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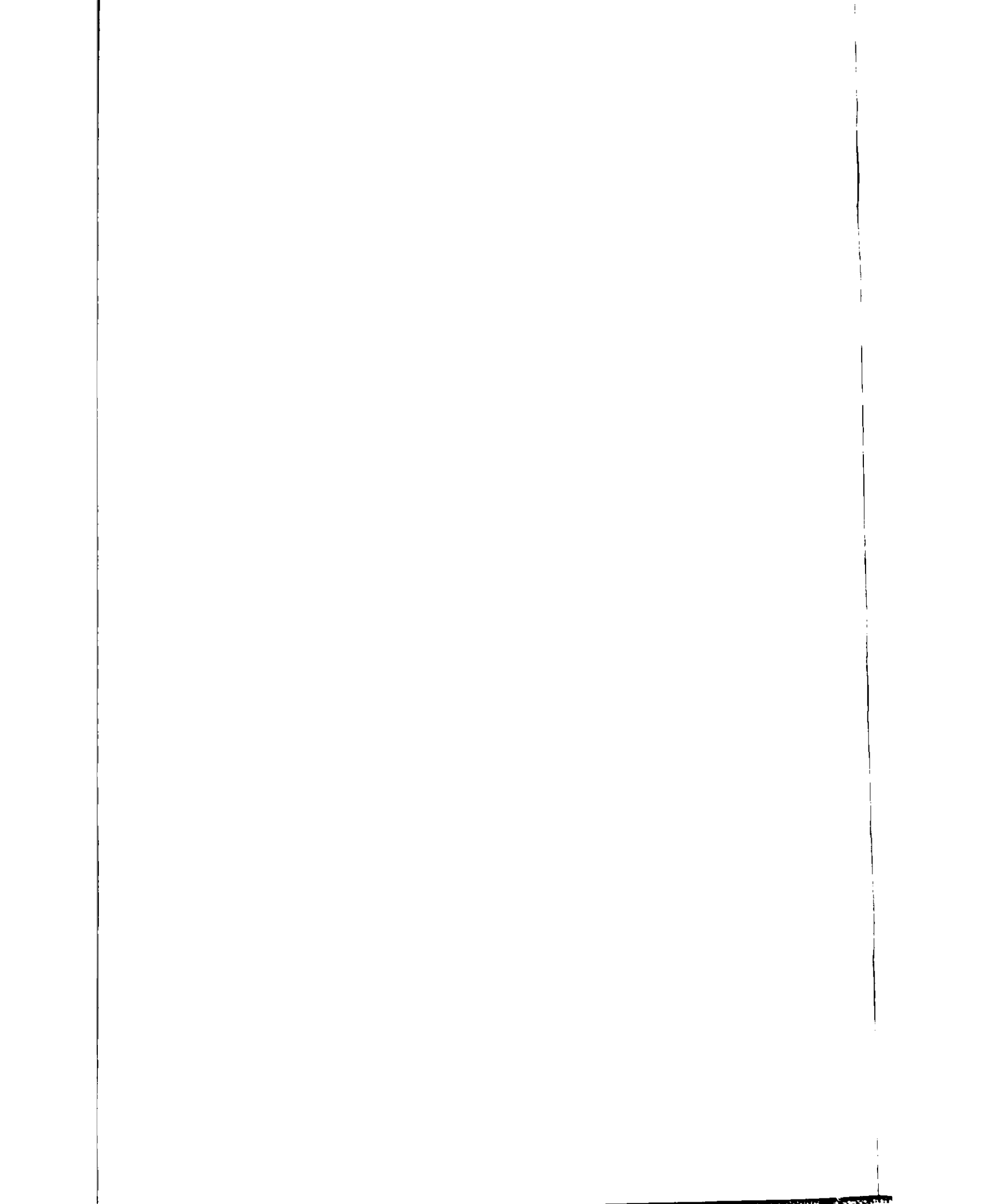**Department of Economics**

Agricultural Liberalization, Income Distribution and Welfare

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Thesis submitted for assessment with a view to obtaining
the degree of Doctor of the European University Institute

