table 6.4: Computing the parity price of an input exported

a	FOB price (foreign currency)	0,7	f.c.
b	Official Exchange Rate	500	d.c.
C=a*b	Border price (local currency)	350	d.c.
d	Export tax (ad valorem %)	20%	
e	Unit export tax	5	d.c.
f=c*d+e	Total export tax	75	d.c.
g	Transport Cost from border to domestic market	10	d.c.
h	Handling Cost from border to domestic market	2	d.c.
i	Storage Cost from border to domestic market	3	d.c.
J=c-f-g-h-i	Parity Price at market level (PPML)	260	d.c.
k	Transport Cost from domestic market to prod site	20	d.c.
l	Handling Cost from domestic market to prod site	10	d.c.
m	Storage Cost from domestic market to prod site	0	d.c.
N= j+k+l+m	Parity Price at production Level (PPPL)	290	d.c.

f.c. and d.c. are respectively foreign currency and domestic currency

Figure 6.8 provides the summary of all computations carried out so far.

Figure 6.8: Parity prices of traded-tradable goods: a synoptic summary



6.2. Appendix: exercises

6.2.1. Exercise 1: Calculating rice parity price

a) Suppose that information provided in Table 6.1 refers to the parity price of 1 kg of rice and that the production costs of 1 kg of domestic rice - equivalent to the imported one -amounts to 750 Monetary Units (MU) in domestic currency at farm gate. Is domestic rice competitive compared to imported rice?

b) If the CIF price were 1.6, what would be the maximum domestic production costs that are compatible for the competitiveness of the domestically produced rice? Discuss the implications of changes in international prices on domestic competitiveness.

c) How does the import tariff impact on producer revenues? Given the production costs (750) and the international price expressed above, which is the minimum level of the import tariff which makes domestic production profitable?

6.2.2. Exercise 2: Calculating milk parity price

a) Assume that information provided in Table 6.2 refers to the export parity price of 1 litre of milk, and that the domestic production costs to produce 1 litre of milk amounts to 400 MU in domestic currency at farm gate. Is domestic milk competitive with respect to imported milk?

b) What is the lowest level of international prices that makes exporting milk a profitable activity? Discuss the implications of international prices variations?

c) Given production costs of 400 MU in domestic currency and the international price in the table, what is the minimum export subsidy that would make it profitable to export?

d) What happens if the domestic currency depreciates by 10%?

6.2.3. Exercise 3: Calculating cattle parity price

Carry out the exercise “Ch 7 _ Parity_Price_Exported_Output.xls” attached to this guide.

Solutions

Exercise 1

a) Yes, because 760 (750 + 5 ‘Handling Cost from production to wholesale market’ + 5 ‘Transport Cost from production to wholesale market’), the Import Parity Price at wholesale level for domestic production, is less than 825 (Import Parity Price at wholesale level for imported rice).

b) If the CIF is 1.6, the Border Price (CIF price in domestic currency) will be 800 and the Import Parity Price at wholesale level for imported rice will be 935, so the maximum domestic costs could be 925: in actual fact, if the domestic costs are 925 (that is the Import Parity Price at production level), the Import Parity Price at wholesale level will be 935 (925 + 5 + 5) that will be the same as the imported parity price.

c) The minimum level is 0: indeed, domestic production will be profitable anyway.

d) For example, if we put the total import tariff equal to 0 (*ad valorem* tax + unit import tariff) the imported *price at wholesale level will be 845, that is higher than the domestic price 760.*

Exercise 2

When we consider an export parity price, "...the border is assumed to be the point where the domestic output competes with analogous goods produced abroad..."

a) No, because the domestic price will be greater than 400 (the border price of imported milk). In fact, to calculate the domestic price, start with the Parity Price at production level (400 in this case); then add the Transport Cost from production level to wholesale market and Handling Cost from production level to wholesale market to calculate the Export Parity Price at wholesale level; and finally also add all costs and taxation to reach the border price for domestic production. By starting with a domestic production price at farm gate of 400, the domestic price at the border will be greater than the border price of imported milk.

b) The lowest level of international prices that makes exporting milk a profitable activity is 0.96 (letter **a** in the table).

c) To calculate it, start with the cost of production of 400 and go back to the border price (c in the table) through the different steps of the table , than multiply the border price found by the official exchange rate in order to find the FOB price (the lowest level of international prices).

These are the step-by-step calculations to be carried out:

- $N = 400$
- $J = N + (k+l+m)$
- $J = 415$
- $J = C - F - (g+h+i)$
- $J = C- (C*d+e) - (g+h+i)$
- $415 = C- (C*0.1+1) - (9+1+4)$
- $430 = C - C / 10$
- $4300 = 9C$
- $C = 478$
- $a = c/b$
- $a = 478/500 = 0.96$

a) The minimum subsidy is that for which the domestic export parity price at the whole sale level will be the same as the export parity price at the whole sale level of the imported input. In this case 70 (domestic wholesale level price – imported input price at whole sale level, 415-345).

b) If the domestic currency depreciates by 10%, the OER will be 550, the border price 440 (550*0.8) and the Export Parity Price at wholesale level 381; the situation for the domestic producer will not change.

7. Decision making from an economy-wide (societal) perspective

Choices that are optimal from the standpoint of a single economic agent may not be optimal for the socio-economic system as a whole, because private agents may encounter different costs and benefits from those borne by society as a whole. In such instances, private agents and the society as a whole see the same policy options from different perspectives. Therefore, when conducting a value chain analysis aiming at assessing the socio-economic impacts of alternative policy options, the analysis should reflect both the perspective of private agents, based on values that they attach to goods and services, as reflected by prices that they actually pay, and the perspective of the society, based on social values, i.e., values that the society attaches to inputs and outputs of the value chain.

This chapter briefly reviews the reasons why private and social perspectives regarding the same policy options may diverge and suggests carrying out the value chain analysis also from the societal perspective, by using an alternative set of prices, the so-called "*Reference Prices*", that are computed in such a way to reflect social values better than what market prices do.

7.1. Social values versus market prices

Assuming existing and well functioning competitive markets for all goods and services, prices should be a reliable signal of both resource scarcity and consumer preferences[88]. Under these assumptions the use of market prices to appraise costs and benefits of different resource uses, should allow economic agents to choose which option entails the highest possible net benefits and allocate resources accordingly. In addition, uncoordinated decisions made on the basis of agents' own interests should bring efficient uses of resources and optimal outcomes for the whole society[89]. The resulting allocation of resources, given the initial endowments, in other words, in perfect competition private marginal costs and benefits coincide with social marginal costs and benefits.

However, in the real world, markets are hardly ever competitive and, as a consequence, prices fail to provide the above-mentioned information and lead to discrepancies between private optima and social optima.

In addition, social values may differ from market prices also if the society considers it as not desirable (socially unacceptable), excessive imbalances in income and wealth distribution across individuals generated by strong disparities in the initial endowments of resources across agents. Therefore, discrepancies between social values and market prices may arise from:

a) Deviations from perfect competition, (the so-called *market failures*).

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[88] On this topic see for example Hayek, F., 1945. The use of knowledge in society, *American Economic Review, 35(4),* pp. 519-530

[89] The "Walrasian" equilibrium achieved through individual optimization in competitive markets is also a Pareto-optimum according to the first theorem of Welfare Economics, i.e., a social optimum by the Paretian point of view. A Pareto-optimum, is a situation where it is not possible to make someone better off without worsening the situation of somebody else in the society.This result is commonly ascribed to the play of the "invisible hand" illustrated by Adam Smith in his "Wealth of Nations" (1776). Despite the rejection of this interpretation by distinguished scholars of A. Smith, the "invisible hand" is popularly taken as an early statement of the coordination and self-regulatory function of markets and as an argument for laissez-faire.

b) Lack of interventions to correct market failures and public policies that generate a misallocation of resources (the so-called *policy failures*)[90].

c) Equity concerns, i.e., undesirable distribution of income, assets and/or capabilities across individuals or households in a society[91].

In the remainder of this chapter, there is a brief account of the reasons of the discrepancies between social values and market prices, with the only purpose of providing readers with concepts that are essential to understand the rationale for value chain analysis from the societal perspective, yet with no pretence of being exhaustive[92].

7.2. Market Failures

When the forces at play in a market fail to achieve an optimal allocation of resources, i.e., a situation where the scarce resources available are used in such a way that the welfare of the society is maximized, this is a market failure. Here "optimal" allocation means an allocation which generates a "Pareto Optimum", i.e., a situation where it is not possible to further increase the welfare of any economic agent without decreasing the welfare of any other economic agent. In other words, the allocation of resources implied by Pareto optimality is such that social welfare is at its maximum for every agent, given the initial endowments of resources of each agent.

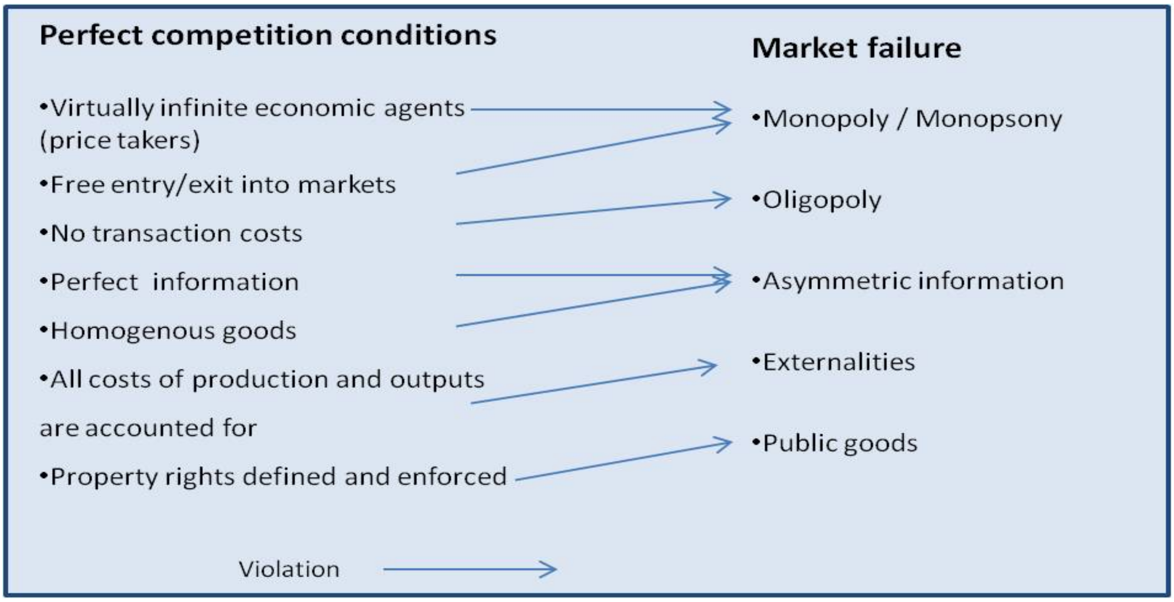
Every time one of the conditions of perfect competition is not met, the economic system is unable to reach a Pareto-optimal equilibrium and a market failure occurs.

It is important to specify that the relation between perfect competition conditions and market failures is not a one-to-one relationship, since one market failure can result from the "violation" of more than one perfect competition condition.

Here below there is a description of selected common market failures such as monopolies and oligopolies, monopsonies and oligopsonies, asymmetric information, adverse selection, moral hazard, public goods and externalities.

[90] A misallocation of resources is an allocation that does not allow the society to achieve the maximum welfare that is attainable given the available resources and its original distribution across agents.
[91] It is worth noting that a Pareto Optimum is not necessarily an equivalent to desirability. As a matter of fact, there can be many possible *Pareto optima*, corresponding to different degrees of distributional equity in the system.
[92] Readers are invited to refer to different sources for more detailed accounts on the subject, for example,Varian, H. L., 1992. *Microeconomic analysis*, Third edition, W. W. Norton & Company.

Figure 7.1: Market failures as deviations from specific perfect competition conditions



a) Monopoly and oligopoly

A ***monopoly*** occurs when there is only one supplier in the market, namely the monopolist, who faces the whole demand schedule and can choose either the quantity to produce or the sale price. The monopolist has the market power, i.e., the capacity to impose the output price, but if he imposes the sale price, he cannot also impose the quantity of the output since the amount of output that consumers will buy depends on the price he charges. Assuming a downward sloping demand curve, the higher the unit price, the lower the quantity demanded and therefore produced (and *vice versa*) (Varian, 1992)[93]. This implies that the marginal revenue (MR) i.e., the change in the total revenue due to an additional unit sold, decreases as long as the quantity supplied increases. Indeed, the monopolist decides the supply quantity in such a way that he maximizes his profits. Under some standard assumptions of the neo-classical marginalistic economic theory regarding the production function, which implies that the larger the quantity produced, the higher the marginal production cost[94], the quantity that maximizes the profits is identified by the equality between Marginal Revenue (MR) and Marginal production Cost (MC):

$$MR=MC$$

Once the quantity that maximizes the monopolist's profit is identified, the sale price is determined on the demand side of the market. The sale price set under monopoly is higher than

[93] Varian, 1992.

[94] The Marginal production cost is the cost of one additional unit produced by a production process, on the top of all the others already produced. The production function is the function that describes how the outputs are linked to the inputs. Standard assumptions for "well behaved" production functions in the micro-economic marginalistic theory refer to the continuity and differentiation w.r.t. inputs in all the domain of the function, absence of economies of scale and decreasing marginal productivity of factors.

the sale price under perfect competition. The cause of this divergence is the recognition by the monopolist that a reduction in the quantity sold allows him to charge a higher price on the remaining sales, with a positive effect on profits (Mas-Colell et al., 1995)[95]. The higher price and related extra-profits will persist as long as entry barriers, which impede competition, last. Entry barriers to the market that can be due to political, legal or institutional factors (such as: patents or restrictions to access specific resources), or due to other factors, such as: credit market imperfections, high start-up costs, etc.

A special case is the so-called "natural monopoly" that occurs when the specific cost structure of an industry implies that the minimization of costs is obtained when only one firm produces all the outputs. In this case, average unit cost AC always exceeds the marginal cost, causing increasing returns to scale. In this scenario the production at the perfect competition equilibrium condition (MC=P) entails a loss (if AC>MC, for MC=P → P<AC) because the price (P) is lower than the unit cost (AC). Hence cost minimization requires the enlargement of the production scale until all the demand is met.

An ***oligopolistic situation*** occurs were only a small number of suppliers are present in the market. In oligopolistic markets the assumptions on the behaviour of competitors are the key of the economic performance of the firm. Indeed the presence and the different strategic behaviours of a few and large suppliers give rise to a number of different outcomes in terms of pricing mechanisms and overall outputs produced in the industry (Varian, 1992).[96] Because of the importance of strategic behaviour in oligopolistic markets, they are often studied through the game theory[97], a branch of applied mathematics that analyzes interactions where an individual's success in making choices depends on the choices of others.

b) ***Monopsony and oligopsony***

In the case of monopsony there is only one buyer in the market, whereas there is a small number of buyers in the market in the case of oligopsony.

As in the case of monopoly and oligopoly, the prices of the transactions between buyers and sellers are not provided but are the results of the interaction of demand and supply, with no single agent having the power to influence it. Indeed, the price is strongly affected by the negotiation power of the side that counts few agents, the demand side in this case.

Monopsonists enjoy positive profits also in the long run, while oligopsonists enjoy profits that are determined by the interplay of oligopsonists' strategic behaviours.

Monopsonies and oligopsonies generally result in lower seller prices than in competitive markets and sub-optimal quantities produced and exchanged.

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[95] Mas Colell, A., Whinston M., & J. Green, 1995. *Microeconomic Theory*, Oxford University Press.
[96] Varian, 1992.
[97] There are many handbooks in Game Theory available. Interested readers can refer to Myerson, Roger B. 1991, or Gibbons, Robert D., 1992.

c) Asymmetric information

A situation of asymmetric information takes place when one economic agent knows something that another economic agent does not know[98]. As a result, the price of commodities and services does not reflect their characteristics and suboptimal quantities of the commodities and services are exchanged on the market. Usually, in this framework, there is a reduction of the quantity exchanged, in other words a rationing of the quantities.

There are two main cases of Asymmetric Information, namely: **adverse selection** and **moral hazard**.

d) Adverse selection

Adverse selection is also known as *ex-ante asymmetric information* (or hidden information) because it takes place when there is incomplete information of one part prior to the transaction between the agents. It arises when an informed individual's trading decisions depend on his/her privately held information in a manner that adversely affects uniformed market participants[99]. G. Akerlof (1970) first illustrated this situation through the example of the second-hand car market (referred to as lemons market). The cars in this market are characterized by different levels of quality and potential buyers do not have the relevant information to determine the quality of a car. The potential buyer's best guess is then that a car is characterized by an average quality that he is willing to pay accordingly. In this context it is not worthwhile for car owners to sell high quality cars on the market. Consequently, high quality cars will get withdrawn from the market and the average quality will lower. Buyers will in turn decrease their evaluations and willingness to pay, leading to the extreme consequence that no transaction at all will take place in the market.

e) Moral hazard

Moral hazard is also known as *ex-post asymmetric information* (or hidden action) and it is usually referred to as *principal-agent problem*. It takes place when one of the two agents involved in a contract does not have complete information after the transaction has taken place. Such a situation occurs, for example, when employers do not have the means to monitor the performance of workers. In this case the incomplete information of the employers, the so-called *principal*, prevents them from verifying whether the workers are effectively working or if they tend to shirk from their duties.

This situation can also occur between politicians (agent) and voters (principal), or managers (agent) and owners (principal).

[98] Varian, 1992.
[99] Mas-Colell al.,1995.

f) Public goods

Public goods are characterized by the non-rivalry in consumption, and by the non-excludability. A good is **non-rival** in consumption if one person's consumption does not reduce the amount available to other consumers[100]. A good is **non-excludable** if no one can be excluded from its fruition. Consequently, nobody has an incentive to be a producer of the good since that person has to bear the cost of production and so the tendency of agents is to wait for someone else to produce it so that they can enjoy its fruition without costs (i.e., free-ride). This situation results in a sub-optimal provision of these goods and this is why the public sector often takes over in their provision. Examples of public goods are: lighthouses, public security, sanitation, defence, etc. Depending on the degree of non-rivalry and non-excludability, commodities range from public to private goods and can be classified into two big groups: the club goods and the common pool resource. The first ones are excludable but not rival and they include satellite television, golf courses, cinemas, etc, while the latter are non-excludable but rival and they include: fish, hunting game, water.

g) Externalities

An externality is a situation arising whenever an economic agent undertakes an action that has an effect on another economic agent without a monetary exchange. In other words it is a cost or a benefit accruing to an agent not involved in the decision and who does not receive any compensation (in the case of a cost) or does not pay a price (in the case of a benefit) for it. Hence, externalities can either be negative or positive and concern either production or consumption activities. In a **consumption externality** the utility of a consumer is directly affected by the actions of another consumer, while in a **production externality** the production set of one firm is directly affected by the actions of another agent[101]. Externalities arise because of the incompleteness of markets, undefined property rights, joint consumption or production activities. Examples of externalities are summarized in Table 7.2.

Table 7.2: Classification and examples of externalities

	Positive Externalities	Negative Externalities
Externalities of Production	Beekeeping (*Pollination*)	Spraying Pesticides (*Pollution*)
Externalities of Consumption	Reading books (*Culture*)	Consuming Alcohol (*Noise*)

[100] Varian, 1992.
[101] Varian, 1992.

7.2.1. Missing policies

As mentioned before, one of the main causes of the discrepancies between market and reference prices is the lack of intervention of the state in correcting market failures; the so-called missing policies. Indeed, the state can attempt to correct or mitigate market failures *via* interventions that range from regulatory measures to involvement in the production processes. In the case of **monopolies**, the state can break up a monopoly and monitor that competition is maintained through antitrust laws, turn it into a publicly owned monopoly, or in case of natural monopolies, set a price-cap regulation. When **asymmetric information** occurs, the state can act by different means in order to correct this failure: it can play a regulatory role and enact laws ensuring warranties on consumer products[102]. It can also favour the establishment of institutions in charge of checking and certifying the quality of product. Again, the state can create incentives for institutions that are in the “agent” position to be more transparent. Finally, in the case of **public goods**, the state can be the direct provider of the public goods itself or it can subsidize the private sector to produce them. Another solution is the establishment of exclusion mechanisms turning public goods into club goods; this is the case of patents and copyrights. This intervention can reduce the free rider problems but it also can create monopoly rents. Common pool resources can be effectively governed by common property regimes, such as arrangements representing a third way with respect to private property or state administration. Moreover, the state can attempt to “internalize” the externalities, by taxing who produces them; in this case, if a firm produces pollution along with a given commodity production, it will be induced to lower the pollution, when charged with a tax that increases its production costs.

Summarizing, it can be said that there is a wide set of policies that can be implemented to resolve market failures such policies intended to solve all “macro” market failures such as (e.g. unemployment and inflation), fiscal policies, monetary policies, sector policies, provision of public goods and other infrastructural policies, industrial policies, exchange rate policies, tariffs, quotas and taxes on internationally traded goods and services.

7.2.2. Policy failures

The last cause of discrepancies between market and reference prices is related to the policy failures or, in other words, the inability of public policies to achieve the targeted objectives and the inability of policy makers to implement them. One argument to justify the inefficiency of policies is that they are formulated on the basis of models of the economy relying on relationships based on historical data. However, when in place, policies change those relationships making the baseline model of the economy obsolete and leading to unforeseen outcomes[103]. With respect to the implementation of policies, a strand of literature known as “*Public Choice Theory*” studied the self-interested behaviour of politicians and governments. This behaviour leads them to the implementation of policies pursuing their personal objectives

[102] Five years after the publication of Akerlof’s paper, the United States of America enacted a federal law of this kind, the Magnuson-Moss Warranty Act.