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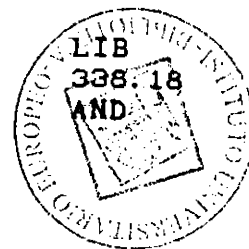**EUROPEAN UNIVERSITY INSTITUTE**
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Agricultural Liberalization,
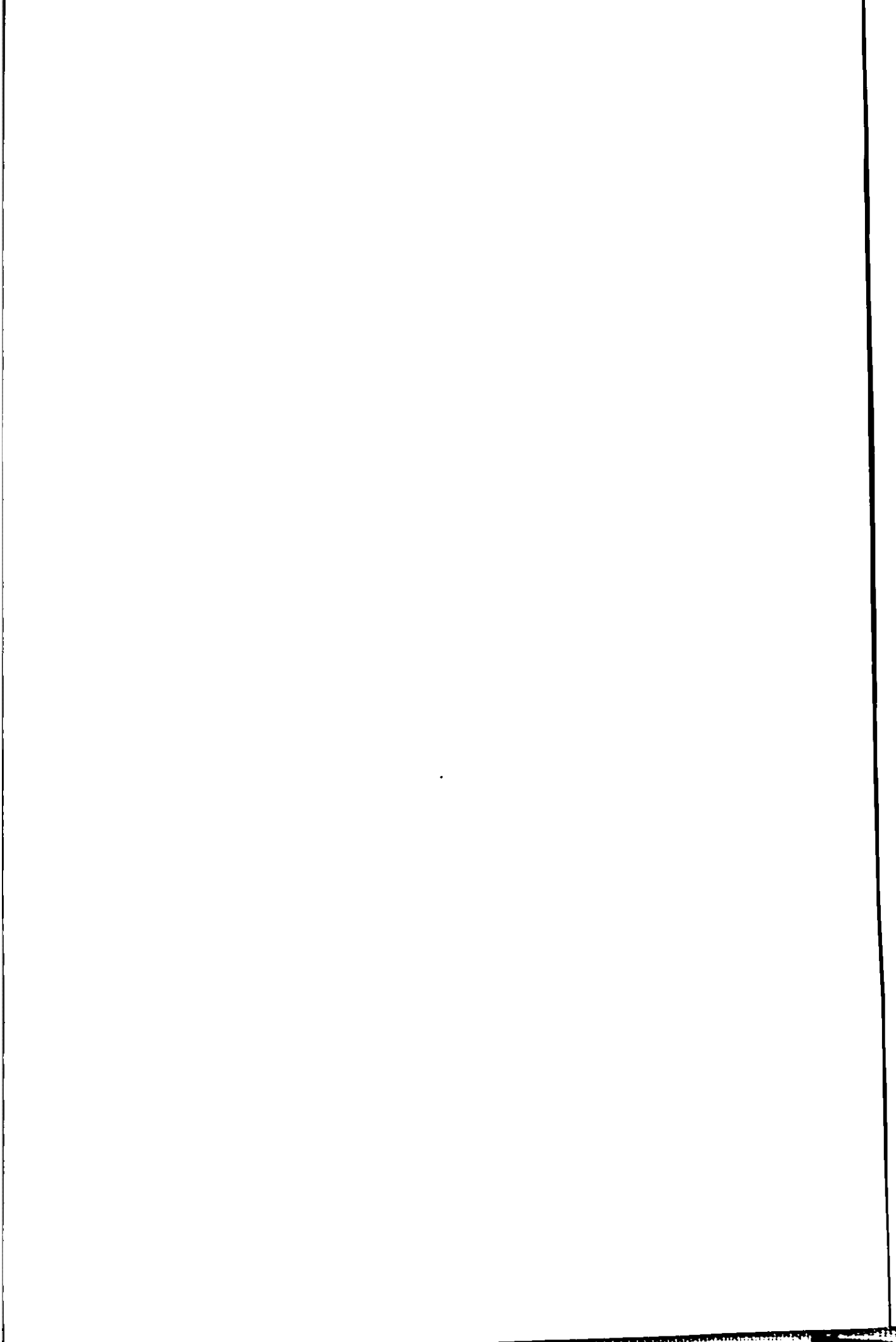
Income Distribution and Welfare