[103] This is the substance of what is known as the “Lucas’ critique”, after the economist Robert Lucas.
Lucas, R., 1976. Econometric policy evaluation: A critique. *Carnegie-Rochester Conference Series on Public Policy* ***1*** *(1), pp 19–46.*

rather than social objectives[104]. Whatever the reasons why policies fail to achieve the objective of maximizing social welfare, their impacts may be such that market prices do not reflect the value of goods and services to the whole society.

7.2.3. Social values and reference prices

The *ex-ante* assessment of policy measures is a powerful tool to single out the most efficient policy measure among a set of possible options. Yet, if the policy options have to be assessed by taking into account the interest of the society as a whole, prices to be used in the analysis have to reflect the value of goods and services to the whole society, rather than to private agents. This implies calculating and using a set of prices, alternative to market prices, that approximate, to the maximum extent possible, social values, i.e., the opportunity costs to the society of producing or consuming goods and services. These are the so-called "*Reference Prices*". These prices are called "reference prices", as they are often based on some prices external to the economic system (e.g., international market prices) acting as reference for the actual value of goods and services. They are also frequently referred to as "social prices" since they aim to reflect values of goods and services to the society or "shadow prices"[105].

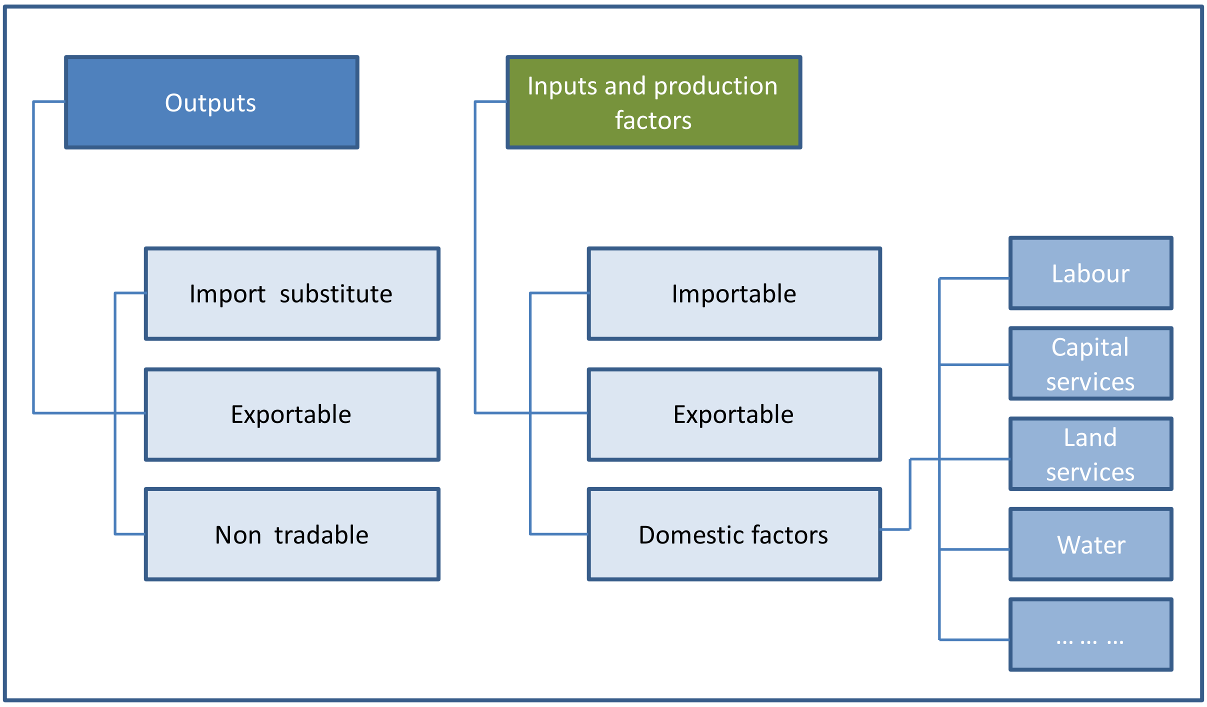
When calculating reference prices, goods and services are categorized on the basis of the existence of a price, external to the economic system that can approximate the opportunity cost to the society to produce an output or consume an input. This classification introduces a distinction between internationally tradable (importable or exportable) and non-internationally tradable goods on one side, and inputs and outputs of domestic production processes on the other side. Therefore, goods and services are categorized as follows (see Figure 7.2):

- exportable domestic output
- domestic output as (current or potential) import substitute
- exportable input in domestic production processes
- a (current or potential) domestically produced substitute of an imported input
- non-internationally tradable output
- non internationally tradable input

[104] A summary of "*Public choice theory*" findings can be found in:
Buchanan J, M, and Robert D. Tollison (Eds), 1984. *The theory of public choice - II*. The University of Michigan, USA..

[105] The name "shadow price" is borrowed by the mathematical programming literature. The Shadow price of a constrained resource is the Lagrange multiplier (or) at the point of equilibrium in the framework where the allocation of resources occurs through the maximization of a social welfare function and measures the change in the value of the social welfare function obtained by relaxing the related constraint by one unit. For a relatively recent review on shadow pricing see: Londero, E., Cervini, H., 2003. *Shadow prices for project appraisal: theory and practice*. Edward Elgar Publishing.

Figure 7.2: Calculating reference prices for categories of commodities



In case of tradable goods and services, this categorization helps to identify the most suitable international price to choose as starting point of the calculation. Indeed for tradable goods the starting point for calculating reference prices is the calculation of parity prices, as illustrated in chapter 6. This categorization also highlights non tradable goods and services, for which reference prices (i.e., their opportunity costs to the society) have to be worked out with other methods. Chapter 8 illustrates how to compute reference prices for these different categories of goods. However, beyond the categorization of goods and services described above, the economic analysis at reference prices implies choosing a common numeraire, i.e., identifying a common unit of measure, for all the reference prices.

7.3. Choosing the numeraire for reference prices

In economic analysis at reference prices, as in any economic analysis which implies adding or subtracting values, all variables must be expressed using a common "numeraire" i.e., a common unit of measure (unit of account), in order to obtain meaningful balances. Inconsistencies arise if we add up monetary values expressed in different currencies (not considering the exchange rate), referring to different points in time (not considering the time-value of money), to different price levels (not considering inflation), to different locations (not considering transport costs), or even to agents with different purchasing power (not considering for instance the varying subjective valuation of net benefits in relation to the social position)[106]. This implies that, in

[106] The issue of choosing the numeraire of the analysis is discussed with some detail in: UNIDO, 1972: *Guidelines for project evaluation*, by P Dasgupta, A.K. Sen and S Marglin, New York. Further discussion on this topic is presented in UNIDO, 1986: *Guide to practical project appraisal: Social benefit-cost analysis in developing countries*, by Hansen, J.R., Vienna, pp.27-32.

VCA, analysts must express all the values of goods and services with reference to one currency, at a specific point in time, in real terms (constant purchasing power), for the same class of citizens, taking into account all the costs and benefits to produce or consume the goods and services (including those not reflected in market prices, i.e., consumption and production positive or negative "*externalities*") and, whenever relevant, in the same physical location. Therefore, in VCA it is customary to express values (revenues and costs) of goods and services in terms of:

- domestic currency
- constant prices
- present value
- location of consumption
- as the goods and services are valued by domestic users with an average income level[107]
- taking into account all the production or consumption positive or negative externalities.

The imposition of a common numeraire when computing reference prices for tradable goods implies that international prices have to be adjusted to reflect the features of the chosen numeraire, for instance, converted in domestic currency, adjusted to a specific location as done for parity prices etc. For non tradable goods the imposition of a common numeraire instead, implies choosing reference prices in such a way to be directly comparable with reference prices of tradable goods when adjusted as above.

The following chapter illustrates how to carry out reference prices for the different categories of goods and services.

[107] This "average" refers to an income level which is such that the government neither taxes nor subsidizes it. This specification, not very often used in practice, as regards to the position within the income distribution to whose benefits of the value chain accrue to. Analysts may embody in the numeraire distributional concerns by giving a different weight (usually higher) to benefits accruing to poorer people.

8. COMPUTING REFERENCE PRICES

As mentioned in the previous chapter, reference prices aim at approximating the values of goods and services, whether inputs or outputs of value chains, the society as a whole attaches to them. Therefore, they have to reflect the opportunity cost of using inputs in a specific value chain, i.e., what the society gives up to divert the use of those inputs from the best alternative use to the specific value chain and the opportunity cost of not producing a given output, i.e., what the society has to give up if this output has to be procured in the best alternative way. There are different ways to identify such opportunity costs. The most straightforward starting point for internationally tradable goods are their parity prices, while for non tradable goods and domestic factors, the starting point for their calculation are prevailing domestic market prices or the costs of producing them. In the next sections we will provide an overview of how to calculate reference prices for both tradable and non tradable goods.

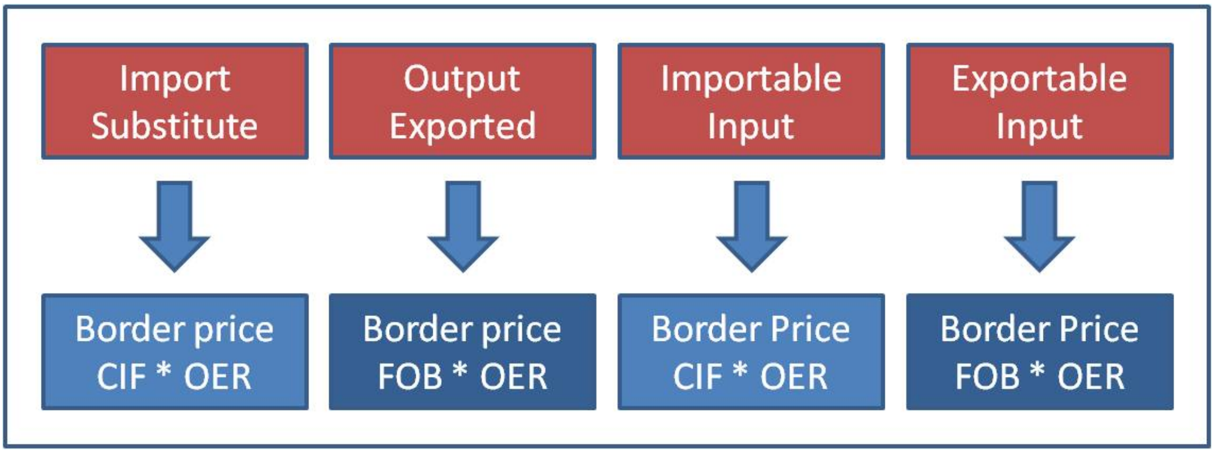
8.1. Calculating reference prices of tradable goods

With regard to traded goods, reference prices are calculated following the procedure that to calculate (private) parity prices. The first step is to identify the category of goods or services for which the reference price has to be computed. The categories are defined on the basis of the nature of a good in the specific production process, i.e. whether it is an output or an input, and on its trade status, i.e., whether an export or an import.
Hence, reference prices are computed for (see also Figure 8.1):

- Exportable domestic output.
- Domestic output as (current or potential) import substitute.
- Exportable input in domestic production processes.
- A (current or potential) domestically produced substitute of an imported input.

Different international prices are used as a benchmark for different categories of commodities, as outlined in Figure 8.1.

Figure 8.1: International prices used to compute reference prices of different categories of commodities



International prices are assumed to reflect social values because they reflect the willingness to pay or to accept of the society to obtain or to sell a given good or service. More specifically:

- For an ***import substitute,*** its CIF border price reflects how much the society is willing to pay in order to get the good for domestic consumption.
- For an ***exportable output,*** its FOB border price reflects what the society would obtain selling that good on the international market (and what they society gives up if it does not sell the good).
- For an ***importable input,*** its CIF border price assesses how much the society is willing to pay to use domestically an input bought on the international market.
- For an ***exportable input***, its FOB border price assesses how much the society is willing to give up to use domestically an input that, otherwise, would be sold on the international market.

Adjustments to be applied to the CIF/FOB prices to reflect the domestic location-specific value of goods, are the same as those adopted to calculate parity prices in Figure 8.1.

However, in addition, further adjustments need to be carried out with respect to:

a) The ***share of taxes*** which is a transfer between agents of the same socio-economic system.
b) The choice of the ***exchange rate*** which reflects the opportunity cost of foreign currency to the whole society.
c) The possible ***positive or negative externalities*** generated in production or consumption processes of goods.

In the following sections each of these adjustments will be explored.

8.1.1. Share of taxes as transfer

A transfer is a redistribution of income between two agents. Given this definition, it can be argued that from the standpoint of the economy as a whole, most taxes represent a *transfer* of resources from one agent to another, both belonging to the same unit since they act in the same national economy. This is also true for subsidies.

As transfers do not imply any actual use but a movement of resources, they entail no opportunity cost and thus are not considered in the calculation of reference prices.

Nonetheless, some taxes are indeed a payment for services provided by the State. Fiscal revenues actually fund services that prove essential for the smooth functioning of value chains and of the whole society, such as: law enforcement, quality controls, defense, etc. These taxes have to be taken into account in the computation of reference prices since they affect the impact of the value chains on the socio-economic system.

Various criteria can be adopted to impute those costs to a specific value chain, such as criteria based on the degree of services fruition and proportionality rules. The adoption of a proportionality rule implies that only the tax share exceeding an average level of taxation should be considered as a transfer, whereas the complementary share is a cost, or a payment for a service.

The share of taxes corresponding to the provision of real services should be taken into account in the calculation of reference prices (not being a transfer).

Following this strand of thought, an issue may rise as to whether interests paid by borrowers to lenders are a transfer or a cost. The interest is defined as a payment of the borrower to the lender for the use of the money that the former does not own, to compensate the latter for postponing the use of his/her purchasing power for consumption. Thus in this light, interests should be considered as costs and not transfers and included in the calculus of reference prices.

Table 8.1 shows an example of the calculation of the reference price of an imported input, where 95% of the import tariff in row *n* is considered a transfer and dropped from the calculation.

In the calculation of reference prices of tradable goods, domestic cost components such as transport, handling and storage costs are assumed to be efficient costs, i.e., are adjusted to reflect their opportunity cost to the society.

Table 8.1: Computation of Parity Prices excluding transfers

Example: IMPORTED INPUT			
a	CIF price in foreign currency	0.5	f.c.
b	Official Exchange Rate	500	d.c./f.c.
c=a*b	Border price (d.c.)	250	d.c.
d	Unit Import tax	5	
e	Import tax (ad valorem %)	10%	
f	Tax (transfer share)	95%	
g=[c*e+d]*(1-f)	Total Import tariff	1.5	d.c.
f	Transport Costs from border to domestic market	10	d.c.
g	Handling Costs from border to domestic market	1	d.c.
h	Storage Costs from border to domestic market	5	d.c.
i=c+g+f+g+h	Price at Market Level *	267.5	d c.
j	Transport Costs from market to production site	1	d.c.
k	Handling Costs from market to production site	1	d.c.
l	Storage Costs from market to production site	0	d.c.
m=i+j+k+l	Parity Price at Production level	269.5	d.c.

8.1.2. Exchange rate

In many instances, the "observed exchange rates", i.e., the market price of any Foreign Currency Unit (FCU) expressed in terms of Domestic Currency Units (DCU), very much like all the other prices, do not reflect the social value of foreign currencies.

In an economy with existing and competitive markets for all products, including the market of foreign currency, or when there are optimal policies, i.e., policies able to restore the optimal allocation of resources should markets fail to allocate them optimally, no such a divergence should arise, as the observed exchange rate should reflect consumers' (marginal) willingness to pay for an additional FCU to import goods or divert exports for domestic consumption[108].

[108] From now on, we will refer to one generic foreign currency, which can be intended as the main convertible currency adopted by the country for international payments. Alternatively, it can be intended as a basket of foreign currencies.

In practice, the existence of such a divergence, can be due to a set of concomitant causes, such as: a) market failures, such as a monopsony in the foreign exchange market, which pushes the price of foreign currency above the optimum price (e.g., to secure rents to some agents, to increase reserves of foreign currency for other purposes than public interest, etc); b) policy failures due to, e.g., the shortsightedness of foreign currency market regulators generating deficits or surpluses of the balance of payments which force the foreign currency price above or below the long-term (sustainable) equilibrium; or c) sub-optimal trade policies altering domestic prices of imported or exported goods with respect to border prices in foreign currency.

In an economic system with trade restrictions where consumers maximize their welfare under consumption possibility constraints, the "optimum" exchange rate "*differs from the official exchange rate a percentage amount equal to a weighted sum of price disparities, where weights are the changes in trade flows*"[109]. The so-called "*official exchange rate*" referred to here is an exogenously determined rate or the "observed" rate at which it is possible to "officially" purchase or sell foreign currency, as per the existing policy setting. Price disparities are the differences between the actual prices paid by consumers, reflecting at the margin their maximum willingness to pay for an additional unit of the goods and services consumed and the border prices converted in LCU with the official exchange rate, exogenously fixed. The weights used here are changes in trade flows generated by one additional unit of FCU available to the economic system.

In practice, to adjust the official exchange rate to approximate an optimum exchange rate, in VCA exercises analysts may use the value that the "*average consumer*" attaches to one unit of foreign currency, approximated by his willingness to pay, expressed in DCU, to get an "*average imported basket*" worth 1 FCU at the border, net of transport, storage and handling related costs required to bring this from the border to the "*average consumption market*", or his/her willingness to pay for the "*average producer*" to secure a basket of exportable goods worth one FCU at the border (i.e., to divert from export to domestic consumption such a basket), net of the cost to bring the basket from the average producer to the main consumption market and increased by the cost the producer would pay to bring the basket to the border), or to get a mix of the two baskets.

Consider the difference between:

a) On the one side, A consumer's willingness to pay for any of those baskets or a for mix of both, and,
b) On the other side, the "*official exchange rate (OER)*" i.e., the price in domestic currency that the "*average consumer*" has to pay to get the unit of foreign currency required to import the basket or to compensate the average producer for the missed export revenue;

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[109] Trent J. Bertrand, 1974: *The shadow exchange rate in an economy with trade restrictions*, Oxford Economic papers. *http://www.jstor.org/discover/stable/2662220*.
Trent shows that in an economic system with trade restrictions where consumers maximize their welfare under consumption possibility constraints, the "shadow price" of one additional unit of FCU made available to the economic system, i.e. the change in real income generated by relaxing by only one unit the consumption possibility constraint is equal to the official exchange rate (exogenously determined) multiplied by a percentage amount equal to a weighted sum of differences between the border prices expressed in DCU by means of the official exchange rate and the domestic prices actually paid by the consumers. Weights are given by the change in the consumption of each imported/exportable good for one unit change of foreign currency available into the system.

This difference represents the *"premium"*, expressed in DCU, above the official exchange rate, that the average consumer is willing to pay to get one unit of foreign currency.

Figure 8.2 reports a simple example to explain the above concept. Assume for instance that at the main country market place (for instance, in the Capital city or at a virtual "average" location at an average distance from the main points of entry into the country), domestic consumers are willing to pay 155 DCU for a composite basket of imported goods worth 1 FCU at the border. Suppose that the transport, storage and handling costs to bring this basket from the main point of entry to the main market place amounts to 20 DCU. This means that, at the border the willingness to pay for such a basket would be 135 DCU. If one unit of FCU at the official exchange rate can be purchased with 120 DCU, it means that the consumer is willing to pay a premium of 15 DCU over the official exchange rate to secure such an import basket.

An analogous reasoning can look at the export side. Assume that the average consumer is willing to pay 175 DCU for a basket of goods the price of which at the border is 1FCU, available at the consumer market location. This implies that he/she is willing to pay 175-20 DCU = 155 DCU, at the producer location. To secure this basket he/she has to pay the producer:

> 1 FCU minus 10 DCU, i.e., what the producer would get at the border minus what the producer would have to pay in terms of transport costs to get 1FCU, i.e. 120 – 10 = 110 DCU.

Therefore the value of 1 FCU for the average consumer is 155+10=165 DCU.

Figure 8.2: Example 1: Premium on the average basket

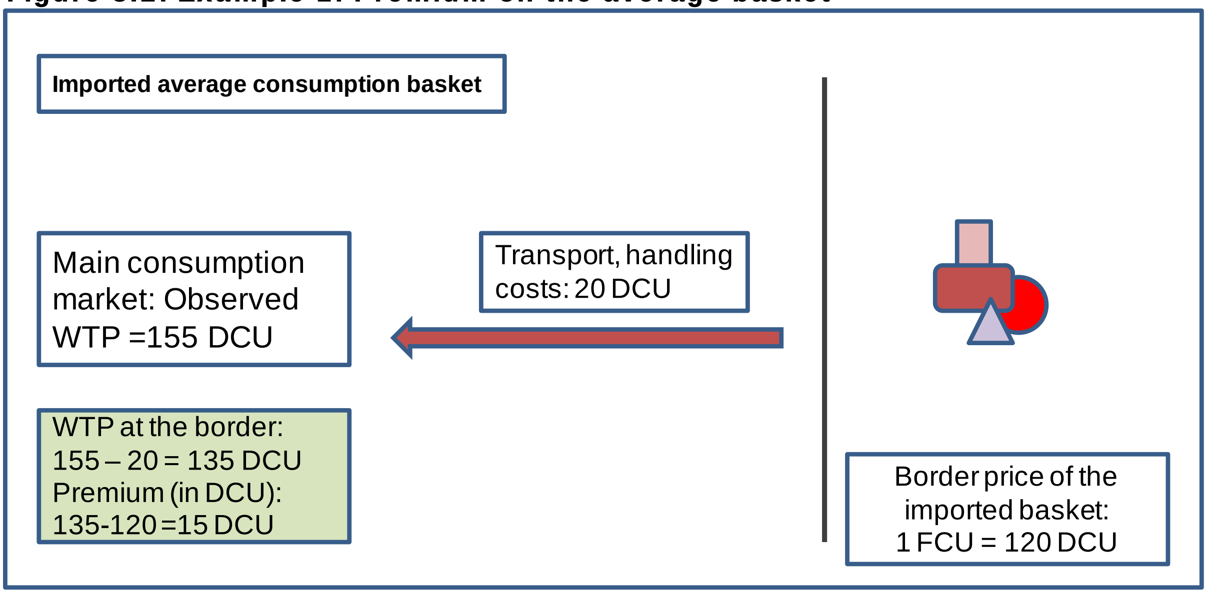
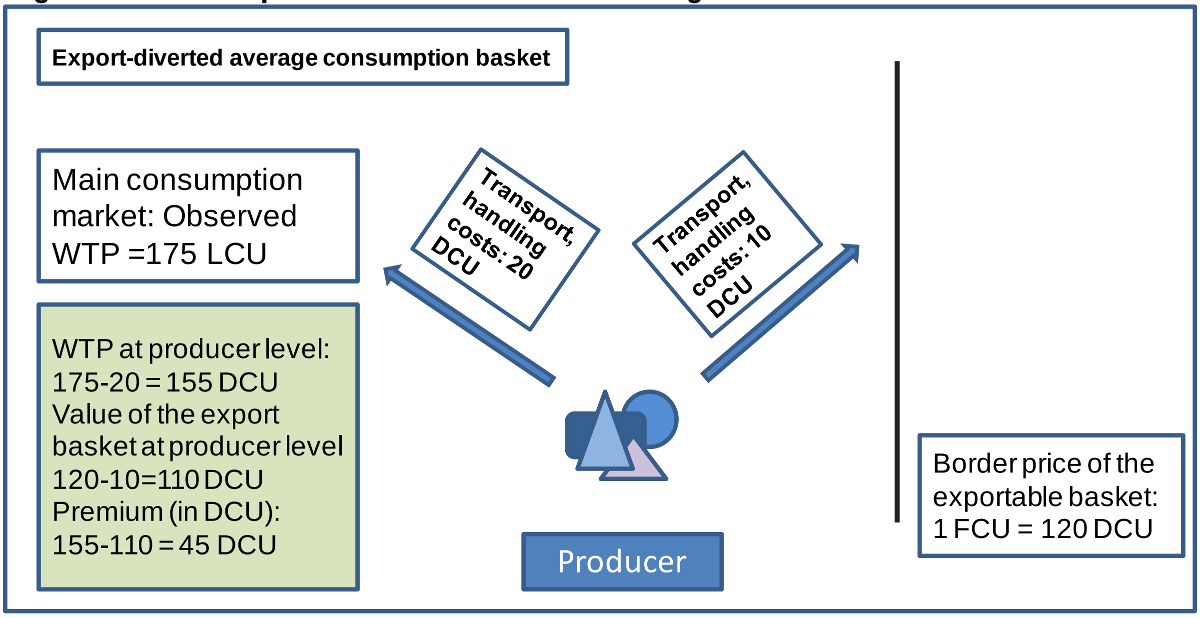


Figure 8.3: Example 2: Premium on the average basket



If one additional unit of FCU is made available or consumed by a value chain as a consequence of a policy measure (or an external shock), its value, measured in our numeraire, i.e., by the point of view of the "average" consumer, is worth what it can buy in terms of imports or diverted exports. For instance, assume that 30% of one additional unit of FCU is used by domestic consumers to import the composite basket and 70 % to divert exports, a plausible measure of its domestic worth would be the weighted average of the willingness to pay for a basket of imported goods and one of diverted exports:

i.e.: 155 x 0.30 + 165 x 0.70 = 162 DCU

This is the so-called ***Shadow Exchange Rate*** (SER). The SER is often estimated as the ratio of the value of traded goods and services at the domestic price level to the value of traded goods and services at the border price level (in foreign exchange).

$$SER = \frac{\sum Q_{import} P_{dom} + \sum Q_{export} P_{dom}}{\sum Q_{import} P_{CIF} + \sum Q_{export} P_{FOB}}$$

Indeed, for the economic analysis, when the domestic currency is used at the domestic price level as the numeraire, the prices of traded goods and services are taken at the "border price" and converted into domestic currency at a "shadow" exchange rate.

It can be helpful for analysts to calculate a coefficient indicating the average shift of the official exchange rate with respect to the shadow exchange rate. This coefficient is the so-called "**Foreign Exchange Premium** (PREM) and it is calculated as follows:

$$PREM = \frac{SER}{OER} = \frac{\sum Q_{import} P_{dom} + \sum Q_{export} P_{dom}}{\left[\sum Q_{import} P_{CIF} + \sum Q_{export} P_{FOB}\right] OER}$$

Table 8.2 illustrates a further example on how to compute SER and PREM in a simplified economy importing wheat and computers and exporting rice.

Table 8.2: Example of computing SER and PREM

		Export	Import	Import
		RICE	WHEAT	COMPUTERS
		kg	kg	unit
a	CIF price in foreign currency	0.4	0.2	500
b	Official Exchange Rate	500	500	500
c=a*b	Border price (d.c.)	200	100	2,500,000
d	Import tariff - export tax	10%	20%	40%
e=c+d	Domestic price	180	120	350,000
f	Quantity	1000	2000	2

$$SER = \frac{1000*180 + 2000*120 + 2*350000}{1000*0.4 + 2000*.2 + 2*500} = 622.2$$

$$PREM = \frac{622.2}{500} = 1.244$$

It is worth noting that import tariffs raise domestic prices with respect to border prices, thus an increase in import tariffs, other things being equal, leads to a greater SER. In the case of subsidies, import subsidies lower domestic prices with respect to border prices and therefore an increase in import subsidies lowers SER, whereas the opposite is true for export subsidies.

Table 8.3 shows how SER enters the computation of a reference price.

Table 8.3: Applying SER

	Example: IMPORTED INPUT		
a	C.i.f. price in foreign currency	0.5	f.c.
b	Official Exchange Rate (OER)	500	d.c./f.c.
c=a*b	Border price (d.c.)	250	d.c.
d	FOREX PREMIUM (PREM)	1.1	
e=c*d	Adjusted border price	275	d.c.
f	Total Import tariff	1.5	d.c.
g	Transport Costs from border to domestic market	10	d.c.
h	Handling Costs from border to domestic market	1	d.c.
i	Storage Costs from border to domestic market	5	d.c.
l=e+f+g+h+i	Price at domestic market level (PPDML)	292.5	d.c.
m	Transport Costs from domestic market to firm/farm	1	d.c.
n	Handling Costs from domestic market to firm/farm	1	d.c.
o	Storage Costs from domestic market to firm/farm	0	d.c.
p=l+m+n+o	Price at firm/farm level (PPPSL)*	294.5	d.c.

8.2. Calculating reference prices of non-tradable goods and services

For tradable goods, border prices represent the opportunity cost of the country to import or export them; thus, they can be used as the starting point to approximate reference prices. For non-tradable goods and services, border prices as such are not available, so reference prices have to be calculated differently. There are several options to obtain reference prices for non-tradable goods and services; the most common are:

a) Taking the CIF price of an import substitute.

b) Decomposing the price of a non- tradable into its traded and non-traded components.

c) Applying to non-tradable goods and services the average gap between reference prices of tradable goods and their respective prevailing market prices.

a) Taking the CIF price of an imported substitute

Even if a commodity is not traded internationally and thus no border price is available, it can exist as a substitute of that commodity and can be instead traded internationally. Hence, the border price of the *substitute good* may be used as the starting point to compute a reference price, just as in the case of tradable goods. Adjustments for quality or other factors may need to be applied as well. For example, the reference price of firewood in Burkina Faso, which is not traded internationally was calculated on the basis of the international price of butane gas, a close substitute source of energy which is imported from abroad, as illustrated in box 8.1 below.

b) Decomposing the price of a non tradable into its traded and non-traded components

The price of a non-traded commodity is made up by tradable and non-tradable components. Thus, by breaking up the price of a non-traded commodity into tradable and non-tradable components, the reference price of the traded components can be calculated with reference to border prices. For example, local transport is a service that is non-traded internationally. However, it can be decomposed in non-tradable goods such as driver time, road and vehicle maintenance and in tradable goods such as fuel. In turn, non-tradable components can be sub-classified in terms of traded, non-traded and labour components. Eventually, by continuing to break down the non-traded components, the total value of the non-traded commodity will be expressed in terms of labour and traded commodities for which we can use world prices. The reference price of labour will be estimated via opportunity costs at the domestic level.

c) Applying the average gap

For non-traded commodities without a traded substitute, or for which the decomposition method proves excessively complicated, an estimate of reference price can be obtained by multiplying the domestic market price by the average ratio of reference price to domestic market price. In actual fact, once reference prices have been calculated for a good number of commodities, an average gap between domestic market and reference prices can be calculated and applied to only a few other commodities. Applying this average gap corresponds to assuming that, for the set of commodities considered, there is not a high variance in the gap between domestic and reference prices (the gap is more or less the same for all), and so the actual price gap of a given commodity can be approximated by the average one.

8.3. Accounting for Externalities in reference prices

The third element that needs to be taken into account for the computation of a reference price is represented by the externalities. As already explained in the previous chapter, an externality is a cost or a benefit accruing to an agent not involved in the decision and who does not receive any compensation or does not pay a price for it.

Externalities can be estimated in several ways; yet they are often neglected in the computation of reference prices, since the identification of relevant externalities and their appraisal can be complex and their measuring may involve a high degree of value judgement.
An overview of the methods for the assessment of externalities goes beyond the purpose of this guide. On these aspects reference is made, for instance, to Markandya et al (2002)[110].

Externalities have to be included in the computation of reference prices whenever possible.

[110] Markandya, A., Harou, P., Bellù L.G., Cistulli V., 2002. *Environmental economics for sustainable growth. A handbook for practitioners*. World Bank - Edward Elgar.

Negative or positive production or consumption externalities are generated by domestic production or consumption processes, respectively. Therefore they concern the value the society attaches to domestic outputs or inputs used, whether they are for import substitution, export or non tradable. However, in VCA, different considerations hold for these different cases. The way of keeping into account externalities in VCA depends upon the specific goals of the analysis and its scope. Some cases are briefly discussed in the following paragraphs and summarized in table 8.5.

8.3.1. Negative and positive production externalities

The way of accounting for production externalities depends on whether the good is an output substitution for an import, an exportable output, an input imported or exportable or a non-traded good.
The reference price of a domestic output which substitutes for imports provides an upper bound to domestic production costs. If a good is domestically produced at a cost which is lower than the reference price, the domestic production process is competitive with the respect to foreign producers. If a ***negative production externality is generated in producing an import substitute***, the threshold constituted by the reference price has to be lowered by the amount of the externality, to keep into account the fact that negative production externalities reduce the convenience to the society to produce the good domestically rather than importing it. The opposite consideration holds whenever a ***positive production externality is generated in producing an import substitute.*** The positive externality increases the convenience to produce the good domestically, therefore the amount of the positive externality has to be added to the reference price at production level.

Similar considerations hold for exportable outputs. On one hand, if a ***negative production externality is generated in producing an exportable output***, the net value the society gets from exporting it is the net payment received from exporting the good less the negative externality imposed to the society by the production process. Therefore the amount of the negative externality has to be subtracted from reference price at the production level. On the other hand, if a ***positive production externality is generated in producing an exportable output***, the value the society gets from producing and exporting the good is the net payment received from exporting the good plus the value of the positive externality. Therefore the amount of the positive externality has to be added to the reference price at the production level.

Dealing with externalities generated in producing inputs of a value chain, whether they are ***imported or exportable inputs,*** requires some more articulated considerations. Externalities generated in producing ***imported inputs*** may affect only the society producing such input. In such cases, if this society is outside the boundaries of the value chain analysis, they should not be taken into account. Other externalities instead, may be transboundary, either for specific reasons (e.g. water pollution in producing chemicals affecting downstream countries) or for their global nature, (e.g. carbon emissions affecting climate change). In such cases, the value of an imported input should embody production externalities as long as the value chain analysis: 1) refers to long run value chain development, as it is likely that in the long run such externalities will be internalized, leading to an upward shift of the input cost; 2) aims at capturing some cross-country interdependencies and /or to elaborate globally sustainable scenarios (for instance, to obtain international certifications of sustainability, fair trade labels etc).
Also for externalities generated in producing an ***exportable input***, some considerations have to

be put forward. The reference price of an exportable input assesses the opportunity cost of diverting this input from export for domestic use in the specific activity (value chain) under investigation. In principle, externalities generated in producing such input should not be taken into account as long as the decision of using it domestically rather than exporting it, does not alter the volumes of production of such input. Indeed a mix of export diversion and increased production could also occur. In any case, if the development of a value chain or a given activity is planned for the long run, where eventually the domestically produced input is going to be an essential component value chain, production externalities should be taken into account and included as a component of the input cost.

In case of a ***negative (positive) production externality generated in producing a non tradable output***, if the reference price is based on production costs assessed at their opportunity cost, the negative (positive) production externality has to be added to (subtracted from) the costs the society has to afford to produce the good. If, instead, the reference price is based on the import price of a close substitute, (see for instance the case of firewood in Burkina Faso in box 8.1), negative (positive) production externalities have to be subtracted from (added to) the reference price.

Table 8.5. Accounting for externalities in reference price calculations

	Output as an import substitute	Output exportable	Input imported	Input exportable	Non-tradable goods
Negative production externalities	To be subtracted from the reference price at producer level	To be subtracted from the reference price at producer level	Inclusion depends on the goal and scope of the analysis *	Inclusion depends on the goal and scope of the analysis *	To be added to production costs or subtracted from subst. price
Positive production externalities	To be added to the reference price at producer level	To be added to the reference price at producer level	Inclusion depends on the goal and scope of the analysis *	Inclusion depends on the goal and scope of the analysis *	To be subtracted from production costs or added to substitute price
Negative consumption externalities	Inclusion depends on the goal and scope of the analysis *	Inclusion depends on the goal and scope of the analysis *	To be added to the reference price at producer level	To be added to the reference price at producer level	To be added to the reference price at user level
Positive consumption externalities	Inclusion depends on the goal and scope of the analysis *	Inclusion depends on the goal and scope of the analysis *	To be subtracted from the reference price at producer level	To be subtracted from the reference price at producer level	To be subtracted from the reference price at user level

* See further explanations in the text.

8.3.2. Negative and positive consumption externalities

Negative or positive consumption externalities are generated by domestic consumption processes. They refer both to final consumption, as well as intermediate consumption in production processes. Final consumption externalities, whether negative or positive, shift up or down the cost of consuming a good or service to the society. Some considerations however

have to be put forward regarding the way of accounting for consumption externalities in value chain analysis, depending on the different uses of the goods in the society, i.e. whether dealing with a domestic output as import substitute, an exportable output or an input imported or exportable.
In principle, if a ***domestic output substitutes for an imported output***, whose consumption generates the same externalities, these externalities do not affect the decision whether to produce domestically or import. However, in VCA, it is often interesting to investigate the extent to which the consumption of a given good or service is implicitly or explicitly subsidized, regardless whether it is domestically produced or imported. In such cases consumption externalities have to be accounted for when calculating the cost to the society of consuming a specific good or service, as negative (positive) consumption externalities constitute an implicit subsidy (tax) to consumers, which may directly or indirectly affect also upstream agents, including producers.

If an ***output is exportable,*** i.e. produced for exports consumption externalities should affect agents outside the society. However, when dealing with transnational value chains, transnational interdependencies or global sustainability issues, i.e. when carrying out analyses with a very broad scope, consumption externalities should be properly considered, if the analyst want to assess the actual cost to the society (broadly intended) of consuming a given good or services.

When calculating the reference price of either an ***imported or an exportable input***, negative consumption externalities should be added to the cost of the input, while positive externalities should be subtracted, to correctly reflect the cost to the society of using such input.

Regarding the reference price of ***non-tradable goods***, consumption externalities affect the cost of final consumption, if the good is used for final consumption of the cost of input use if the good is used as an input in a domestic production process. In both cases negative externalities should be added to the cost of using such good, while positive externalities should be subtracted.

8.3.3. Other remarks regarding externalities in VCA

One further remark regarding the way of accounting for externalities in domestic production processes is the importance of avoiding double counting of externalities by e.g. attributing them both to input costs, with the result of increasing the cost of production of a good to the society, and to the output value, by decreasing its reference price, i.e. its net value to the society of producing that output.

Finally, it has to be noted that externalities in VCA can be accounted for not only through shifting reference prices of outputs and/or inputs but also by considering positive externalities as specific outputs an negative externalities as specific inputs, albeit associated to other outputs and inputs. This would allow the analyst to highlight these items by reporting them explicitly in the VCA accounts. In addition, this would allow the analyst to highlight situations or scenarios where an externality, whether negative or positive, is only partially internalized. In such cases the "*market price*" of such item would reflect the internalized part, while its "*reference price*" would reflect its full value to the society.

Table 8.6: Computation of Reference Prices including externalities

	Example: IMPORTED INPUT		
a	CIF price in foreign currency	0.5	f.c.
b	Official Exchange Rate	500	d.c./f.c.
c=a*b	Border price (d.c.)	250	d.c.
d	FOREX PREMIUM	1.1	
e=c*d	Adjusted border price	275	d.c.
f	Total Import tariff	1.5	d.c.
g	Transport Costs from border to domestic market	10	d.c.
h	Handling Costs from border to domestic market	1	d.c.
i	Storage Costs from border to domestic market	5	d.c.
j=e+f+g+h+i	Reference Price at domestic market level	292.5	d.c.
k	Negative consumption Externality	-6.5	d.c.
l=j-k	PPDML including consumption externality	299.0	
m	Transport Costs from domestic market to production level	1	d.c.
n	Handling Costs from domestic market to production level	1	d.c.
o	Storage Costs from domestic market to production level	0	d.c.
p=l+m+n+o	Reference Price at Production level	301.0	d.c.

BOX 8.1 Computing the reference price of a non-traded good: firewood in Burkina Faso

To assess the societal interest of Burkina Faso to support firewood production, processing and use through appropriate policies, the calculation of the reference price of firewood, a good which is not traded internationally, is based on the opportunity cost of the energy in the country, notably on the cost of importing its closest substitute, i.e. the butane gas. In Burkina Faso, butane gas is imported from neighbouring countries in bottles and distributed for household consumption.

Starting with the international price of one kilogram of butane in Euros (the CIF price), the calculation of the reference price of firewood at production level is carried out in six steps, as reported in table 8.7:

1) Calculation of the border price of butane gas. This calculation converts the value of one kilogram of butane expressed in foreign currency into domestic currency by using the shadow exchange rate (or the official one as its proxy) (rows from a to c)

2) Calculation of the reference price of butane at wholesale level. This step implies adjusting the border price to take into account the different location with respect to the border where the butane is traded off with firewood, i.e. the point of competition of the imported good (butane) with the domestic one (firewood). To this end, storage and transport costs from the border to the wholesale market are added to the border price (rows from d to f).

3) Calculation of the implicit price of firewood in terms of energy content. As one kilogram of butane has a higher caloric content than firewood, we cannot directly apply the price of one kilogram of butane to a kilogram of firewood. An *energy adjustment coefficient* is calculated, based on the tons of oil equivalent of the two products to divide the price of butane, to obtain the implicit price of firewood in terms of energy content rows from g to j).

4) Adjustment for consumer use preference. When calculating the reference price of one good on the basis of another good chosen as reference (benchmark), we have to take into account the preferences of consumers in using one good with respect to the other, as expressed by their willingness to pay for specific features (qualities) of the good, other thinks equal. The butane gas, other things equal, is easier to use than firewood, as it implies less storage and transport efforts at domestic level, readiness of use etc. Based on expert judgement, it has been retained that consumers are willing to pay half a calorie produced with firewood with respect to the same calorie produced with butane. A "*Energy-Quality-adjusted price*" of firewood is therefore calculated (rows from k to l).

5) Consumption externalities. Consuming the domestic good rather than the imported one may imply generating more or less externalities. Using firewood rather than butane implies reducing carbon emissions (i.e. an implicit carbon sequestration). Assuming that the society is concerned with these externalities, the reference price of firewood has to be adjusted accordingly. The implicit carbon sequestration due to the use of one kilogram of firewood, rather than its equivalent in caloric content of butane, net of the emissions required to produce and transport on kilogram of firewood, is evaluated in monetary terms by using an estimate of the price of carbon dioxide emissions. The firewood reference price is than adjusted by adding the value of this positive externality. Adding this externality to the energy-quality adjusted price leads to the "*Energy-Quality-Externality-adjusted price*" (rows from m to y).

6) Adjustment of the price at production level. The Energy-Quality-Externality-adjusted price is further adjusted to calculate the reference price of firewood at production level. This implies subtracting transport and handling costs from the production zone to the wholesale level. (rows from z to B).