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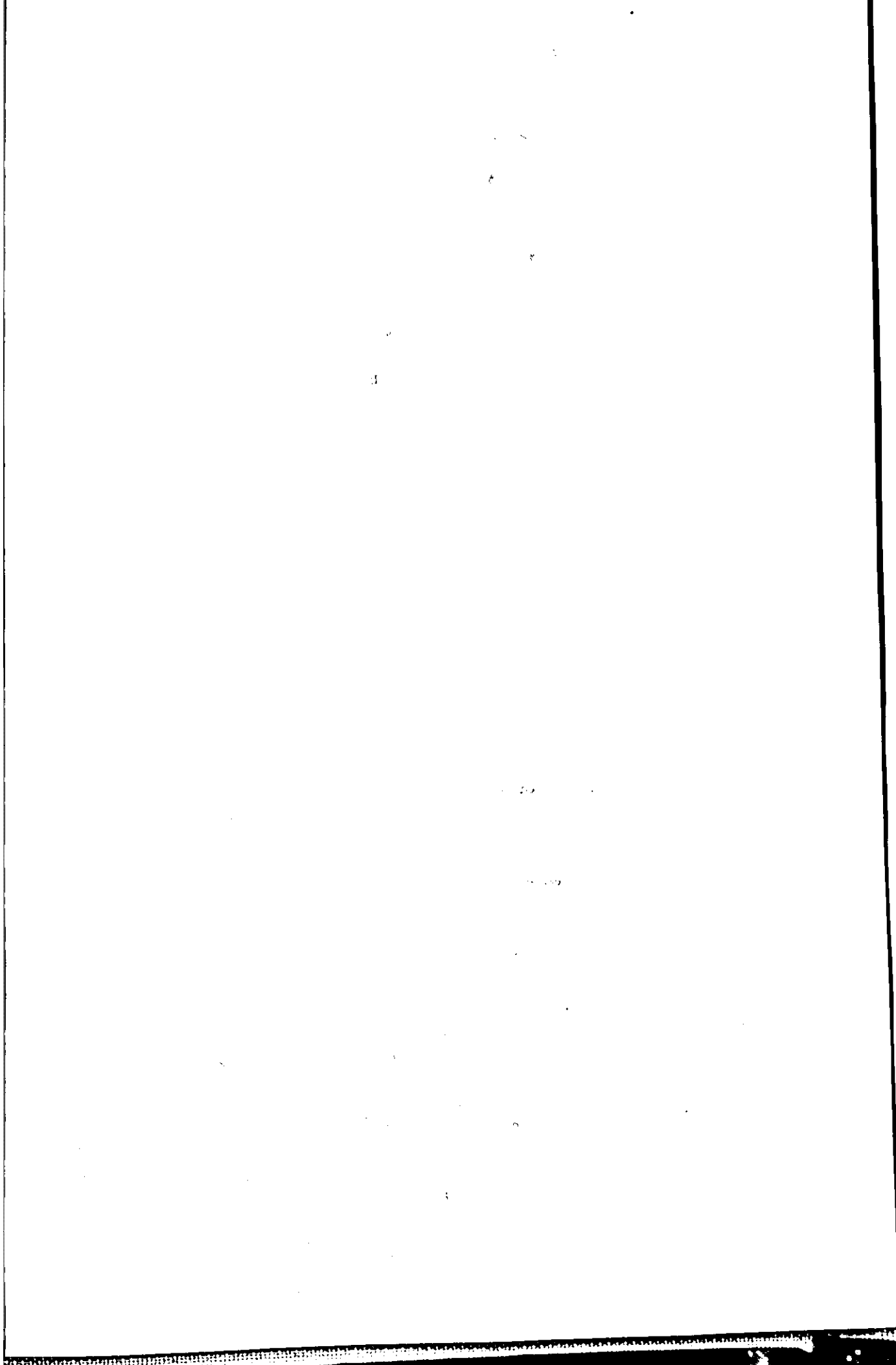- Hubert Kempf, Université de Paris I

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Acknowledgments

Abstract

Agriculture is currently being liberalized. In industrialized countries, it consists in reducing agricultural support, while in developing countries, agricultural taxation has to be reduced. Simultaneously, the farmer's status has significantly changed over the last two decades, both in industrialized and developing countries, with more and more farmers also having off-farm occupations. This dissertation describes these changes, and provides a quantitative assessment of the distributive effects of agricultural reforms. Indeed, these reforms lead to dramatic consequences in terms of welfare distribution, between farmers and non-farmers, and among farmers themselves. This analysis complements already existing studies by taking into account the changing definition of a farmer, leading to new results about the agricultural instruments most adapted to different economic, political and social objectives.