As it is apparent from this case, the calculation of reference prices, specifically those of goods not traded on international market, requires merging information from different sources, including information regarding the physical features of goods, comparisons of consumer preferences, often based on expert judgement or other qualitative assessments and monetary evaluations of single components and/or specific features of the good under investigation. Given the complexity of this process and a certain degree of subjectivity, the analyst has to complement calculation of reference prices with full information regarding calculation modalities, assumptions made and sources of relevant information. This allows for checking, replicability, discussions and validation across different stakeholders and sensitivity of the cost-benefit analysis results to selected assumptions regarding the calculation of reference prices.

Table 8.7: Computing the reference price of a non traded commodity: the case of firewood in Burkina Faso

a	CIF price of a kg of Gas Butane	Euro/kg butane	0.50
b	Exchange rate	FCFA/Euro	655.00
c=a x b	**Border price of a kg of Gas Butane**	**FCFA/kg butane**	**325.70**
d	Transport from border to wholesale domestic market	FCFA/kg butane	180.69
e	Storage at domestic wholesale market	FCFA/kg butane	93.88
f=c+d+e	**Domestic price at wholesale market level of one kg Butane**	**FCFA/kg butane**	**600.27**
g	Tons of Oil Equivalent (TOE) of Butane	Tons butane/ton oil	0.85
h	Tons of Oil Equivalent (TOE) of Firewood	Tons firewood/Ton oil	2.86
i=h/g	Energy adjustment coefficient	Tons fir/Ton but.	3.37
j=f/i	**Implicit price of firewood in terms of energy content**	**FCFA/kg firewood**	**178.05**
k	Quality adjustment factor in terms of WTP of consumers	FCFA cal.fir/FCFA cal.b	0.50
l=j/k	**Quality-energy adjusted firewood price at market level**	**FCFA/kg firewood**	**89.02**
m	Carbon emissions (CO2 equivalent) of one Kg of oil *	Kg CO2eq/Kg oil	2.63
n=m/g	Carbon emissions (CO2 equivalent) of one Kg of butane	Kg CO2eq/Kg butane	3.10
o=n/i	Carbon sequestration per Kg of firewood used as substitute	Kg CO2eq/Kg firewood	0.92
p	Carbon emission per Kg of firewood produced *	Kg CO2eq/Kg firewood	0.01
q	Liters of diesel per Kg of firewood transported **	Liters/kg firewood	0.02
r	Specific weight diesel	kg/liter	0.85
s=r x q	Kilograms Diesel per Kg of firewood transported	kg diesel/kg firewood	0.016
t=s x m	Carbon emission per Kg of firewood transported	Kg CO2eq/Kg firewood	0.04
u=o-p-t	Net carbon sequestration per ton of firewood ***	Kg CO2eq/Kg firewood	0.87
v	Price of one Kg of CO2 equivalent	Euros/Kg CO2 equiv	0.010
x=u x v x b	Positive externalities of carbon sequestration from firewood use	FCFA/Kg firewood	5.71
y=l+x	**Energy-Quality-Externality-adjusted fiewood price at market level**	**FCFA/Kg firewood**	94.74
z	Transport from production zone to wholesale market	FCFA/kg firewood	15.80
A	Storage at wholesale market	FCFA/kg firewood	2.41
B=y-z-A	**Quality-energy-externality adjusted firewood price at production**	**FCFA/kg firewood**	**76.53**

*Source: Adapted by the author on the basis of: DGPSA (2007a). *) Data on carbon emissions are from the EX-ACT (2011) database. **) Data on diesel for firewood transport is drawn from DGPSA (2007a). ***) The Price of CO2 equivalent is a lower bound based on http://www.emissierechten.nl/*

8.4. Reference prices applied: analysis of organic bananas in Ecuador

Bananas are the world's most exported fresh fruit in terms of volume and value and contribute significantly to the income of agricultural workers as well as being a resource for poor farmers in various low income countries, such as Ecuador, Honduras, Guatemala, Cameroon, Côte d'Ivoire and The Philippines[111]. In the last decade the conventional production of bananas has been complemented by another kind of production: organic bananas[112].

[111] Arias, P., Dankers, C., Liu P., and Pilkauskas P. 2003. *The World Banana Economy 1985-2002*, FAO, Rome, Italy.

[112] "In 1999 the Committee on Food Labeling of the Codex Alimentarius Commission adopted Guidelines for the Production, Processing, Labeling and Marketing of Organically Produced Foods. According to the Codex definition, "*organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system.*"

This diversification in the banana sector is due to several causes, the most relevant are:

- the recent oversupplies of conventional products, which caused several price falls;
- the greater attention to environmental sustainability; and
- the growing demand for organic products, especially from Europe and North America.

In Ecuador, the banana sector is an especially important part of the rural economy. The country is thereby the world's largest banana exporter and the fourth largest producer behind India, Brazil and China. It shipped an estimated 4.5 million tons worldwide in 2007. Although it entered the organic industry relatively late, Ecuador's organic banana output has risen fast since 2004. In 2007, Ecuador became the world's largest supplier, accounting for roughly 40% of global exports of organic bananas[113]. The value chain of the banana sector is made up of different agents: farmers, processors, retailers, exporters and consumers.

Purpose of the analysis. The analysis here below aims to assess the net benefits of shifting from conventional banana production to organic banana production in Ecuador focusing on the primary actor of the chain: the farmer. It highlights economic, health and environmental aspects, merging these dimensions in the economic analysis at reference prices[114].

This assessment is based on the comparison of two scenarios: a base scenario that serves as the reference scenario (without-policy scenario), reflecting the conventional production of a representative medium scale banana farm (60 ha) and a second scenario (with-policy scenario) representing the same farm converted to organic banana production.

Data about banana production technologies such as production factors (labour, capital, land), yields of organic and conventional production practices, physical quantities of inputs used (fuel, materials, etc.), prices of inputs, outputs and factors have been mainly drawn from Ochoa and Benavides, (2001). Information about health impacts on the use of pesticides and related costs was based on Athukorala, Wasantha, and others. (2010).[115] For data on carbon emissions reference is made to the emission factors established by the Intergovernmental Panel on Climate Change (IPCC), embodied in the FAO EX-ACT software for carbon emissions analysis[116].

The carbon emissions analysis in the two different production systems[117]. The first step of this analysis is to estimate the sequestration and/or emissions of Greenhouse Gases (GHG) associated to the various activities of the banana production process. Several studies estimate that one ton of bananas emit, from cradle to the supermarket shelf, one ton of carbon dioxide-

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FAO Liu, P. 2008. *Certification in the value chain for fresh fruits. The example of banana industry*, FAO, Rome, Italy.

[113] Arias, P., Dankers, C., Liu P., and Pilkauskas P. 2003. *The World Banana Economy 1985-2002,* FAO, Rome, Italy.

[114] Two FAO analytical tools were used to carry out this analysis: the Ex-ante Carbon balance Tool (FAO EX-ACT) and the Value Chain Analysis Tool (FAO VCA-Tool)EX-Act: **http://www.fao.org/tc/exact/en/** ; FAO VCA-Tool: **http://www.fao.org/easypol**

[115] Athukorala,Wasantha, *et al*. 2010. Determinants of health costs due to farmers' exposure to pesticides: an empirical analysis, *Journal of Agricultural Economics, Volume 63, Issue 1, pages 158–174, February 2012.*

[116] EX-ACT website *www.fao.org/tc/exact*

[117] This analysis is based on: Bockel L. and Grewer, U., 2013. *Analysis of carbon balance for organic and conventional banana production. An application of FAO EX-ACT*. Unpublished technical note. FAO 2013.

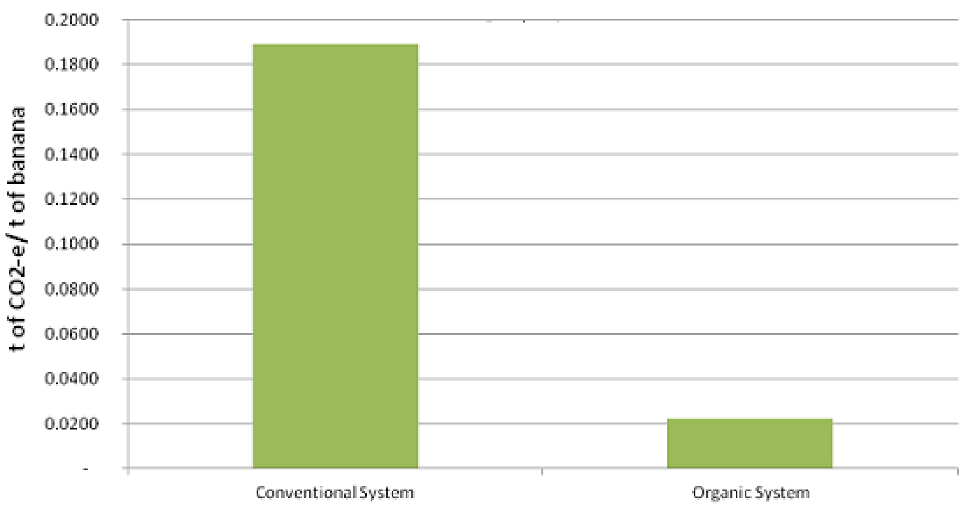
equivalent (CO_2-e) [118], while Lescot (2012) [119] estimated that the carbon footprint of one ton of bananas, including the stages until they arrive at the port of an overseas' destination, ranges between 0.652 and 0.959 ton of CO_2-e. This study however concentrates on the emissions generated until the farm gate.

The principal sources of GHG emissions for banana production are associated to:

- direct emissions of nitrogen dioxide (N_2O) from soil due to nitrate reduction following the application of nitrogen fertilizer and organic nitrogen sources;
- indirect emissions of Carbon dioxide (CO_2) created by production, packaging, storage and transport of fertilizers, herbicides, fossil fuels and other inputs;
- direct emissions of CO_2 from the combustion of fossil fuels for agricultural machinery (including irrigation facilities); and
- direct emissions of CO_2 from mineralization of urea (nitrogen-release fertilizer)

For our representative farm, the analysis indicates that after conversion to organic practices the carbon footprint of 1 ton of bananas decreases from 0.189 to 0.022 tons of CO_2-e (Figure 8.4). Organic agriculture can thus, in addition to other impacts, decrease the GHG balance of a farm by replacing inorganic fertilizers with manure and compost as well as eliminating agro-chemicals by means of integrated pest management practices.

Figure 8.4: Carbon emissions' comparison: conventional versus organic production system



Source: Bockel and Grewer, FAO (2013)

More specifically, this decrease is attributed to the strong decrease in nitric oxide and carbon dioxide emissions from urea applications as well as the decrease in emissions due to fertilizer and agrochemical production, packaging, storage and transport[120].

[118] Luske, 2010, p.45, and Craig *et al.*, 2012.
[119] Lescot (2012, p.11)
[120] The difference 0.167 t CO_2-e of GHG emitted per ton of banana may not necessarily be applicable to different farm sizes, where different technologies may apply.

Comparative cost-benefits analysis. After having obtained data referring to GHG emissions, it is possible to analyze the costs and benefits for the two alternative production technologies. In the cost-benefit analysis, both the results of the carbon balance analysis and health costs are included. This comparative analysis, carried out by means of the FAO VCA-Tool software, implies creating a dataset containing information on prices and physical quantities of inputs, outputs and production factors for the two alternative scenarios. The first scenario is the "Base scenario", reflecting the conventional banana production technology. The second scenario represents the organic production. The two different production technologies imply the use of different inputs (in terms of labour, fertilizers, etc.).

In addition to carbon emissions, the conventional production technology generates health costs due to the intensive use of chemicals. This aspect is included in the cost-benefit analysis.

Costs and benefits under the two scenarios are compared both from the private agent perspective and from the perspective of the society as a whole. For the first case, market prices have been used, while for the second case, reference prices have been applied. In the analysis at market prices, i.e., from the private perspective, carbon emissions and health costs are zero, because private agents do not pay for them. In the analysis at reference prices these items generate costs. A reference price for the carbon emissions at 5 USD per ton of CO_2-e has been assumed[121]. The different results of the two analyses are shown in Figure 8.5. In both methods (conventional and organic) and analyses (market and reference prices) the representative farmer is making profits, but there are some differences that must be highlighted.

Figure 8.5: Profits in conventional and organic banana production

	Conventional Farm	Organic Farm	Difference in profits/losses (for organic farm)
Profits/Losses at market prices	141,704	159,884	13%
Profits/Losses at reference prices	132,560	159,632	20%
Difference between market and reference prices	-9,144	-252	

Differences due to the costs of the emission of carbon (for 60 ha banana farming unit) and the health costs.

Source: own elaborations based on FAO VCA-Tool results.

As reported in Figure 8.5, at market prices**,** profits accruing to the private agent are higher (+13%) under the organic production scenario, despite reduced yields (-25%), due to higher prices of the organic bananas with respect to conventional ones and reduced input costs

[121] The price of 5 USD/t of CO_2-e is a conservative assumption for illustrative purposes only and took the price for CO_2-e of the EU Emissions Trading System (ETS) for power stations and industrial plants as rough orientation (c.f. for price data e.g. to www.pointcarbon.com).

(chemicals and fertilizers). Furthermore, the net value added is higher due to the more labour-intensive process.

At “reference prices” the difference between profits in organic production and profits in the conventional system is even higher (+20%) than the difference at market prices, due to almost zero carbon emission costs and the absence of health-related costs.

These results show that on the basis of the assumptions adopted in this case and other things being equal, it is profitable, both by the private and social point of view to shift from conventional to organic bananas.

8.5. Exercise: computing reference prices with externalities

PART FIVE: Assessing the competitiveness

Background

The government wants to assess the potential of the domestically produced parboiled rice to compete with - and eventually to substitute – the imported parboiled rice.
Moreover, consider that the quality of the product is still lower than the average standards of the international market.
The wholesale domestic market is considered the point where domestically produced parboiled rice (the import substitute) competes with the imported rice. Available information on imported parboiled rice is provided in Table 8.8.

Table 8.8: Data for the reference price of parboiled rice[122]

DATA		
a	Benchmark price (CIF) in foreign currency	470
b	OER: Official Exchange Rate	500
c	Forex Premium Coefficient	1
d	Import tax (unit)	0
e	Import tax (ad valorem %)	44.6
f	Transport from border to domestic market	277.7
g	Handling from border to domestic market	23.9
h	Storage from border to domestic market	14.4
i	Observed market price (OMP)	270000
j	Transport from production level to domestic market	85
k	Handling from production level to domestic market	3.5
l	Storage from production level to domestic market	1.5
m	Observed price at production level (OPPL)	250000
s	Quality adjustment	-2000

*The letters used in the first column are those used in the FAO VCA-Tool for the same items.

[122] If the calculation are made by the use of the FAO VCA-Tool you need to introduce the FOREX rate in the parameters of the software: open the *Options* menu, click on *Parameters* and then, once the Parameters’ window is open click on *Forex Data Entry*; in this case Official Exchange Rate and Shadow Exchange Rate are the same, so introduce the same value in both the exchange rate (500); now click on *Compute Forex Premium* and the software will calculate the Forex Premium Coefficient that will be used in the calculation of the reference prices. Once the Forex Premium Coefficient has been calculated click on *Register* and then *Save and Exit.*

In addition, it has been estimated that the reference price of the fertilizer (NPK) is 300,000 FCFA per ton.

Assignment
Calculate the reference price of parboiled rice and work out selected competitiveness indicators based on the Policy Analysis Matrix.

Hints
Calculate the revenues, input costs, value added and profits at reference prices and compare the results with the ones calculated at market prices using the policy analysis matrix framework (at value chain level).

9. Profitability, competitiveness and protection indicators

As already mentioned in the previous chapter, comparing costs and benefits of value chains and related activities computed at domestic prices with costs and benefits computed at reference prices, provides analysts with information about discrepancies between the interest of private agents to engage in such a value chain and the interest of the society as a whole to host such activities. These discrepancies materialize as “wedges” between the net benefits accruing to private agents and the net benefits accruing to the society as a whole. Since the deviation of market prices from reference prices are mainly due to market and policy mechanisms (Chapter 6), the comparison between net benefits calculated with the two alternative sets of prices provides information about the extent to which the functioning (or mal-functioning) of markets and policies affect the interest of private agents and make it diverge from the interest of the whole society. Regarding these wedges, when analyzing the net benefits for a value chain, or for specific activities within it, three cases may arise:

a. ***Net benefits are higher at market prices than at reference prices.*** This implies that private agents are favoured (incited) by the society to engage in that value chain or in specific activities within it. Incentives may be generated for instance by policies protecting domestic producers from international competitors through import tariffs or export subsidies, or by policies (or missing policies) allowing them to benefit from unpaid inputs, e.g., negative production externalities.

b. ***Net benefits are lower at market prices than at reference prices.*** This implies that private agents do not benefit from all the advantages they generate. They are disfavoured by the society to engage in the activities of that value chain. Disincentives may be generated for instance by policies taxing domestic producers (above the average taxation level) in a specific value chain or not remunerating them for positive externalities that they generate.

c. ***Net benefits at market prices are equal to net benefits at reference prices.*** In this case private agents are neither favoured nor disfavoured by the policy or market setting under which they operate[123].

However, in the framework of policy impact analysis, incentives or disincentives observed in a given situation, for example, in the base scenario, can be modified in different ways by given policy measures. For instance, a policy measure may reduce disincentives to producers of cereals by providing compensations for existing land erosion control practices (internalization of positive externalities) or may increase disincentives through taxation of selected inputs.
Analyzing the extent to which, under different policy scenarios, net benefits to private agents and net benefits to the whole society vary, both in absolute and relative terms, provides important insights on socio-economic impacts of policy options. This chapter provides a

[123] On the one hand, incentives affecting private agents can be seen as implicit transfers from the society to them. On the other hand, disincentives are implicit transfers from the private agents to the society.

conceptual and operational framework, based on the so-called *"Policy Analysis Matrix"* (hereafter called PAM), to calculate net benefits accruing to private agents, net benefits to the society as a whole, and to compare them through the use of selected indicators.

After introducing the PAM, three groups of indicators will be considered: a) Profitability and value added indicators at market prices; b) Profitability and value added indicators at reference prices; c) Protection indicators (incentives-disincentive indicators to private agents based on wedges).

9.1. Structure of the Policy Analysis Matrix (PAM)

The PAM[124] is a synoptic two-entry table reporting the accounts of a whole value chain, or an activity or a set of activities, both at market and reference prices. In VCA, these activities can be, for instance, the sets of activities carried out by an agent, the activities of a segment of a value chain of the whole activities of a value chain. In its basic version the PAM presents four columns and three rows (Figure 9.1), the elements included in the columns are:

a. First Column: *Revenues*, defined as the number of units sold multiplied by unit price.

b. Second Column: *"Tradable" Inputs*: comprising intermediate inputs directly generating outlays of foreign currency (if importable items) or forgone foreign currency (if exportable items), the remuneration of factors belonging to foreign agents (wages, interests and other capital remunerations at a "normal" remuneration rate) and the tradable component of non-tradable inputs[125].

c. Third column: *Domestic Factors*: comprising factors remunerated through value added to domestic institutions: domestic labour, interest paid to domestic institutions, rents for natural resource use belonging to domestic agents along the production process (labour), remuneration of capital (at a "normal" remuneration rate, given the class of risk of the investment) to domestic institutions and the domestic factor component of non-tradable inputs.

d. Fourth column: *Profits*, defined as the revenues minus tradable inputs and domestic factors, i.e., the difference of the first column minus the other two. Given the fact that the "normal" remuneration of risk capital should be already included in the cost items, profits here should be intended as extra-profits above the "normal" level of remuneration for capital invested in operations in the same risk category (super-normal profits). However, in practice this item is often representing a mixed-income item, capturing the remuneration for entrepreneurial capacities, part of the remuneration of capital and remuneration of labour efforts of the entrepreneur himself, whenever these items are not accounted for in the domestic factor column.

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[124] See Monke E.A. and S.R. Pearson, 1989. *The Policy Analysis for Agricultural Development*, Cornell University Press.

[125] The rationale for separating tradable inputs from domestic factors is based on the use of PAM items to calculate competitiveness indicators, as explained in the next section. For a definition of tradable versus non-tradable items see e.g. on UNIDO (1986): Guide to practical project appraisal, UNIDO – Vienna 1986, p.22.

In practice, many cost items cannot be directly classifiable either as tradable inputs or domestic factors. They appear as domestically produced items the value of which is rather a mix of imported/exportable items and domestic factor costs. In principle, analysts should separate the tradable component from the domestic factor component of domestically produced items. This implies breaking down the value by looking into the production process of such domestically produced items to calculate the value of tradable inputs and domestic factors. This also implies separating the remuneration of factors paid to foreign agents (e.g., wages paid out to foreign workers, expatriated profits by foreign investors etc.) and the foreign component of the consumption of fixed capital (depreciation)[126].

If the break-down is systematically carried out and the remuneration of foreign factors and the foreign components of the consumption of fixed capital are imputed under the second column, the third column of the PAM will display the ***"implied domestic value added"*** [127], net of the extra-profits (but gross of the factor component of the consumption of fixed capital).

The rows of the PAM display the following info:

a. First row: revenues, costs and profits at market prices.
b. Second row: revenues costs and profits at reference prices.
c. Third row: differences between the first row and the second row, i.e., the wedges between the values at market prices and the values at reference prices.

In the PAM framework, it is assumed that reference prices approximate prices that would prevail under perfect competition, while (observed) market prices embody the effects of existing policy failures and/or missing policies. Therefore, the wedges between values at market prices and values at reference prices reported in the third row of the PAM reflect the failure of existing policies to set actual prices at the first best (perfect competition) level and/or the failures of markets (missing policies). This explains why the PAM, which is built to provide these wedges to policy analysts, is called "Policy Analysis Matrix". These wedges therefore represent a monetary configuration of the distance of the actual socio-economic system under analysis from a hypothetical optimal situation approximated by values expressed at reference prices[128]. In this light, the wedges in the third row of the PAM can be seen as transfers from/to

[126] Some software for value chain analysis such as the FAO VCA software tool allow for a percentage decomposition of the various inputs and outputs into tradable and domestic components. Subsequently, in the PAM calculation, the tradable components are imputed into column 2 while the domestic components are imputed to column 3.

[127] "Implied value added" is the value added that includes the remuneration of factors directly contributing to the activity under analysis, the value added in the production of the intermediate inputs used by this activity, the value added in the production of the inputs used to produce the inputs used by this activity and so on, proceeding backward in the production processes.

[128] Of course, this monetary configuration is a good representation of such a distance to the extent to which reference prices adopted are a good representation of prices that would prevail under perfect competition.

the private agents to/from the society (depending on their sign) in the prevailing market and policy setting, compared with a hypothetical optimal situation.

Figure 9.1: Structure of a Policy Analysis Matrix (PAM)

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
Market Prices	A	B	C	D
Reference Prices	E	F	G	H
Wedge	I	J	K	L

Profits at market prices (private profits). The difference between revenues and costs of both tradable inputs and domestic factors at market prices provides a measure of the *private profits* of a given activity of an economic system. The term “private” refers to revenues and costs reflecting actual market prices received or paid by economic agents. The private profits thus incorporate the underlying economic costs and valuations and the effects of the policies and market failures.

This measure shows the competitiveness of the production system from the standpoint of the private agent involved, given the current technologies, the output values, the input costs and policy transfers. As shown in Figure 9.2, the first rowcalculations are:

$$D = A - (B + C)$$

Figure 9.2: Private and social profits

	REVENUES		COSTS				PROFITS
			Tradable Inputs		Domestic Factors		
At market prices	A	—	B	—	C	=	D=A-(B+C)
At reference prices	E	—	F	—	G	=	H=E-(F+G)
Wedges	I	—	J	—	K	=	L=I-(J+K)

When the costs of capital and entrepreneurial capabilities included in the domestic factor costs (*C*) increase, the profits (*D*) may be negative ($D<0$). In this situation, the agents have no incentive to remain in business and they are expected to exit from this activity. Whereas, if these costs decrease, agents may earn positive returns ($D>0$) and it is reasonable to expect future expansions of the system (assuming there are no constraints to expansion) or an accumulation of rents in case of entry barriers.

Profits at reference prices (Social profits). *Social profits* are the difference between revenues and costs both measured at reference pricescomputed as:

$$H = E - (F + G)$$

Social profits represent an efficiency measure, since outputs and factors/inputs are valued at prices reflecting social opportunity costs. When social profits are positive ($H>0$), the economic activities under analysis create above normal wealth for the society (factors used can be remunerated above their opportunity cost).

Profit wedge (net transfers). The comparison of private with social profits provides insights on the net transfers implied by the activity under analysis between private agents and the society as a whole. The wedge between private profits and social profits can be calculated as:

$$L = D - H$$

L can be positive (for $D>H$) or negative (for $D<H$). This difference sheds light on the extent to which the agents in the value chain earn more (or less) than they would if there were no policy or market failures.

Net transfers occurring between private agents and the society as a whole can be decomposed by looking at transfers on the output, input and domestic factor side, as follows:

$$L = I - (J + K)$$

where (see Figure 9.3):

I is the *Output wedge*, i.e., the wedge between the output value at market and reference prices, reflecting transfers occurring on the output side:

$$I = A - E$$

J is the *Traded inputs wedge*, i.e., the wedge between tradable inputs at market and reference reflecting transfers occurring on the traded input side:

$$J = B - F$$

And *K* is the *Domestic factor wedge*, i.e., the wedge between domestic factors valued at market and reference prices reflecting transfers occurring through domestic factors:

$$K = C - G$$

Figure 9.3: Wedges on revenues, costs and profits

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market Prices	A	B	C	D
At reference Prices	E	F	G	H
Wedges	I = A - E	J = B - F	K = C - G	L = D - H

Alternative policy measures affect revenues and costs of specific activities and of whole value chains. PAMs calculated in the base case and under different policy scenarios provide a synoptic view of the changes in revenues, costs and related profits induced by policies. Summary indicators based on PAM's values help to highlight specific policy impacts. An example of policy impact analysis using the PAM is provided in the following paragraph.

9.2. Impact analysis of policy options and PAMs

Consider for instance an agricultural production activity aimed at producing an import substitute. Revenues and costs in the base scenario are expressed in Monetary Units (MU) in panel A of Figure 9.4. At market prices, Domestic factors absorb all the value added (the difference between revenues and input costs), so that this activity, at market prices, just breaks even. At reference prices, revenues are lower than those at market prices due to an import tariff raising the domestic market price above the opportunity cost for the society as a whole. This gives rise to a wedge on revenues of 100 MU. In addition, under the base scenario, the cost of inputs is lower at reference prices than at market prices because inputs are taxed. This originates a wedge on input costs of 50 MU. Factor costs are the same at market and reference prices. This generates a net loss at reference prices of 50MU. Given that at market prices the activity just breaks even, this activity implies an implicit net transfer of 50 MU (see the positive wedge on extra-profits) from the society to the producer.

Figure 9.4. Impact analysis of policy options with PAMs

Panel A: Base scenario: inefficient activity

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1300	700	0
At reference prices	1900	1250	700	-50
Wedges	100	50	0	50

Panel B: Policy option 1 reduction of input costs and increase of factor use

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1100	800	100
At reference prices	2100	1050	800	250
Wedges	-100	50	0	-150

Panel C: Policy option 2 increase of input cost and decrease of factor use

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1500	400	100
At reference prices	1800	1600	140	60
Wedges	200	-100	260	40

Assume that a policy option (policy option 1) is designed to increase profits through a reduction of input costs compensated by an increase of domestic factors (Panel B). This may be the case for instance of some "*Good Agricultural Practices*"[129] or "*Save and Grow*"[130] policy measures aimed at reducing the use of chemicals in agriculture. According to the data in panel B, other things equal, this policy option generates extra-profits both at market and reference prices this is the result of concurring changes in revenues and costs. On the one hand, the policy measure leaves revenues at market prices unchanged but raises revenues at reference prices because the technology change brings positive environmental externalities in terms of soil conservation and increased fertility, generating a negative wedge on revenues. On the other hand, input cost reduction more than offset the increase in factor costs, both at market and reference prices. The

[129] See for instance a seminal concept paper on GAPs:
Poisot A.S. et al., 2004: Good Agricultural Practices: a working concept. Background paper for the FAO Internal workshop on Good Agricultural Practices. FAO GAP working paper series 5, FAO UN - Rome
http://www.fao.org/prods/gap/Docs/PDF/5-GAPworkingConceptPaperEXTERNAL.pdf
On good agricultural practices at country level see e.g.: Bellaver, C., 2002. *Guidelines for Good Agricultural Practices* FAO UN – EMBRAPA, Brasilia
http://www.fao.org/prods/gap/DOCS/PDF/Guidelines_for_Good_Agricultural_Practices.pdf.
[130] FAO UN, 2011: *Save and Grow. A policymaker's guide to the sustainable intensification of smallholder crop production*. http://www.fao.org/docrep/014/i2215e/i2215e.pdf

wedge on extra profits shifts from 50 MU in the base case to – 150 MU, signalling a net transfer from private agents to the society.

Consider also a second policy option, (policy option 2, panel C), aimed, at favouring the adoption of a more input intensive technology and the decrease of factor costs through a reduction in the use of labour. This policy measure is implemented through the replacement of input taxes with input subsidies, funded through a taxation of labour. This policy option presents: a) reduced revenues at reference prices due to the missed soil conservation effects with respect to policy option 1 and further soil degradation with respect to the base case, raising the wedge on revenues to 200 MU; b) increased use of inputs with increased costs for the society due to subsidies, leading to a larger wedge (in absolute terms) on inputs of -100 MU; c) reduced costs of domestic factors due to reduced use of labour, partially countervailed by taxes on labour, raising the wedge on factors to 260 MU; d) higher market price than the opportunity costs of labour for those employed, due to taxes on labour; e) unchanged profits at market prices (100 MU) with respect to policy option 1 but reduced extra-profits at reference prices (60 MU) with a wedge on extra-profits of 40 MU, signalling a net transfer from the society to the private agents.

These different policy scenarios are better analyzed by calculating and comparing summary indicators based on PAM's figures. In VCA indeed, it is often more convenient to make use of ratios or coefficients rather than monetary amounts. This eases for instance the comparisons not only among different policy scenarios but also comparisons across different value chains. In the next section some currently used indicators are presented and discussed.

9.3. Profitability and value added indicators at market prices

Indicators at market prices provide information about the impacts of policy options under investigation on private agents. They comprise, among others, the Private Cost Ratio (PCR) and the Private Value Added Ratio (PVAR).

Private Cost Ratio (PCR). The private cost ratio is the ratio of domestic factor costs (*C*) to the value added created at private prices ($A - B$)[131]:

$$PCR = \frac{C}{A - B}$$

This ratio can be read as the ratio between the "implied" ***normal*** remuneration of domestic factors and the implied ***total*** remuneration of domestic factors (implied value added). Therefore, the *PCR* is the share of the (implied-domestic) value added absorbed by the "normal" remuneration of factors at market prices. Assuming that the (implied-domestic) Value Added *(A-B)* is positive and the "normal" remuneration of domestic factors *C* is non-negative, the *PCR* ranges between zero, (when C=0) and, virtually, infinity, (for very large *C*

[131] Note that here A-B is the implied value added described in the paragraph above, gross of the extra-profit component recorded under the fourth column.

or very small *A-B)*[132]. $PCR \geq 1$ implies that $C \geq (A - B)$, i.e. $(C - A + B) \geq 0$, or also $(A - B - C) \leq 0$, that is: $D \leq 0$. Therefore, *PCR=1* signals that no extra-profits occur at market prices and the activity just breaks even. *PCR>1* implies the presence of negative extra-profits, that is, the activity does not remunerate all the domestic factors at market prices, i.e., it generates losses. When $0 < PCR < 1$, $D > 0$ i.e., positive extra-profits occur.

Table 9.1 summarizes the possible values for PCR:

Table 9.1: Possible values for PCR

$PCR = 0$	**No remuneration of factors at market prices occurs (All the value added goes to extra-profits).**
$0 < PCR < 1$	Part of the value added is absorbed to remunerate factors at market prices and the reminder generates extra profits (e.g., PCR=0.8 means that 80% of the value added is absorbed for the normal remuneration of factors and 20% are extra-profits)
$PCR = 1$	All the value added is absorbed to remunerate factors at market prices, so no extra profits occur (the activity breaks-even)
$PCR > 1$	The remuneration of factors at market prices exceeds the value added of the activity, which is generating losses (the activity is not able to remunerate at market prices the domestic factors used)

Figure 9.5 presents the PCRs for the policy options illustrated above. The values of the PAMs used to calculate the PRCs are highlighted. In the base scenario (panel A) domestic factors, remunerated at market prices, absorb all the value added (the difference between revenues and input costs). As no extra-profits arise, PCR=1. Under policy option 1 (panel B), extra-profits arise to private agents because the increase of factor costs with respect to the base case is more than compensated by the decrease of input costs. The presence of extra profits signalled by the PCR below the unity, at 0.89.

[132] This assumption rules out some concrete cases, where intermediate input costs exceed sales revenues. In this case, (A-B) < 0. If we assume that the "normal" remuneration of factors at market prices is positive, i.e. C>0, the PCR results to be negative.

Figure 9.5: Private Cost Ratio (PRC) examples

Panel A: Base scenario: Zero (= normal) profits

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1300	700	0
At reference prices	1900	1250	700	-50
Wedges	100	50	0	50

PCR
1.00

Panel B: Policy option 1: reduction of input cost and factor use increase

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1100	800	100
At reference prices	2100	1050	800	250
Wedges	-100	50	0	-150

PCR
0.89

Panel C: Policy option 2: increase of input cost and factor use decrease

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1500	400	100
At reference prices	1800	1600	140	60
Wedges	200	-100	260	40

PCR
0.80

Under policy option 2, (panel C), other things equal, i.e., the same revenue and extra-profits, the shift of costs from factors to inputs leads to a further decrease of the PCR, to 0.8.

It is apparent that the PCR not only is sensitive to changes of extra-profits, but also to shifts between domestic factors and tradable inputs. Progressively shifting costs from domestic factors to tradable inputs, other things equal, leads to PCR decreases, virtually down to zero when all the costs are represented by traded inputs. On the other side, the adoption of labour intensive technologies, will push the PCR up, other things equal, virtually until its upper limit, which is represented by the Cost-Revenue Ratio (CRR)[133]. The above considerations imply that clearly, while the PCR is a suitable indicator of the capacity of the activity, under a given policy scenario, to remunerate factors above their market prices, it is not a suitable indicator to measure the capacity of the activity to generate domestic value added. Indeed, a lower PCR of an activity, while revealing the higher capacities to remunerate factors at higher prices, other things equal, may also reveal a lower capacity of the activity to generate domestic value added. If the analyst wants to get a more comprehensive picture of the likely economic impacts of a policy option, the PCR needs to be complemented with other indicators. A suitable indicator

[133] When using market prices the CRR is qualified as Private Cost/Revenue Ratio, (PCRR) in the PAM framework is defined as: PCRR=(A-D)/A. In both examples in panels B and C in figure 9.7, PCRR= (2000-200)/2000 , i.e. 0.90. Note that, given revenues and extra-profits, the PCRR is given as well.

to measure the contribution of the activity to the domestic value added at market prices is for instance the Value added Ratio at market prices.

Value Added Ratio at market prices (Private Value Added Ratio - PVAR). The contribution of an activity to domestic value added generation at market prices can be assessed looking at the Private value added ratio PVAR. This ratio is the share of value added (including extra-profits) in the revenues and can be considered as the value added intensity of the activity:

$$PVAR = \frac{A-B}{A}$$

Note that, assuming positive revenues (*A>0*) and positive traded (intermediate) inputs are not greater than the revenues ($0 \le B \le A$), *PVAR* ranges between 0, limit occurring when the intermediate inputs absorb all the revenues, and 1, occurring when no intermediate inputs are used and all the revenues are value added ($0 \le PVAR \le 1$).

When comparing a "With Policy" scenario with the base-case, an increase in the *PVAR*, other things equal, signals that the policy measure under analysis is increasing the domestic value-added intensity of the activity, probably entailing more domestic multiplier effects through domestic income generation and reduced leakages due to imports of intermediate inputs. In general, however, it is worth jointly looking at the Private Cost Ratio (PCR) and the Private Value Added Ratio (*PVAR*). In this case, one of the nine cases illustrated in Table 9.2 occur, signalling different policy impacts regarding the value added generation and the remuneration of factors.

Table 9.2. PCR versus PVAR changes (↑: increase; ↓: decrease; → constant)

	A. PCR ↑	B. PCR→	C. PCR ↓
1. PVAR ↑	1A. The measure increases the domestic value added *per* unit of revenue but decreases the capacity to remunerate factors beyond market prices.	1B. The measure increases the domestic value added per unit of revenue but does not change the possibility to remunerate factors beyond market prices.	1C. Both the domestic value added *per* unit of revenue and the possibility of the activity to remunerate factors above market prices increase.
2. PVAR→	2A. The measure does not increase the activity's value added intensity and decreases the possibility to remunerate factors.	2B. The measure does not bring any change either in the domestic value added intensity or in the capacities to remunerate factors.	2C. The measure does not increase the activity's domestic value added intensity but increases the possibility to remunerate factors.
3. PVAR ↓	3A. Both the domestic value added *per* unit of revenue and the possibility of the activity to remunerate factors above market prices decrease.	3B. The measure decreases the domestic value added *per* unit of revenue and does not change the possibility to remunerate factors beyond market prices.	3C. The policy measure decreases the domestic value added *per* unit of revenue but the activity increases its capacity to remunerate factors beyond market prices.

The case 1A, for instance is likely to occur whenever the policy measure under analysis, other things equal, shifts production modalities towards a more factor intensive technology in a context where particularly costly imported inputs can be replaced with cheap domestic labour, giving rise to extra-profits. Whether these extra-profits will stay in the hands of the entrepreneurs or will affect be captured by other agents to increase their own factor remunerations such as wages or land rents, depends on the institutional context, the bargaining power of the various factor providers and/or the existence of entry barriers for other suppliers to join the market, thus affecting or maintaining the output price level. Other policy measures leading to case 1A, for instance, may be factor policies directly downward shifting wage levels, such as lifting minimum wage regulations or the like, which would lead to substituting inputs for labour while raising extra-profits.

The case 3A for instance may occur when other things equal, a policy measure shifts production towards more foreign capital intensive technologies. Imported capital services reduce domestic value added as well as extra-profits of domestic entrepreneurs[134].

9.4. Profitability and value added indicators at reference prices

The same type of indicators used to assess profitability (PCR) and value added intensity (PVAR) at market prices, can be calculated at reference prices. They give rise respectively to the Domestic Resource Cost Ratio (DRC) and to the Social Value Added Ratio (SVAR). Being based on reference prices, these indicators provide information on value added and profits by the point of view of the society as a whole, which may differ, even substantially in some instances, by the private point of view. Therefore, the shifts in DRC and SVAR observed when comparing for “WiP” with “WoP” scenarios, signal the impacts of the policy measure not only on marketed goods and services but also on social values not entirely reflected by existing market prices or associated to non marketed goods such as environmental externalities, social stability, cultural values, etc.

Domestic Resource Cost Ratio (DRC). The *domestic resource ratio* (DRC) is the ratio between the domestic factor costs at reference prices and the value added at reference prices:

$$DRC = \frac{G}{E - F}$$

As reference prices are proxies for social opportunity costs, the *DRC* provides information on the capacity of the specific activity to generate extra domestic value added beyond the amount of value added required to remunerate factors at their opportunity costs.

[134] The calculation, comparison and discussion of PVARs for the policy scenarios in the example above are left as an exercise to the reader.

The concept and the measure of DRC, originally introduced by Bruno (1965)[135] to rank and select the most efficient export-promoting and import-substituting projects, has since been considered an indicator of the comparative advantage of an economic system to undertake a given activity. Indeed if the value of the domestic resources used by the activity at their opportunity cost (*G* at the numerator), are lower than the foreign currency inflows (for exports) or savings, (for import substitution), net of the outlays due to intermediate consumption (*E-F* at the denominator), the country has an advantage to domestically produce a given good or service which it can either substitute for imports or can be exported. In this case, DRC<1.

In general, the *DRC* reads exactly as the *PCB* ratio (see Table 9.3). Assuming that the (implied-domestic) value added at reference prices *(E-F)* is positive and the "normal" remuneration of domestic factors *G* is non-negative, the *DRC* ranges between zero, (when *G*=0) and, virtually, infinity, (for very large *G* or very small *E-F)*[136]. $DRC \geq 1$ implies that $G \geq (E-F)$, i.e. $(G-E+F) \geq 0$, or also $(E-F-G) \leq 0$, that is: $H \leq 0$. The presence of negative extra-profits means that the activity cannot remunerate all the domestic factors at their opportunity cost, i.e., it generates losses to the society. A *DRC=1* signals that no extra-profits occur at reference prices and the activity just breaks even. When $0 < DRC < 1$, $H > 0$, i.e., positive extra-profits occur. The lower DRC is, the higher the efficiency of the activity.

Table 9.3: Possible values for DRC

$DRC = 0$	**The opportunity cost of factors is zero (All the value added goes to extra-profits).**
$0 < DRC < 1$	Part of the value added is absorbed to remunerate factors at their opportunity cost and the remainder generates extra profits (e.g. DRC=0.8 means that 80% of the value added is absorbed for the normal remuneration of factors at their opportunity cost and 20% constitutes extra-profits).
$DRC = 1$	Factors, valuated at their opportunity costs absorb all the value added so no extra profits occur (the activity breaks-even).
$DRC > 1$	The remuneration of factors at their opportunity cost exceeds the value added of the activity, which is generating losses (the activity is not able to remunerate factors used at their opportunity cost).

Figure 9.6 provides an example about the use of DRC for policy impact analysis. The same policy options illustrated in Figure 9.7 are considered. The values of the PAMs used for calculating the *DRCs* are highlighted. For the base case, the *DRC* is greater than 1, since the cost of domestic factors exceeds the value added at reference prices. Under policy option 1, the decrease of the DRC from 1.08 to 0.76 with respect to the base case signals that this policy

[135] Micheal Bruno firstly introduced the concept of Domestic Resource Cost to assess international the comparative advantage of Israel to engage in specific activities.
Bruno, M. 1965. *The optimal selection of export-promoting and import-substituting projects, in Planning the External Sector: Techniques, Problems, and Policies,* New York, 'United Nations, 1965, pp. 88-136.
[136] This assumption rules out some concrete cases where intermediate input costs exceed sales revenues, i.e. $(E-F) < 0$. Assuming that the "normal" remuneration of factors at reference prices is positive, i.e. *G>0*, in these cases the *DRC* is negative.

option generates a comparative advantage for that activity. Policy option 2 further reduces DRC to 0.70.