The methodology used is a calibrated mono-country general equilibrium model, applied to the European Union and to a very poor representative developing country, where the share of agriculture in the economy is very large. The main results show that, in both kinds of countries, agricultural liberalization improves the global welfare of the society, although some groups suffer from it. Indeed, in the European Union, farmers' s welfare decreases dramatically when agricultural support measures are eliminated. Some compensation schemes should hence be implemented, and direct payments appear to be the best instrument to target specific farmers. In developing countries, agricultural liberalization is likely to hurt the most vulnerable part of the society, urban poor and rural small producers. In this context, the elimination of the production tax should be preferred to that of marketing boards.

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List of acronyms

CAP: Common Agricultural Policy
EU: European Union
FOC: First Order Condition
GDP: Gross Domestic Product
HDI: Human Development Index
NZ: New Zealand
OECD: Organization for Economic Cooperation and Development
PC: Permanent Consumption
PPP: Purchasing Power Parity
PSE: Producer Subsidy Equivalent, or Producer Support Estimate
TFP: Total Factor Productivity
TSE: Total Support Estimate
USA: United States of America
USD: United States Dollar
WTO: World Trade Organization
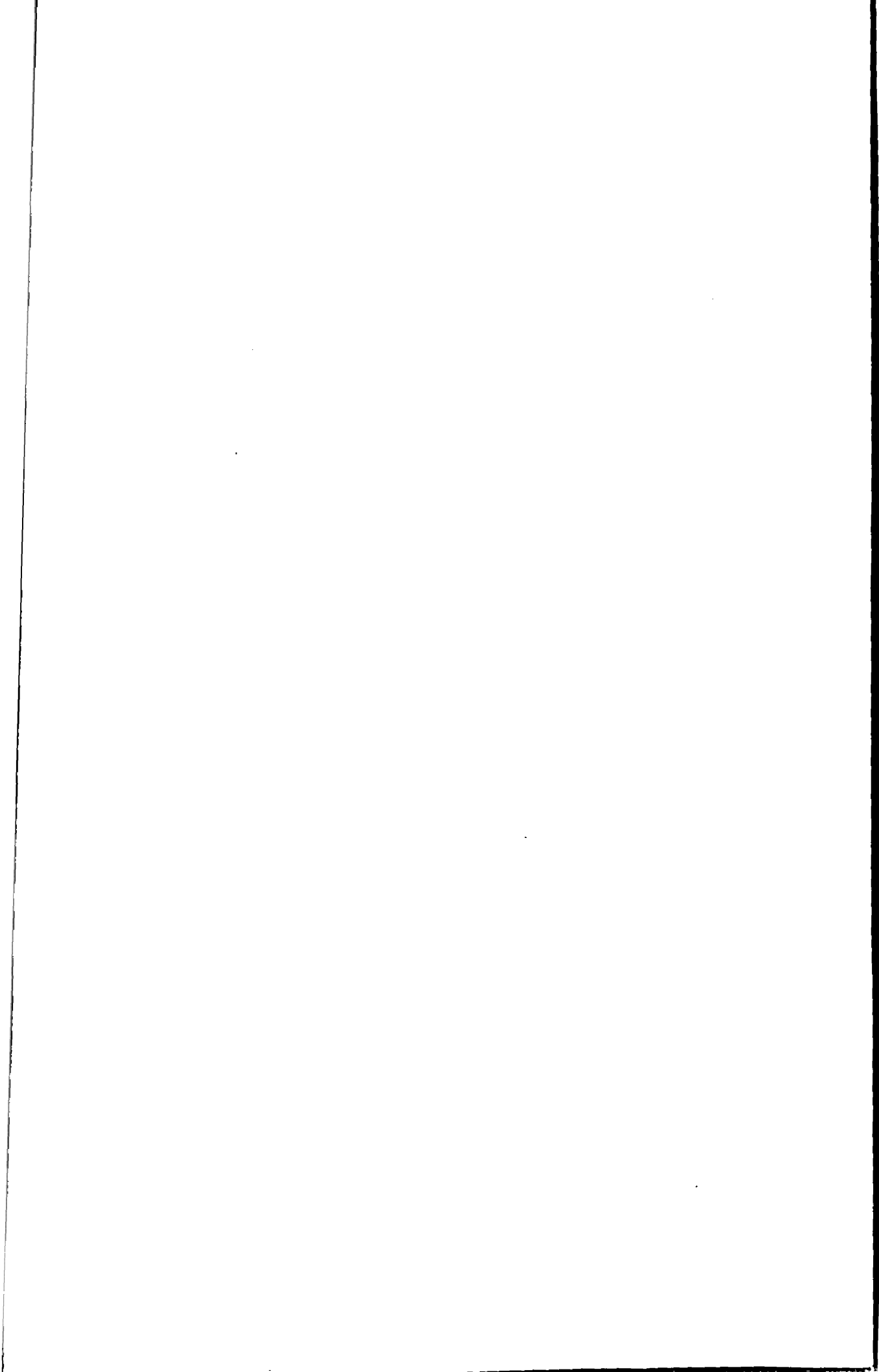
Introduction