Figure 9.6 Policy impact analysis using the DRC: example

Panel A: Base scenario: inefficient activity

	REVENUES	COSTS		PROFITS	DRC
		Tradable Inputs	Domestic Factors		
At market prices	2000	1300	700	0	1.08
At reference prices	1900	1250	700	-50	
Wedges	100	50	0	50	

Panel B: Policy option 1 reduction of input costs and increase of factor use

	REVENUES	COSTS		PROFITS	DRC
		Tradable Inputs	Domestic Factors		
At market prices	2000	1100	800	100	0.76
At reference prices	2100	1050	800	250	
Wedges	-100	50	0	-150	

Panel C: Policy option 2 increase of input cost and decrease of factor use

	REVENUES	COSTS		PROFITS	DRC
		Tradable Inputs	Domestic Factors		
At market prices	2000	1500	400	100	0.70
At reference prices	1800	1600	140	60	
Wedges	200	-100	260	40	

This signals an efficiency increase in the use of domestic resources, i.e., that extra profits accruing to the society per unit of domestic factor costs are higher under option 2 than under option 1. However, ranking policy options with the DRC alone may be misleading. Note for instance that the domestic value added produced under policy option 2 (M.U. 200) is lower than the value added produced under policy option 1 (M.U. 1050). Policy option 2 implies, other things equal, a lower contribution of the activity to the GDP, increased leakages of domestic wealth for importing inputs and lower employment opportunities. In addition domestic factors freed under policy option 2 may be left unemployed. Furthermore, leakages due to imports will reduce the likely multiplier effects associated to value added generation and distribution, with detrimental effects to development.

To address this issue we need to complement the DRC with other indicators capturing different developmental dimensions, such as the Social Value Added Ratio.

Social Value Added Ratio (SVAR). The SVAR, conceptually analogous to the PVAR, is the share of value added (including extra-profits) in the revenues, valued at reference prices:

$$SVAR = \frac{E - F}{E}$$

Note that, assuming that positive revenues (*E>0*) and positive traded (intermediate) inputs are not greater than the revenues ($0 \leq F \leq E$), *SVAR* ranges between 0, limit occurring when the intermediate inputs absorb all the revenues, and 1, occurring when no intermediate inputs are used and all the revenue translates into value added ($0 \leq SVAR \leq 1$).

Note that the same considerations put forward for the different combinations of *PCR* and *PVAR* (see Table 9.2) hold for the combinations of *DRC* and *SVAR*[137].

9.5. Protection indicators

Market imperfections and policy failures materialize in the form of incentives or disincentives to private agents which alter their revenues, costs and related margins with respect to what would happen under optimum conditions. Increases in revenues and/or reduction of costs constitute implicit transfers from the society to private agents which protect them from competitors, who do not benefit from the same transfers, on the output or input and factor markets. On the other hand, decreases of revenues and/or increases of costs constitute implicit outlays from private agents to the society, which act as a negative protection and weaken the position of private agents with respect to competitors who do not bear this burden. To assess the sign and degree of protection affecting private agents in the base case as well as in different policy scenarios, various coefficients and ratios are usually calculated. In this section four indicators will be presented: the Nominal Protection Coefficient on Outputs (NPCO), the Nominal Protection Coefficient on Tradable Inputs (NPCI), the effective protection coefficient (EPC) and the subsidy ratio to producers (SRP)[138].

Nominal Protection Coefficient on Outputs (NPCO). This indicator looks at the output side of the value chain or of specific activities and compares revenues at market prices with revenues at reference prices. It is computed as:

$$\mathrm{NPCO} = \frac{\mathrm{A}}{\mathrm{E}}$$

and shows how many times social revenues have to be multiplied to get private revenues. This indicator ranges between minus infinity to plus infinity.

[137] Analogously to the *PVAR*, the calculation, comparison and discussion of *SVAR*s for the policy scenarios in the example above are left as an exercise to the reader.

[138] Regarding protection, these guidelines refer to "coefficients" (not "rates") adopting the same terminology and formulas used in e.g., Monke and Pearson ,1989 (ref.) and OECD, 2010: OECD's Producer support estimate and related indicators of agricultural support: Concepts, calculations, interpretation and use (The PSE Manual), OECD – Paris *http://www.oecd.org/tad/agriculturalpoliciesandsupport/46193164.pdf*

- An NPCO>1 indicates that producers are benefiting from protection, having higher revenues at market price than the revenues accruing to the society.

- An NPCO<1, indicates that producers are negatively affected by the prevailing policy and market setting as they produce more revenue accruing to the society than what they receive.

NPCOs are calculated for the policy option examples above, and reported in Figure 9.7. PAMs' values used for their calculations are highlighted.

Figure 9.7: Policy impact analysis using the NPCO: example

Panel A: Base scenario: inefficient activity

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1300	700	0
At reference prices	1900	1250	700	-50
Wedges	100	50	0	50

NPCO: 1.05

Panel B: Policy option 1 reduction of input costs and increase of factor use

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1100	800	100
At reference prices	2100	1050	800	250
Wedges	-100	50	0	-150

NPCO: 0.95

Panel C: Policy option 2 increase of input cost and decrease of factor use

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1500	400	100
At reference prices	1800	1600	140	60
Wedges	200	-100	260	40

NPCO: 1.11

In the base scenario, private agents are protected because the revenues they get exceed the revenues received by the society, due to an import tariff that raises the market price of the goods domestically produced above the value of the goods to the whole society, reflected by the cost of importing them. Under policy option 1, the adoption of an environmentally friendly technology brings additional outputs in terms of soil conservation and fertility improvements, raising the revenues at reference prices above revenues at market prices, as reflected by NPCO below the unity, at 0.95. Under policy option 2, the reverse happens. Negative environmental externalities lower revenues for the whole society below revenues of private agents, which are now, under this policy scenario, 11% above social revenues, as signaled by the NPCO at 1.11[139].

Nominal Protection Coefficient on tradable inputs (NPCI). This indicator looks at the input side of the value chain or of specific activities and compares tradable inputs assessed at market prices with the same inputs assessed at reference prices. It is computed as:

$$NPCI = \frac{B}{F}$$

The NPCI shows how many times the cost of tradable inputs at reference prices have to be multiplied to get the cost of tradable inputs for the private agents. This indicator ranges between minus infinity to plus infinity.

- An NPCI>1 indicates that the private agents pay higher prices than the opportunity costs to the society to get the inputs, thus implicitly transferring wealth to the society through the consumption of such inputs.
- An NPCI<1, indicates that producers pay less than the cost accruing to the society to use the inputs in the production process.

NPCIs are calculated for the policy option examples above, and reported in Figure 9.8. PAM values used for their calculations are highlighted.

[139] Note that here, negative externalities are accounted for as negative revenues, to ease the comparison with policy option 1.

Figure 9.8: Policy impact analysis using the NPCI: example.

Panel A: Base scenario: inefficient activity

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1300	700	0
At reference prices	1900	1250	700	-50
Wedges	100	50	0	50

NPCI
1.04

Panel B: Policy option 1 reduction of input costs and increase of factor use

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1100	800	100
At reference prices	2100	1050	800	250
Wedges	-100	50	0	-150

NPCI
1.05

Panel C: Policy option 2 increase of input cost and decrease of factor use

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market prices	2000	1500	400	100
At reference prices	1800	1600	140	60
Wedges	200	-100	260	40

NPCI
0.94

In the base scenario, the NPCI is 1.04, signaling that inputs are more expensive for private agents than for the society. This is due to taxes on inputs. NPCI > 1 occurs also under policy option 1, confirming the disincentive for the private agents to use those inputs. Under policy option 2, NPCI < 1, signaling an incentive to private agents on the input side. This reflects the subsidies that this policy option would introduce to shift the agents towards an input intensive technology.

Effective Protection Coefficient (EPC) Incentives or disincentives on the output side combine with incentives or disincentives on the input side. Indeed, in most instances, agents make their decisions on what to produce (output) and how to produce (technology, input mix) jointly. What is left in their hands to remunerate factors is the value added. Therefore, policies and market failures impinge on private decisions as long as they alter net incentives or disincentives, i.e., alter the value added. To capture the net effects on incentives or disincentives on both output and input sides the "Effective" Protection Coefficient is used. The effective protection coefficient is computed as a ratio between the value added expressed in private prices (*A* - *B*) and the one expressed at reference prices (*E* - *F*):

$$EPC = \frac{(A - B)}{(E - F)}$$

This indicator ranges between minus infinity to plus infinity.

An EPC>1 indicates that private agents enjoy a higher value added than the society, thus benefitting from a net transfer from the society to engage in such activity. This net transfer from the society acts as an incentive to engage in such activity.

An EPC<1 indicates that private agents enjoy a lower value added than the society, thus transferring in various forms portions of the value added they generate to the society. This net transfer to the society acts as a disincentive to engage in such activity.

EPCs are calculated for the policy option examples above and reported in Figure 9.9. PAM values used for the calculations are highlighted.

Figure 9.9: Policy impact analysis using the EPC: example

Panel A: Base scenario: inefficient activity

	REVENUES	COSTS		PROFITS	EPC
		Tradable Inputs	Domestic Factors		
At market prices	2000	1300	700	0	1.08
At reference prices	1900	1250	700	-50	
Wedges	100	50	0	50	

Panel B: Policy option 1 reduction of input costs and increase of factor use

	REVENUES	COSTS		PROFITS	EPC
		Tradable Inputs	Domestic Factors		
At market prices	2000	1100	800	100	0.86
At reference prices	2100	1050	800	250	
Wedges	-100	50	0	-150	

Panel C: Policy option 2 increase of input cost and decrease of factor use

	REVENUES	COSTS		PROFITS	EPC
		Tradable Inputs	Domestic Factors		
At market prices	2000	1500	400	100	2.50
At reference prices	1800	1600	140	60	
Wedges	200	-100	260	40	

In the base scenario, private agents are protected because they enjoy a higher value added than the whole society. This is signalled by the EPC > 1. This protection arises because the taxes on inputs do not offset the protection enjoyed on the output side due to the import tariff. Under policy option 1, EPC < 1, signalling net transfers from private agents to the society. This indeed occurs both on the output side, due to positive environmental externalities, which more than offset the protection generated by the import tariff, and on the input side, due to taxes on inputs. Policy option 2 completely changes the situation. The EPC is well above the unity (at 2.50), signalling a very high protection of private agents. This occurs due to the concurring protection on the output side, due to unpaid negative environmental externalities and import tariffs and on the input side, due to input subsidies.

9.6. Other protection indicators

Other indicators bases on PAM values help analysts to gain a more precise picture of the impacts of various policy options. These include, for instance, the Domestic Factor Ratio (DOFAR) or the Subsidy Ratio to Private Agents (SURPA), presented here below.

Domestic Factors Ratio (DOFAR). In some cases, private agents may receive incentives to hire specific production factors. For instance, to promote employment, hiring of specific categories of employees, e.g., young workers, females, workers to be redeployed, veterans etc, may be subsidized. This implies that the wages paid by private agents are below the opportunity cost of labour. In other cases, the cost of factors faced by private agents may exceed their opportunity cost for the society as, for instance, labour may be taxed, minimum wages may be imposed or other forms of labour pricing mechanisms may push the wages above the opportunity cost of labour. In any case, factor costs to private agents may diverge from factor costs to the society. In addition, policy measures affecting the factor mix or shifting factor prices may increase or reduce the wedge for factor costs. The Domestic Factors Ratio, computed as a ratio between the factor costs expressed at private prices (C) and factor costs expressed at reference prices (*G*), captures these divergences:

$$\mathrm{DOFAR} = \frac{\mathrm{C}}{\mathrm{G}}$$

This indicator ranges between minus infinity to plus infinity.

- DOFAR>1 indicates that private agents pay higher factor costs than the society, thus transferring wealth to the society. This net transfer to the society acts as a disincentive to engage in such activity requiring those factors.

- DOFAR<1 indicates that private agents enjoy lower factor prices than the society, thus receiving transfers from the society.

DOFAR=1 indicates that private agents remunerate factors at their social opportunity cost.

DOFARs are calculated for the policy option examples above, and reported in Figure 9.10. PAM values used for the calculations are highlighted.

Figure 9.10: Policy impact analysis using DOFARs: example

Panel A: Base scenario: inefficient activity

	REVENUES	COSTS		PROFITS	DOFAR
		Tradable Inputs	Domestic Factors		
At market prices	2000	1300	700	0	1.00
At reference prices	1900	1250	700	-50	
Wedges	100	50	0	50	

Panel B: Policy option 1 reduction of input costs and increase of factor use

	REVENUES	COSTS		PROFITS	DOFAR
		Tradable Inputs	Domestic Factors		
At market prices	2000	1100	800	100	1.00
At reference prices	2100	1050	800	250	
Wedges	-100	50	0	-150	

Panel C: Policy option 2 increase of input cost and decrease of factor use

	REVENUES	COSTS		PROFITS	DOFAR
		Tradable Inputs	Domestic Factors		
At market prices	2000	1500	400	100	2.86
At reference prices	1800	1600	140	60	
Wedges	200	-100	260	40	

In the base scenario and under policy option 1, no divergences arise between factor costs at market and reference prices, as signaled by DOFAR=1. Under policy option 2, factors, notably labour, are heavily taxed, shifting up the burden of factor costs to private agents. This is signaled by the DOFAR well above the unity, at 2.86. Note, however, that taxes on factor costs are not high enough to countervail the negative environmental externalities, the tariffs on imports and input subsidies, leaving higher extra-profits to private agents (100 MU) than to the society as a whole (60 MU), as indicated by the positive wedge on extra-profits (40 MU). An indicator, such as the Subsidy Ratio to Private Agents (SURPA), that captures the net (joint) effect of policies and/or market failures on revenues, inputs and factors altogether may be useful to provide a consolidated picture of transfers.

Subsidy Ratio to Private Agents (SURPA)[140]. This indicator measures the net transfer to private agents as a proportion of the total revenues at reference prices. It is computed as:

$$SURPA = \frac{L}{E}$$

It is interpreted as the net transfer per Monetary Unit (MU) of output valued at reference prices, or, analogously, as the share of revenues accruing to the society transferred to private agents. As it is based on the wedge on extra profits it provides a consolidated measure of positive and negative transfers occurring on revenue, inputs and factors sides.

As net transfers may virtually exceed in absolute terms the revenue accruing to the society, i.e., revenue at reference prices, this indicator virtually ranges between minus infinity to plus infinity, although values in the range $-1<SURPA<1$ are more likely.

- A SURPA>0 indicates that private agents enjoy net transfers from the society, which act as an incentive to engage in such activity.
- A SURPA<0 indicates that private agents provide net transfers to the society, which act as a disincentive to engage in such activity
- A SURPA=0 indicates that no net transfers occur.

SURPAs are calculated for the policy option examples above, and reported in Figure 9.11. PAM values used for the calculations are highlighted.

[140] The Subsidy Ratio to Private Agents (SURPA), denominated as Subsidy Ratio to Producers (SRP) is presented in Monke and Pearson (1989).

Figure 9.11: Policy impact analysis using SURPAs: example

Panel A: Base scenario: inefficient activity

	REVENUES	COSTS		PROFITS	SURPA
		Tradable Inputs	Domestic Factors		
At market prices	2000	1300	700	0	0.026
At reference prices	1900	1250	700	-50	
Wedges	100	50	0	50	

Panel B: Policy option 1 reduction of input costs and increase of factor use

	REVENUES	COSTS		PROFITS	SURPA
		Tradable Inputs	Domestic Factors		
At market prices	2000	1100	800	100	-0.071
At reference prices	2100	1050	800	250	
Wedges	-100	50	0	-150	

Panel C: Policy option 2 increase of input cost and decrease of factor use

	REVENUES	COSTS		PROFITS	SURPA
		Tradable Inputs	Domestic Factors		
At market prices	2000	1500	400	100	0.022
At reference prices	1800	1600	140	60	
Wedges	200	-100	260	40	

Note that in the base case, private agents just break even, while the society makes losses. This implies an implicit transfer from the society to private agents, signalled by the SURPA=0.026. Under policy option 1, both private agents and the society make extra-profits, but extra-profits are larger for the society, implying a net transfer from private agents to the society, as signalled by the negative SURPA = -0.071. Under policy option 2, the reverse applies, as the SURPA=0.022 signals a net transfer from the society to private agents.

9.7. A synoptic view of PAM indicators for policy impact analysis

As the different indicators proposed in the previous sections provide different information about the relationships between private agents and the society as a whole and about the extent to which the various policy options affect these relationships, it is advisable to make use of the whole range of indicators. A synoptic table, proposed in Figure 9.12, may help to simultaneously look at the various dimensions highlighted by the different indicators.

Figure 9.12. Synoptic table of PAM-based indicators

Indicator	Acronym	Base scenario	Policy option 1 Factor intensive technology	Policy option 2 Input intensive technology
Private Cost Ratio	PCR	1.00	0.89	0.80
Private Value Added Ratio	PVAR	0.35	0.45	0.25
Domestic Resource Cost Ratio	DRC	1.08	0.76	0.70
Social Value Added Ratio	SVAR	0.34	0.50	0.11
Nominal Protection Coefficient on Outputs	NPCO	1.05	0.95	1.11
Nominal Protection Coefficient on Inputs	NPCI	1.04	1.05	0.94
Effective Protection Coefficient	EPC	1.08	0.86	2.50
Domestic Factors Ratio	DOFAR	1.00	1.00	0.86
Subsidy Ratio to Private Agents	SURPA	0.026	-0.071	0.022

From this synoptic table of summary indicators it is possible to see that, overall, policy option 1 increases the profitability both for private agents and the society as a whole. This is signalled by the reduction of both the Private Cost Ratio (PCR) and the Domestic Resource cost Ratio (DRC) with respect to the base scenario. This implies that, on the private side, there is room for remunerating factor costs above the market prices. If owners of factors (e.g., workers or land owners) are able to extract extra-profits from the entrepreneurs they can enjoy higher remunerations than in the base scenario. On the other side, the society has an interest to employ scarce factors in that activity under policy option 1. Note also that the value added intensity increases both at market and reference prices (PVAR and SVAR respectively). Probably, more multiplier effects *via* domestic expenditure have to be expected under policy option 1 than in the base-scenario, due to a higher proportion of revenue left to remunerated domestic factors. For policy option 2, the opposite considerations than policy option 1 hold. In addition, the protection on the input side, which is negative in the base case scenario (NPCI greater than 1), materializes under policy option 2 (NPCI lower than 1).

Regarding the protection enjoyed by private agents, it is apparent that, in the base scenario and under policy option 2, private agents are protected, as revealed by the NPCO>1, the EPC>1 as well, the DOFAR<1 (for option 2), and the SURPA, which consolidates the protection on the different components, greater than zero. Under policy option 1 instead, the private producers face negative protection (NPCO <1, NPCI >1, EPC<1 society benefits more than private agents, as revealed by SURPA<1.

Overall, other things equal, policy option 1 ranks superior as both private and social profitability are greater than in the base case and under policy option 2. Policy option 1 indeed increases incentives to private agents to engage in the activity while also increasing the advantages to the society as a whole.

Table 9.4 provides a summary of the PAM-based indicators presented above.

Table 9.4. Summary of PAM-Based indicators

Policy Analysis Matrix - Based Indicators		
Indicator	**Description**	**Boundaries**
	Profitability and value added indicators	
PCR	Private Cost Ratio is the ratio of domestic factor costs to the value added created *at market prices*. PCR is the share of value added absorbed by the remuneration of factors *at market prices*	Assuming that the Value Added is positive and the remuneration of domestic factors is non-negative, the PCR ranges between zero, and, virtually, infinity.
PVAR	Private Value Added Ratio indicates the contribution of an activity to domestic value added generation *at market prices*; it could also be considered as the value added intensity of an activity.	Assuming positive revenues and positive traded (intermediate) inputs are not greater than the revenues, PVAR ranges between 0 and 1.
DRC	Domestic Resource Cost ratio is the ratio between the domestic factor costs *at reference prices* and the value added at reference prices. DRC provides information on the capacity of the specific activity to generate extra domestic value added beyond the amount of value added required to remunerate factors at their opportunity costs.	Assuming that the value added at reference prices is positive and the remuneration of domestic factors is non-negative, the DRC ranges between zero, and, virtually, infinity.
SVAR	Social Value Added Ratio is the share of value added (including extra-profits) in the revenues, valued *at reference prices*.	Assuming that positive revenues and positive traded (intermediate) inputs are not greater than the revenues , SVAR ranges between 0 and 1.
	Protection indicators	
NPCO	Nominal Protection Coefficient on Outputs compares revenues at market prices with revenues at reference prices; It shows how many times social revenues have to be multiplied to get private revenues.	Assuming that revenues are positive at market and at reference prices, NPCO ranges between 0 and infinity.
NPCI	Nominal Protection Coefficient on tradable inputs looks at the input side of the value chain or of specific activities and compares tradable inputs assessed at market prices with the same inputs assessed at reference prices; it shows how many times the cost of tradable inputs at reference prices have to be multiplied to get the cost of tradable inputs for the private agents.	Assuming that traded intermediate inputs are positive at market and at reference prices, NPCI ranges between 0 and infinity.
EPC	Effective Protection Coefficient is computed as a ratio between the value added expressed in private prices and the one expressed at reference prices.	EPC ranges between minus infinity and plus infinity.
	Other indicators	
DOFAR	Domestic Factors Ratio is computed as a ratio between the factor costs expressed at private prices and factor costs expressed at reference prices; DOFAR shows for example if the cost of factors faced by private agents exceed their opportunity costs for the society or not.	DOFAR ranges between minus infinity and plus infinity.
SURPA	Subsidy Ratio to Private Agents measures the net transfer to private agents as a proportion of the total revenues at reference prices. It is interpreted as the net transfer per Monetary Unit (MU) of output valued at reference prices, or, analogously, as the share of revenues accruing to the society transferred to private agents. As it is based on the wedge on extra profits it provides a consolidated measure of positive and negative transfers occurring on revenue, inputs and factors sides	As net transfers may virtually exceed in absolute terms the revenue accruing to the society, i.e., revenue at reference prices, SURPA virtually ranges between minus infinity to plus infinity, although values in the range -1<SURPA<1 are more likely.