The purpose of this dissertation is to provide a quantitative assessment of the distributive effects

of agricultural reforms in some developed and developing countries. The agricultural sector is very

important when looking at economic development, since the size of this sector often reflects the stage

of development of a country. In fact, in many developing countries, the agricultural sector still employs

most of the active population and contributes to a large share of GDP. In industrialized countries, on the

contrary, this sector has shrunk dramatically, and it represents nowadays a marginal share of employment

and GDP. Nevertheless, despite its tiny contribution to economic activity in industrialized countries,

from a political and social point of view, this sector remains important. Therefore, all over the world, the

agricultural sector either represents a large share of the economic activity (in less developed countries)

or still has a significant influence on the social and political structure of the country (in industrialized

countries). Agricultural policies are hence scrutinized everywhere: In developing countries, because

they have a direct impact on a large share of the population; in industrialized countries, because they

are often much more expensive than one might expect given the share of the sector in the economy. In

fact, in industrialized countries, the agricultural sector is subsidized, whereas it is traditionally taxed in

developing countries.

All over the world, and whatever is the agricultural policy, the sector is currently being liberalized,

under some domestic and international pressures. Such liberalization measures will undoubtedly lead to

large economic and social changes. A large literature exists on the topic, the main goal of which is to

assess the efficiency and welfare consequences of agricultural liberalization. Indeed, the consequences

in terms of welfare distribution, among farmers, and between farmers and non-farmers, are salient:

Changes in agricultural policies are likely to lead to changes in the level of income available to economic

agents, and also to changes in income distribution between agents.

The dissertation focuses on this welfare distribution issue. It complements already existing studies

by taking into account a recent evolution of the agricultural sector, occurring both in industrialized

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and developing countries. This recent evolution consists in a dramatic change in the farmer's status over the last two decades, since more and more farmers also have off-farm occupation. The traditional definition of a farmer hence needs to be revised, and the target of agricultural policies needs to be clearly identified. The dissertation inserts this changing definition of a farmer into a welfare distribution analysis of liberalization measures, and assesses the optimal sequencing of liberalization measures according to different objectives.

To reach this objective, the methodology used is a calibrated mono-country general equilibrium model. It is first solved analytically, and it is afterwards calibrated for some representative industrialized and developing countries. The effects of several agricultural policies are tested. The model is kept very simple, in order to assess easily the links between agricultural policies and reaction of the endogenous variables. The obvious limitation of such a simple model is its lack of realism on many issues, such as uncertainty and missing markets for instance. However, these issues may be of second order compared with distortions induced by agricultural taxes and price wedges. The results reached permit to draw conclusions on the best agricultural instruments to be used according to the definition of farmers chosen.

The dissertation is organized as follows: The first chapter presents the stylized facts of the agricultural sector and policies in industrialized countries. The reciprocal link between the evolution of the agricultural sector and the agricultural policy reforms is shown. It is also shown how this evolution has an influence on income distribution in the agricultural sector and on the definition of a farmer. Given these stylized facts, a model is developed in chapter 2, and it is used to assess the income distribution consequences of the Common Agricultural Policy reforms in the European Union. In chapter 3, this model is adapted in order to study a representative developing country in which the anti-agricultural bias is being removed.