Table 9.5 provides a synoptic view of PAM indicators for selected value chain analyses carried out in different countries in recent years for policy impact assessment.

Table 9.5. PAM indicators for selected country cases.

Country	Value Chain	Year	Policy Measure	PCR		PVAR		DRC		SVAR		NPCO		NPCI		EPC		DOFAR		SURPA	
				WoP	WiP	WoP	WiP	WoP	WiP	WoP	WiP	WoP	WiP	WoP	WiP	WoP	WiP	WoP	WiP	WoP	WiP
Burkina Faso	*Rice*	*2010*	increase the use of HQ seeds and extension of the rice-growing area	0.68	0.59	0.91	0.88	0.95	0.80	0.90	0.87	0.98	0.98	0.91	0.91	0.99	0.99	0.70	0.74	0.24	0.17
	Fisheries	*2010*	increase the purchase of fish eggs and ehance the human capital through specialized trainings to the fishermen	0.69	0.70	0.58	0.58	1.93	1.93	0.17	0.17	1.32	1.32	0.67	0.67	4.45	4.45	1.61	1.60	1.60	0.38
	Firewood	*2008*	improve the management and productivity of the forests	0.42	0.42	0.90	0.90	0.10	0.08	0.97	0.97	0.40	0.40	1.45	1.42	0.37	0.53	1.57	1.96	-0.66	-0.68
Kenya	*Sugarcane*	*2009*	increase the number of the extension agents	0.67	0.62	0.89	0.90	0.84	0.74	0.87	0.89	1.23	1.23	0.99	1.13	1.26	1.24	1.01	1.05	0.22	0.17
	Cotton	*2009*	increase the use of HQ seeds through subsidies	0.98	0.79	0.89	0.82	1.03	0.83	0.87	0.80	1.02	1.02	0.91	0.92	1.04	1.05	0.99	0.99	0.04	0.04
	Mango	*2009*	establishment of producer marketing organizations (collective marketing) - input at lower prices	0.24	0.21	0.96	0.97	0.17	0.27	0.95	0.97	0.82	1.15	0.95	0.99	0.81	1.16	1.02	1.02	0.14	-0.18
Nigeria	*Cassava*	*2013*	no policies	0.39		0.61		0.39		0.61		1.00		1.00		1.00		1.00		0.00	
Ecuador	*Bananas*	*2013*	Conventional scenario / Organic scenario	0.34	0.36	0.72	0.72	0.37	0.36	0.72	0.72	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.99	0.02	0.00
Syria	*Fisheries*	*2010*	no policies	0.79		0.26		0.63		0.34		0.87		0.97		0.68		0.85		-0.07	
	Cotton	*2010*	re-introduction of the cotton seeds in the chain	0.48	0.32	0.82	0.87	1.95	1.02	0.52	0.67	2.31	2.21	0.87	0.87	3.62	2.85	0.89	0.89	1.48	1.33
	Potatoes	*2010*	no policies	0.42		0.66		0.36		0.76		0.70		0.97		0.61		0.71		-0.21	
	Haricot	*2010*	no policies	0.30		0.80		0.48		0.79		0.96		0.94		0.97		0.61		0.12	

9.8. Assessing policy impacts with PAMs. A real-case example from Burkina Faso

Firewood consumption in Burkina Faso poses problems related to the sustainable exploitation of national forests as illustrated in Box 3.2. To cope with the demand pressure, a policy measure aimed at improving the management and the productivity of forests has been considered by the government, as explained in Box 5.1.

To evaluate how this policy measure could impact private agents and the society as whole, the analysts used the Policy Analysis Matrix, among other tools. This framework helps to see the profitability of the firewood value chain comparing the private agents' perspective with the perspective of the society, using market prices and reference prices respectively. PAMs indeed, allow analysts to measure the effects of divergences between the two different perspectives due to market failures and/or missing policies. On the basis of the same data sources used in Box 5.1, two PAMs for the base scenario (Without Policy –WoP) and a With Policy (WiP) scenario respectively, have been built, and are reported in Table 9.5.

Table 9.5: PAMs of firewood policy impact analysis in Burkina Faso

	Revenues*	Tradable Inputs*	Domestic factors *	Profits*
WoP Scenario				
At market prices	1,214	119	468	625
At reference prices	3,009	83	297	2,628
Wedges	-1,795	37	171	-2,003
WiP Scenario				
At market prices	1,836	181	709	945
At reference prices	4,552	128	362	4,063
Wedges	-2,716	53	347	-3,118

*Total values expressed in millions of FCFA. Source: Adapted by the author on the basis of the EASYPol series 106[141]. WoP and WiP refer to the scenarios without and with the forest management policy (see Box 5.1)

To compute the reference price of firewood, which is a non-traded good, analysts may assume as a reference point the international price of the butane gas, a relatively close tradable substitute. In addition, they may take into consideration the negative externalities generated by firewood use related to deforestation. As reported in Box 5.1, inputs are mainly related to transportation activities; their reference prices have been computed with the methodology explained in Chapters 7 and 8 of these guidelines.

As Table 9.5 shows, private agents in the firewood value chain earn positive profits both under the WoP as well under the WiP policy scenarios. Moreover, higher profits under the WiP scenario signal that there is a potential to include more private agents (farmers, middlemen, processors, etc.,) in the value chain, once forests are properly managed, and/or to increase the welfare of already involved agents. Also profits accruing to the society as a whole are positive in both the scenarios. However, the profit wedge between private and social profits highlights that there is an implicit net transfer of income from private agents to the society, which increases in the WiP scenario.

By using some summary indicators helps analysts better understand the profitability and the protection of the firewood value chain and how the policy measure aimed at improving the management and productivity of forests could actually improve the value chain (Table 9.6).

[141] VV.AA., 2007. *Analyse des impacts financiers et economiques de la filiere bois-energie organisee approvisionnant la ville de Ouagadoungou*, Module EASYPol 106, FAO.

Table 9.6: Selected PAM indicators

	WoP Scenario	WiP Scenario	Variation
Selected Profitability and value added Indicators			
Private profits: WiP/WoP variation	625	945	51.20%
Social Profits: WiP/WoP variation	2,628	4,063	54.60%
Private Cost Ratio (PCR)	0.427	0.428	0.001
Private Value Added Ratio (PVAR)	0.901	0.901	0.000
Domestic Resource Cost Ratio *(*DRC)	0.102	0.082	-0.020
Protection Indicators			
Nominal Protection Coeff. on Output (NPCO)	0.403	0.403	0.000
Nominal Protection Coefficient on Input (NPCI)	1.434	1.414	-0.020
Effective Protection Coefficient (EPC)	0.374	0.374	0.000
Subsidy Ratio to Private Agents (SURPA)	-0.666	-0.685	-0.019

*Total values expressed in millions of FCFA. Source: Adapted by the author on the basis of the EASYPol series 106[142]. WoP and WiP refer to the scenarios without and with the forest management policy (see Box 5.1).

The *Private Cost Ratio (PCR)* shows that the value chain creates positive extra-profits in the hands of private agents in both WoP and WiP scenarios, with values of 0.427 and 0.428, respectively. This signals that 42.7% and 42.8% of the (implied-domestic) value added is absorbed to remunerate factors at market prices, while the remaining part is left for extra-profits.

The high value of the *Private Value Added Ratio (PVAR)* highlights that both under the WoP and WiP scenarios few intermediate imported inputs are used and about 90% of the revenues translate into value added. Therefore, the firewood value chain is largely value added-intense, with a large part of value added left to extra-profits[143]. Whereas the *Domestic Resource Cost Ratio (DRC)* measures the comparative advantage of the chain, comparing the costs of domestic factors with the difference between the revenues and the tradable inputs at the reference price. Considering the lower value of the DRC for the scenario with policy (0.082 *versus* 0.102 without policy), it can be concluded that this policy measure brings more efficiency to the system, meaning that proportionally, extra profits are accruing to the society.

It is important to analyze the divergence between private and social profitability. This analysis allows analysts to understand that the social profitability is much higher than the private

[142] VV.AA., 2007.: *Analyse des impacts financiers et économiques de la filière bois-énergie organisée approvisionnant la ville de Ouagadougou*, EASYPol series 106, FAO.
[143] As we are considering here the aggregate PAM for the whole value chain, it is not possible to look at the way the value added is

profitability, as signalled by the DRC, which is much lower than the PCR. It appears that this divergence is mainly due to the fact that revenues at market prices are much lower than revenues at reference prices, as signalled by the NPCO, which is well below the unity in both the WoP and WiP cases. Therefore private agents are negatively affected by the current setting of the output market.

Considering the input side, the *Nominal Protection Coefficient on tradable inputs (NPCI)* shows that current policy and market settings increase the market prices for tradable inputs above their social opportunity costs (more than 40%), implicitly transferring wealth from input users to the society. This effect is slightly lower once the forest management policy is on.

The *Effective Protection Coefficient (EPC)* with a value of 0.374 for both scenarios without and with policy, signals that the value chain is implicitly or explicitly transferring money to the society, due to the cumulated effects on the output and input sides.

The *Subsidy Ratio to Private Agents* (SURPA), for both WoP and WiP scenarios, shows to what extent the private agents are providing net transfers to the society. Values ranging between -0.66 and -0.69 in the WoP and WiP scenarios respectively, signal that slightly less than 70% of the value generated by the firewood value chain is not enjoyed by the agents involved but is implicitly transferred to the society as a whole. This fact most likely acts as a disincentive to private agents to get involved in the firewood value chain.

9.9. Expanded PAMs

Given the complexity of actual socio-economic systems within which value chains develop and the interdependencies among changes induced by specific policies in different parts of the economy, it is difficult to quantify the extent to which specific policies or market failures determine the wedges between revenues and costs at market and reference prices and how new policies would modify these wedges[144]. As a matter of fact, in real life, economic agents receive incentives or dis-incentives to carry out specific activities from various interrelated sources, such as:

a. "Autonomous" shifts in prices of outputs, inputs and factors. This refers to changes in value chain-relevant prices due to changes in prices of complements or substitutes, shifts in consumers' income, changes of tastes etc...
b. Commodity-sector specific price policies directly affecting value chain-relevant output and input prices.
c. Features of input-output markets and related changes. This refers to factors affecting the relative position of the agent with respect to surrounding economic partners (customers, suppliers), such as entrance, exit, consolidation, transformation of partners in the economic

[144] This is particularly true whenever reference prices are calculated without the support of a comprehensive model of the socio-economic system under investigation.

sector-segment in which the agent operates, including mono-oligopolies, mono-oligopsonies and other market features allowing for rent-seeking behaviours.

d. Changes in infrastructural services available to the agent, such as transport and communication networks, changes in the provision of other public goods.

e. Commodity-sector specific policies affecting technological choices, portfolios of technological options, technical progress etc.

f. Macro-economic policies affecting all the above and in particular exchange rates, interest rates, inflation.

g. External shocks (external to the economic system) affecting all the above, such as international price shocks, natural-climatic events, etc.

h. Other sources of incentives or disincentives (context-specific, such as geo-political geo-strategic changes etc).

An attempt to disentangle some of these effects can be carried out in the PAM context, by adopting an "*Expanded policy Analysis Matrix*"[145], where the "total" wedges calculated in the previous section are split in different components through the identification of specific elements influencing the calculation of reference prices. These elements can be, for instance:

a. Domestic or international policies (including missing policies at both levels) influencing international market prices (CIF or FOB prices to the country).

b. Policies and market failures influencing the exchange rate.

c. Import-export price policies (e.g., tariffs, export taxes) or non-tariff border policies (e.g., quotas or other tariff-equivalent restrictions).

d. Policies and market failures affecting market access costs, e.g., excessive transport costs, (with respect to somewhat established "standard" costs somehow reflecting "efficiency" transport costs), for instance from the border to the domestic market, thus raising domestic prices of imported goods and protecting domestic producers, or from the production sites to the border, thus protecting domestic consumers, or from the production sites to domestic markets, acting as disincentive for domestic producers[146].

e. Positive or negative externalities of production or consumption, acting as incentives or disincentives.

f. Direct monetary transfers from/to the public budget, associated to specific products, or production processes or categories of producers.

g. Lower or higher domestic quality requiring price adjustments to make the value of domestic products compatible with international standards.

[145] Monke and Pearson, 1989, p. 22, adopt this terminology for an expanded matrix in which the total wedge is split in three components to reflect effects of market failures, effects of "distorting" policies (policy failures) and the effects of "efficient" policies i.e. policies aimed at offsetting the effects of market failures.
[146] Different combinations of these situations and other ones are possible in practice, giving rise to either incentives or disincentives to domestic producers.

h. Other "residual" factors introducing wedges between "observed" market prices and reference prices.

Each of the above elements contributes to generate the total wedge. Output, input and factor values can be calculated using different reference prices configurations reflecting the absence or presence of each element or combinations of specific elements. Taking the differences between output, input and factor values calculated with different price configurations give rise to partial wedges associated to one or more of the elements listed above. The difference between the sum of the partial wedges and the total wedge gives a "residual wedge", i.e., the "unexplained" wedge component of the total wedge. As an example, assume for instance that two sets of reference prices for outputs and inputs are calculated. For the first set we adopt the market (observed) FOB-CIF prices, reflecting missing national negotiating policies on non-competitive international markets, while for the second set of reference prices we adopt "adjusted" FOB-CIF prices estimated to somehow reflect the implementation of more effective national negotiating policies on international markets. The difference between revenues and costs calculated with the two different sets of prices gives partial wedges of revenues and costs due to an "efficiency" adjustment of international prices (the "international price adjustment wedges"). A residual wedge can then be calculated as the difference between the total wedges and the "international price adjustment wedges". Therefore, by construction, total wedges result as:

Total wedges = International price adjustment wedges + residual wedges.

Analogous procedures can be adopted for instance using two sets of prices not adjusted and adjusted for "efficiency" transport costs respectively, allowing analysts to calculate an "efficiency in market access" wedge, or sets of reference prices not adjusted and adjusted for environmental externalities, allowing analysts to also calculate "environmental externalities wedges). If these computations are carried out for various adjustments, the total wedges can be decomposed for instance as:

Total wedges = International price adjustment wedges + exchange rate adjustment wedge + border policies wedges + efficiency in market access wedges + environmental externalities wedges + quality adjustment wedges + residual wedges.

Analysts may carry out analyses adopting more or less refined decompositions of wedges depending on the supposed greater or lesser degree of subjective judgement required to calculate selected adjustments to reference prices.[147] Analysts are then left with the possibility to calculate PAM indicators adopting different wedge and reference prices configurations, e.g.,

[147] For instance, it is a relatively uncommon practice to adjust international FOB-CIF prices using the argument of "missing national negotiating policies with international counterparts" while, for some reasons it is more common to adjust domestic transport costs using the argument of "inefficient" or "below achievable standards" transport costs.

SURPA based on wedges that include or exclude environmental externalities or EPCs based reference prices which include or exclude international price adjustments.

In any case, whatever the degree of subjectivity analysts are ready to introduce in the analysis, splitting the wedges as illustrated above, while possibly providing additional information on the origin of inefficiencies affecting a specific value chain, which also implies adopting strong assumptions about the additive nature of the partial wedges. This has not to be taken for granted at all, at least not under normal circumstances, in complex economic systems where markets and policy failures, including missing "efficient" policies, interplay with changing agents' behaviours. This implies for instance that, if a tariff on an imported good is removed, the new price on the domestic market after removing a tariff will never be the previous price minus the tariff. The new price will be determined by a set of interacting factors such as the possible shift of the exchange rate, the reaction of domestic producers, shifts on interest rates due to changes in the budget deficit or surplus, and so on.

9.10. How to deal with protection pass-through between agents

In the PAM methodology, the wedges between the revenues and costs at domestic market prices and revenues and costs at reference prices are generally computed at production and wholesale levels by using observed prices at both levels. While the reference price of traded goods and services is computed on the basis of border prices, for non-traded goods and services this computation normally relies on the sum of opportunity costs of intermediate inputs and factor costs. These indeed are split into tradable inputs and domestic factors, as explained in the previous sections.

This implies that the PAM referring to the production of a non-traded good will always show zero extra-profits at reference prices. Here, we show that the Effective Protection Coefficient (EPC) fails to capture the transfer that arises when an agent manages to extract some protection from a downstream or upstream agent, see the example provided. Let us consider two types of agents operating in the value chain of sugar: the sugarcane producer and the sugar plant. In the computation of the PAM for each of the two agents the cost of sugarcane enters the PAM of the sugar plant split into its tradable and non-tradable components, as it results from the PAM of the sugarcane producer, since the sugarcane is one of the inputs of sugar production (amounts in red). The two PAMs are then displayed in Figure A.1:

Figure A.1: Policy Analysis Matrix in the base scenario

Sugarcane Producer

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
Market Prices	120	30	80	10
Reference Prices	110	40	70	0
Wedges	10	-10	10	10

Sugar Plant

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
Market Prices	1000	200+30 = 230	500+80+10= 590	180
Reference Prices	800	200+40= 240	500+70= 570	-10
Wedges	200	-10	20	190

In the base scenario, the sugarcane producer enjoys revenue of 120 MU. Both the sugarcane producer and the sugar plant enjoy higher revenues and higher profits than the society as a whole. Let us assume that this is due to the fact that domestic market prices of both sugarcane and sugar are higher than their social values due to an import tariff on sugar, protecting the domestic sugar value chain. Now, suppose that, all other things being equal, the sugarcane producer, under a scenario reflecting the adoption of a policy measure aimed at increasing his negotiating capacities, is able to sell the sugarcane to the sugar producer at a higher price, say at 130 MU. This reduces the sugar plant's profits. This situation is reflected in the policy scenario illustrated by the PAMs in Figure A.2. The Effective Protection Coefficient (EPC) is computed in Figure A.3.

Figure A.2: Policy Analysis Matrix : policy scenario

Sugarcane Producer

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market Prices	130	30	80	20
At reference Prices	110	40	70	0
wedges	20	-10	10	20

Sugar Producer

	REVENUES	COSTS		PROFITS
		Tradable Inputs	Domestic Factors	
At market Prices	1000	200+30 = 230	500+80+20= 600	170
At reference Prices	800	200+40= 240	500+70= 570	-10
Wedges	200	-10	30	180

Figure A.3: Effective Protection Coefficients

	SUGARCANE PRODUCER	SUGAR PLANT	VALUE CHAIN
BASE SCENARIO	1.29	1.37	1.37
POLICY SCENARIO	1.43	1.37	1.37

The EPC of the sugarcane producer under the policy scenario is higher than the one in the baseline situation, because part of the protection enjoyed by the sugar plant has been transferred to the sugarcane producer. Surprisingly enough, this same transfer is not captured by the EPC of the sugar producer, which in turn stays unchanged, even though the profits of the sugar producer have decreased.

Therefore, the Effective Protection Coefficient calculated at different levels of the value chain may not properly reveal the change induced in the value chain by a policy. Futhermore, other widely used indicators in the PAM framework, such as the Domestic Resource Ratio (DRC), would fail to capture this change at sugar producer level, because it does not imply any change in the reference prices.

To detect the extent to which the protection enjoyed by the whole value chain extends to the different agents in the chain, it is advisable to look at the Private Cost-Benefit Ratio (PCBR), which is a profitability indicator, defined as:

$$PCBR = \frac{A}{B + C}$$

The calculation highlights the level of revenues with respect to costs.

- If PCBR>1, the private agent enjoys extra-profits.
- If PCBR<1, the private agent is making a loss.
- If PCBR=1, the agent just breaks even.

If, other things being equal, *A* increases (decreases) the PCBR increases (decreases) as well. Once assessed through the EPC the overall protection of the chain, the PCBR calculated for all the segments of the chain signals the extent to which this protection spreads along the chain and how a policy option changes the situation. In Figure A.4 the PCBR for the example above is reported. As the sugarcane producer sells now its output to the sugar plant at a higher price (130 as opposed to 120), its profitability increases, while the profitability of the sugar pant decreases, as reflected by changes in the respective PCBRs.

Figure A.4: PCBR indicator in the two scenarios

	SUGARCANE PRODUCER		SUGAR PLANT	
	Base scenario	Policy Scenario	Base scenario	Policy Scenario
PCBR=A/(B+C)	1.09	1.18	1.21	1.20

10. GLOSSARY TO THE GUIDE

Activities
A number of activities may be undertaken along a value chain, such as: production of primary commodities, processing, delivery, wholesaling, retailing, consumption of one/many final outputs.

Agent
An economic agent is defined as the basic unit operating in the value chain. It can be a physical person (farmer, trader, consumer, etc) or a legal entity (a business, an authority, a development organization). Most often, we call “agent” a group of individuals sharing common characteristics. For example, the agent "farmer" can refer to all farmers, the agent "trader" to all traders, and the agent “rest of the world" to all economic agents located outside of the national border.

Fixed asset consumption
The timing of consumption of fixed capital is inextricably linked with the question of its valuation. Consumption of fixed capital is a cost category that accrues over the whole period the fixed asset in question is available for productive purposes. The exact proportioning to accounting periods depends on the rate of depreciation (System of National Accounts, 2008).

Free Entry/Exit into markets
A situation where a firm is free to enter and exit an industry without incurring sunk costs (costs that are specific to the industry and cannot be recuperated, such as trainings to make human capital apt, and others) or other barriers.

Market
It is the physical or virtual place where sellers and buyers meet to exchange goods and services.

Market price
Market prices for transactions are defined as amounts of money that willing buyers pay to acquire something from willing sellers; [..] Thus, according to this strict definition, a market price refers only to the price for one specific exchange under the stated conditions. A market price defined in this way is to be clearly distinguished from a price quoted in the market, a world market price, a going price, a fair market price, or any price that is intended to express the generality of prices for a class of supposedly identical exchanges rather than a price actually applying to a specific exchange. Furthermore, a market price should not necessarily be construed as equivalent to a free market price; that is, a market transaction should not be interpreted as occurring exclusively in a purely competitive market situation. In fact, a market transaction could take place in a monopolistic, monopsonistic, or any other market structure.
Indeed, the market may be so narrow that it consists of the sole transaction of its kind between independent parties (System of National Accounts, 2008).

Monopoly
It describes the market where a single agent is the only supplier of a particular commodity or service, which sets the price of the service/commodity traded (so called "price maker"), is profit maximizer and put entry barrier to the market.

Monopsony
It is the situation in which only one buyer faces many sellers, controlling the market for its suppliers in the same way a monopolist does with its buyers.

Oligopoly
It describes a market form in which the industry (i.e. the sector) is dominated by a small number of firms that are "price setters". Each firm has a market share and their interaction can lead to different competitive equilibria.

Oligopsony
It is the situation in which the number of buyers is small and they face many sellers.

Perfect competition
It describes the market where a large number (virtually infinite) of economic agents (buyers/sellers) trade small quantities, thus having no power to set the price of the service/commodity traded (they are so called "price takers"). In perfect competition, price is determined by the interaction of total demand and total supply of a good/service. It reflects information about both supply and demand sides, such as scarcity and consumers' preferences. Other features of a competitive market are: homogeneity of products traded and no costs associated to entry/exit into/from the market or to make transactions.

Perfect competition equilibrium implies: (i) efficient allocations of resources among alternative uses, (ii) zero profits in the long run equilibrium, (iii) market prices that reflect both resource scarcity and consumers' preferences.

Private Price
Private prices are the prices (expressed in monetary terms) used by different agents to purchase (sell) their inputs and domestic factors (outputs).

Property rights
The right of the owner of a property (such as: real property (land), personal property (physical possessions belonging to a person), private property (property owned by legal persons or business entities), or intellectual property (exclusive rights over artistic creations, inventions) to consume, sell, rent, mortgage, transfer, exchange or destroy their property, and/or to exclude others from doing these things, are recognized and enforceable.

Reference Price

Reference prices are the price (expressed in monetary terms) that reflect the value the society attaches to inputs, domestic factors and output as they were not modified by market imperfections and/or policy failures.

Transaction costs

The costs incurred when exchanging goods/services on the market, such as: contract enforcement costs, search and information costs, commissions to intermediaries.

Value added

Value added is a measure of wealth created in an economic system by a production process, net of the resources that were consumed in the process. Therefore, value added can be thought of as what results from a production process that is not merely self-preserving but actually generating new wealth. The gross domestic product (GDP) of a country is actually an aggregate measure of value added (gross of depreciation) and its per capita value is taken as a primitive measure of economic development.

The System of National Accounts, 2008 defines **Gross value added** the value of output less the value of intermediate consumption and **Net value added** the value of output less the values of both intermediate consumption and consumption of fixed capital.

Value chain

The term “value chain” refers to a set of vertically linked economic agents, where each agent is customer of an upstream agent belonging to the chain as well as supplier of a downstream agent belonging to the chain. These agents contribute directly to the production, processing and delivery of a commodity, through the different stages that add value to the country’s resources. Thus, a value chain starts with the producer of a primary commodity and ends with the consumer of a final product.

Within a single value chain, “sub-chains” can be identified on the basis of the processing techniques or uses of the primary output. For example, within the rice value chain, two different sub-chains can be identified on the basis of the processing technique: on-farm husked rice or industrial processed rice., whereas in the cotton value chain, two main sub- chains can be identified on the basis of the output: cotton fibber production and cotton seeds production.

11. References

African Economic Outlook, 2012. *Zimbabwe. African Development Bank Group, United Nations Economic Commission for Africa*, UNECA, 2012. *http://www.africaneconomicoutlook.org*

Agence des Participations de l'Etat, 2008. Report 2008 : French State as a Shareholder. Ministère de l'Économie, de l'Industrie et de l'Emploi, Paris, 2008.

Akerlof, G., 1970. The market of lemons, uncertainty and the market mechanism, Quarterly Journal of Economics. *http://www.jstor.org/stable/pdfplus/1879431.pdf?acceptTC=true*

Altman, D., 2006. Managing globalization, *In: Q & Answers with Joseph E. Stiglitz*, Columbia University and The International Herald Tribune, October 11, 2006.

Anneli Lagman-Martin, 2004. *Shadow exchange rates for project economic analysis: Toward improving practice at the Asian Development Bank*, ERD Technical Note Series, Asian Development Bank.

Arias, P., Dankers, C., Liu P., and Pilkauskas P. 2003. *The world banana economy 1985-2002*, Food and Agriculture Organization of the United Nations, Rome, Italy, *http://www.fao.org/docrep/007/y5102e/y5102e00.htm*

Athukorala,W., *et al*. 2010. Determinants of health costs due to farmers' exposure to pesticides: an empirical analysis, *Journal of Agricultural Economics, Volume 63, Issue 1, pages 158–174, February 2012*

Baumol, W.J., 1972. On taxation and the control of externalities, *American Economic Review, 62(3), pp. 307-322.*

Bellaver, C., 2002. *Guidelines for good agricultural practices*, Food and Agriculture Organization of the UN – EMBRAPA, Brasilia http://www.fao.org/prods/gap/DOCS/PDF/Guidelines_for_Good_Agricultural_Practices.pdf

Bellù, L.G., 2010. Mimeo, *Incentives-disincentives in transnational value chains: the example of Burkina Faso*, Food and Agriculture Organization of the UN, Rome, Italy.

Bellù L.G. and Cappi C., 2010. *FAO-VCA software tool 3.1*, *EASYPol series n. 073*, Food and Agriculture Organization of the UN, Rome, Italy. www.fao.org/easypol

Bellù L.G., 2013. *A Software for Value Chain Analysis. Manual for FAO VCA Software Tool 3.1*. *EASYPol series n. 074*, Food and Agriculture Organization of the UN, Rome, Italy. www.fao.org/easypol

Bellù L.G. and Pansini R.V., 2009. *Quantitative Socio-Economic Policy Impact Analysis: A Methodological Introduction, EASYPol series n. 068*. Food and Agriculture Organization of the UN, Rome, Italy. www.fao.org/easypol pp.11-12

Bernoux, M.,Bockel, L., Branca, G., Colomb, V., Gentien, A., Tinlot, M., 2011. *EX-ACT, EX-ANTE Carbon-Balance Tool, Guidelines*, EASYPol series no. 101, Food and Agriculture Organization of the UN, Rome, Italy, http://www.fao.org/docs/up/easypol/780/ex-act-tech-guidelines_101en.pdf,

Bertrand, T.T., 1974. *The shadow exchange rate in an economy with trade restrictions*, Oxford Economic papers. http://www.jstor.org/discover/stable/2662220.

Birkhaeuser, D., R. Evenson and G. Feder. 1991. The economic impact of agricultural extension: a review. Economic Development and Cultural Change 39 (3): 507-521.

Bindlish, Vishva, and Robert E. Evenson. 1993. Evaluation of the Performance of T& V Extension in Kenya. World Bank Technical Paper No. 208, Africa Technical Department Series, World Bank, Washington, D.C.

Bockel L. and Grewer, U., 2013. *Analysis of carbon balance for organic and conventional banana production. An application of FAO EX-ACT*. Unpublished technical note. Food and Agriculture Organization of the UN, Rome, Italy.

Bockel L, Fabre P. and Mansouri M., 1994. *Analyse de filière: application à l'analyse d'une filière d'exportation de coton*. Cappa, Training materials for agricultural planning n. 36. Food and Agriculture Organization of the UN, Rome, Italy.

Bockel L. and Tallec F., 2005. *Value chain analysis: functional financial and economic analysis*. EASYPol series 043, 044, 045 and 046, Food and Agriculture Organization of the UN, Rome, Italy www.fao.org/easypol

Bockel L. and Tallec F., 2005. *Case study on commodity chain analysis: Irrigated rice chain of the Niger's office (Mali): Financial and Economic Account*, EASYPol series n.047, Food and Agriculture Organization of the UN, Rome, Italy. www.fao.org/easypol

Brealey S. and Myers C., 2003. *Principles of corporate finance*, McGraw-Hill/Irwin 7th edition

Bruno, M. 1965. The optimal selection of export-promoting and import-substituting projects, *in Planning the External Sector: Techniques, Problems, and Policies*, United Nations, New York, USA, pp. 88-136.

Buchanan J, M, and Robert D. Tollison (Eds) (1984) The Theory of Public Choice - II . The University of Michigan.

Coase R. H., 1937. The Nature of the Firm, *4 ECONOMICA 386*, Blackwell Publishing

Coase, R.H., 1960. *The Problem of Social Cost*, Journal of Law and Economics, Vol. 3 (Oct., 1960), pp. 1-44.

Colander, David C., 2006. *Economics*, McGraw-Hill/Irwin 6th edition

Dasgupta, P., Sen, A.K., Marglin, S., 1972.*Guidelines for project evaluation*, UNIDO, Project Formation & Evaluation Series

Da Silva C. A. and H. M. De Souza Filho, 2007. *Guidelines for rapid appraisals of agrifood chain performance in developing countries*, Agricultural Management, Marketing and Finance Occasional Paper, FAO, Rome, Italy.

Direction Générale de la Promotion de l'Economie Rurale (DGPER) 2009 : Analyse de la compétitivité de la filière Riz Local au Burkina Faso. Ministère de l'Agriculture, de l'Hydraulique e des Ressources Halieutiques. Ouagadougou. EASYPol series 131 FAO UN-Rome http://www.fao.org/docs/up/easypol/938/analyse-filiere-riz-local-burkina-faso_131fr.pdf

Direction Générale des Prévisions et Statistiques Agricoles. Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques , 2007a. *Analyse de la filière Bois de Feu (Firewood) au Burkina Faso*, DGPSA, Ouagadougou, Burkina Faso.

Direction Générale des Prévisions et Statistiques Agricoles. Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques, 2007b. *Analyse de la filière pèche (Capture Fisheries) au Burkina Faso*, DGPSA, Ouagadougou, Burkina Faso.

Direction Générale des Prévisions et Statistiques Agricoles. Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques, 2007c. *Analyse de la filière bétail-viande (Livestock) au Burkina Faso,* DGPSA, Ouagadougou, Burkina Faso.

Direction Générale des Prévisions et Statistiques Agricoles. Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques, 2007d. *Analyse de la filière maraîchage (Vegetables) au Burkina Faso*, DGPSA, Ouagadougou, Burkina Faso.

Direction Générale des Prévisions et Statistiques Agricoles. Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques, 2007[e]. *Analyse des impacts des politiques de développement agricole et rural et des filières Agro-sylvo-pastorales sur la pauvreté et la sécurité alimentaire: résultats synthétiques,* DGPSA, Ouagadougou, Burkina Faso.

Evenson, R. and G. Mwabu, 1998. The effects of agricultural extension on farm yields in Kenya, *Economic Growth Center Discussion Paper No. 798*. Yale University. New Haven, USA.

Fabre P., 1994. *Note de méthodologie générale sur l'analyse de filière pour l'analyse économique des politiques*, Cappa, Training materials for agricultural planning. 35. FAO, Rome, Italy.

Food and Agriculture Organization of the United Nations, 1994. *Guide for Training in the Formulation of Agricultural and Rural Investment Projects: planning tools, case studies and exercises*, Vol. 3: . FAO, Rome, Italy.

Food and Agriculture Organization of the United Nations, 2008. *Draft report on mango value chain policy analysis in Kenya*. Unpublished. FAO, Rome, Italy.

Food and Agriculture Organization of the United Nations, 2009, FAO Policy Learning Programme Module 1, P*olicy Framework, session 1.5: Policy Making in the National Context*, available at www.fao.org/easypol

Food and Agriculture Organization of the United Nations, , 2010 (1). Global forest resources assesment 2010 – Main report, *FAO Forestry Paper no.163*, FAO, Rome, Italy

Food and Agriculture Organization of the United Nations, 2010 (2). *Policy Measures in the Sugar Value Chain*, Unpublished draft document prepared by a working group in the Ministry of Agriculture, Kenya

Food and Agriculture Organization of the UN, 2011. *Save and grow. A policymaker's guide to the sustainable intensification of smallholder crop production*. http://www.fao.org/docrep/014/i2215e/i2215e.pdf

Gereffi, G., 1994. The organization of buyer-driven global commodity chains: How US retailers shape overseas production networks, in G. Gereffi and M. Korzeniewicz (eds.), *Commodity Chains and Global Capitalism,* Praeger, London, UK.

Gibbons, Robert D.,1992. *Game theory for applied economists*, Princeton University Press, USA.

Grossman, S. J. and Hart, O. D., 1986. The costs and benefits of ownership: A theory of vertical and lateral integration, *The Journal of Political Economy, 1986, 94(4), p.691*

Hansen, J.R., 1986. *Guide to practical project appraisal: Social benefit-cost analysis in developing countries*, Vienna, Austria. pp.27-32.

Hayek, F., 1945. The use of knowledge in society, *American Economic Review*, *35(4), pp. 519-530*

IFPRI, 2011. *Glossary: definition of key terms*, http://www.foodsecurityportal.org/policy-analysis-tools/glossary-definition-key-terms

Jamoza J.E, (2005). Sugar Cane Variety Improvement in Kenya. Kenya Sugar Research Foundation (KESREF).

Joskow P.L., 2010. *Symposium in honor of Oliver Williamson*, Antitrust Bulletin, p.3.

Joskow P.L., 2005. Vertical integration, in, *Handbook of new institutional economics 319* (C. Menard & M. Shirley eds., Springer 2005.

Kapuya, T., Saruchera, D., Jongwe, A., Mucheri, T., Mujeyi, K., Ndibongo, L.T., & Meyer, F., 2010. *The grain industry value chain in Zimbabwe*, Food and Agriculture Organization of the UNFAO, Rome, Italy (with funding from the EU All ACP Agricultural Commodities Programme).

Kaplinsky R., and Morris, M., 2000. *A Handbook for value chain research*, International Development Research Centre, Canada, IDRC, Canada.

KARI, *Biennial Scientific Conference*, November 2010.

Lançon, F. 2011. *Assessment of competitiveness of Syrian agriculture: an application to selected representative chains*, National Agriculture Policy Center (NAPC)

Liu, P. 2008. *Certification in the value chain for fresh fruits. The example of banana industry*, Food and Agriculture Organization of the United Nations, Rome, Italy.

Londero, E, Cervini H. 2003. *Shadow prices for project appraisal: Theory and practice*. Edward Elgar Publishing.

Lucas, R (1976): "Econometric policy evaluation: A critique". Carnegie-Rochester Conference Series on Public Policy **1** (1), pp 19–46.

Mankiw, N. Gregory, 2001. *Principles of economics*. 2nd ed. Forth Worth: Harcourt Publishers.

Markandya, A., Harou, P., Bellù L.G., Cistulli V., 2002. *Environmental economics for sustainable growth. A handbook for practitioners*. World Bank - Edward Elgar.

Mas-Colell, A., M. Whinston and J. Green, 1995. *Microeconomic theory*, Oxford University Press, UK.

MECV, 2004. *Note d'information sur la filière bois – énergie au Burkina Faso.* Ministère de l'Environnement et du Cadre de Vie, Direction des Aménagement Forestiers, Ouagadougou, Burkina Faso.

Miller C., and Jones L., 2010. *Agricultural value chain finance: tools and lessons.* Food and Agriculture Organization of the UN and Practical Action Publishing. *http://www.fao.org/docrep/017/i0846e/i0846e.pdf*

Ministère de l'Environnement et du Cadre de Vie, 2007. *Analyse des impacts financiers et economiques de la filiere bois-energie organisee approvisionnant la ville de Ouagadoungou*, Série EASYPol 106, Food and Agriculture Organization of the UN, Rome, Italy.

Agence des Participations de l'Etat, 2008. Report 2008 : French State as a Shareholder. Ministère de l'Économie, de l'Industrie et de l'Emploi, Paris, 2008.

Ministère de l'Environnement et du Cadre de Vie, 2004. *Note d'information sur la filière bois – énergie au Burkina Faso / Ministère de l'Environnement et du Cadre de Vie* – Direction des Aménagement Forestiers, MECV, Ouagadougou, Burkina Faso.

Ministère des Mines, des Carrières et de l'Energie, 2007. *Stratégie nationale de la filière commerciale bois – énergie à l'horizon 2015 (version provisoire)*, MMCE, Ministère de l'Environnement et du Cadre de Vie, Ouagadougou, Burkina Faso p. 46.

MMCE, 2007. *Stratégie Nationale de la filière commerciale bois – énergie à l'horizon 2015* (version provisoire) Ministère des Mines, des Carrières et de l'Energie – Ministère de l'Environnement et du Cadre de Vie ; p. 46.

Monke, E. A. and S. R. Pearson, 1989. *The policy analysis matrix for agricultural development*, Cornell University Press, USA.

Myerson, Roger B., 1991. *Game theory: analysis of conflict*, Harvard University Press, USA.

Nordhaus W., 1975. *The political business cycle*, Review of Economic Studies.

OECD, 2010: OECD's Producer support estimate and related indicators of agricultural support: Concepts, calculations, interpretation and use (The PSE Manual), OECD – Paris, France, http://www.oecd.org/tad/agriculturalpoliciesandsupport/46193164.pdf

OECD Glossary of statistics *http://stats.oecd.org/glossary/*

OECD 2001: *Measuring capital. Manual measurement of capital stocks, consumption of fixed capital and capital services*. OECD, Paris, France. http://www.oecd.org

Ouedraogo, B., 2002. *Eléments économiques pour la gestion de l'offre et de la demande du bois – énergie dans la région de Ouagadougou/Thèse pour le Doctorat ès Sciences Economiques*, Universités de Ouagadougou et de Montesquieu – Bordeaux IV (France).

Osrom, E., 1995. *Governing the commons: The evolution of institutions for collective action*, Cambridge Univ. Press, UK.

Pigou, A.C., 1920. *The economics of welfare*, Macmillan, London, UK.

Poisot A.S. et al., 2004: Good agricultural practices: a working concept. Background paper for the FAO Internal workshop on Good Agricultural Practices. *FAO GAP working paper series 5*, Food and Agriculture Organization of the UN, Rome, Italy.

http://www.fao.org/prods/gap/Docs/PDF/5-GAPworkingConceptPaperEXTERNAL.pdf

Porter M. E, 1985. *Competitive advantage: Creating and sustaining superior performance*, N. York: The Free Press, USA.

Porter, M.E., 1990. The competitive advantage of nations, *Harvard Business Review 68 no.2*.

Ricardo D., 1817. *On the principles of political economy and taxation*, John Murray, London, UK.

Robbins L., 1932. *Essay on the nature and significance of economic science*, Mc Millan and Co, London first edition, UK.

Romani, M., 2003. *The impact of extension services in times of crisis: Côte d'Ivoire 1997-2000* Centre for the Study of African Economies, University of Oxford. CSAE WPS/2003-07.

Santopietro G. D., 1998. *Alternative methods for estimating resource rent and depletion cost: the case of Argentina's YPF*, Resources Policy, Volume 24, Issue 1, March 1998, Pages 39-48

Sheeraz Ahmad, G. Prior, H.J., Thomas, P., Burrell, D. 2012. *The role of extension in changing the dairy industry in Pakistan: A review, International Workshop on Dairy Science Park,* Peshawar, Pakistan. *International Workshop on Dairy Science Park, Peshawar, Pakistan*

Smith A., 1776. *An inquiry into the nature and causes of the wealth of nations*

Stiglitz, J.E., 1988. *Economics of the public sector*, Norton&Co, New York, USA.

Trent J. Bertrand, 1974. *The shadow exchange rate in an economy with trade restrictions*, Oxford Economic papers. *http://www.jstor.org/stable/2662220*

Tsakok, I., 1990. *Agricultural price policy: A practitioner's guide to partial equilibrium analysis*. Cornell University Press, Washington DC.

Umm e Zia, T. Mahmood and Ali M.R., 2011. *Dairy development in Pakistan*, Food and Agriculture Organization of the UN, 2011, Rome, Italy.

United Nations, Statistical Division, 2008. *System of National Accounts*, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank, New York, *http://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf*

United Nations, Statistical Division, 1993. *System of National Accounts*, section 6.178.

United Nations *et al*., 2003. *International Handbook on Integrated Environmental and Economic Accounting*. *http://unstats.un.org/unsd/envaccounting/seea2003.pdf*

Varian, H. L., 1992. *Microeconomic analysis*, Third edition, W. W. Norton & Company.

Yoskov P.L., 2005. Vertical integration, *in Handbook of New Institutional Economics 319*, C. Menard & M. Shirley eds., Springer, USA.

Williamson, O. E., 1971. The vertical integration of production: Market failure considerations, *American Economic Review 61, pp. 112-23.*

Wynn, P., Harris, D., Moss, R., Clem, B., Sutton, R., & Doyle, P. 2006. *Report on dairy mission to Pakistan*, Australian Centre for International Agricultural Research, ACIAR, Australia.