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Chapter 1

The farm sector and agricultural policy in the OECD

1.1 Introduction

The agricultural sector has changed in the last two decades in all OECD countries. It has changed in many aspects, but the one we focus on regards income distribution issues. To this extent, the main changes in the agricultural sector can be characterized by an increase in the number of farmers having another activity (off-farm), by the catch-up of non-farmers' income by farmers' one, thanks to these off-farm activities, and by the persistence of income inequalities in the farm sector. At the same time as these changes took place, some agricultural policies reforms were implemented, towards more liberalization. These policy reforms were both a reason and an effect of the structural changes observed in the farm sector. Indeed, there is a direct link between agricultural policy and income distribution evolution: Agricultural policy used to act negatively on income distribution in the farm sector since support was very much linked to output. There is also an indirect link between agricultural policy and income distribution through the evolution of the farm sector: Since the farmers' income caught up the non-farmers' one, the main goal of the agricultural policy could no longer be to support farmers' income. Besides, with the development of off-farm work by farmers, the question of the changing definition of a farmer arises, and agricultural support has to be more targeted. These changes hence make necessary an evolution of the agricultural support instruments.

This chapter presents the interactions between the economic and social sides characterizing the farm sector in the OECD and it shows how these interactions can be used to explain the evolution of income distribution. It first presents the changes of the agricultural sector, focusing on the evolution of the share of the sector in the total economy and on the evolution of agricultural policies. The European Union agricultural policy is studied in more detail, since it is the application country of one

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of the models presented in the thesis. Although agricultural sectors have experienced different kinds of evolution in the OECD countries, their agricultural policy has often been quite similar to the European one. Therefore, the model applied to the European Union could be extended to other industrialized countries. The second part of the chapter focuses on the evolution of income distribution induced by and leading to changes in the agricultural sector. By income distribution is meant distribution between farmers and non-farmers, as well as inside the farmers group. The confrontation of these two aspects of the evolution of the farm sector (agricultural policy, income distribution) allows us to look at the consequences of agricultural liberalization with a new perspective in the other chapters of the thesis.

1.2 Evolution of the agricultural sector and policy reforms

There is a twofold link between the evolution of the agricultural sector and agricultural policy reforms: Agricultural policy has an influence on the evolution of the agricultural sector, which in turn leads to further agricultural policy reforms. This section first presents the economic evolution of the agricultural sector for several OECD countries. It then describes the agricultural policies implemented, with a special focus on the European Union Common Agricultural Policy.

1.2.1 Weight of the agricultural sector in some industrialized economies

In all OECD countries, the share of the agricultural sector in the whole economy has been shrinking over the last 4 decades. It now represents a small share of GDP and employment. However, the share of the rural population is still very important, and there is an increasing interaction between the agricultural sector and the rural areas.

1.2.1.1 The agricultural sector in the European Union

The agricultural sector represents 3 % of GDP and 5 % of the labor force in the European Union in 2001. Agricultural land used represents 57 % of the EU surface. These global data hide

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some large differences between countries. For instance, in 1998, only 1.7 % of the active population of the United Kingdom worked in the agricultural sector, compared to 18.2 % in Greece. Similarly, the agricultural sector represents only 1 % of German GDP, compared to 11 % in Greece. The EU agricultural exports and imports to and from the rest of the world represented respectively 7 and 7.7 % of total EU exports and imports in 1998 (27 % of the exports in Greece, 22 and 23 % respectively for Denmark and the Netherlands). To this extent, the EU displays the same features as the rest of the world since agricultural products trade represented 7.6 % of world trade in 1998.

Although the agricultural sector represents a small share of the industrialized economies, it receives a large share of the public subsidies given to any productive sector. In 2000, the European agricultural policy accounted for 48 % of the European Union budget (73 % in 1985) and represented 0.49 % of EU GDP (2.5 % in 1988). This share of agricultural policy in GDP corresponds to the OECD average.

1.2.1.2 The agricultural sector in other industrialized countries

The agricultural sector accounts for 1.7 % of GDP in the United States and in Japan. This share is up to 5.6 % in New Zealand. The agricultural sector employs 2.6 % of the active population in the USA, 8.1 % in New Zealand and 9 % in Japan. Agricultural products represent 4 % of US imports, 5 % of the New-Zealand ones, and 12 % of the Japanese ones. Regarding exports, agricultural products represent 6 % of the total American exports (one third of the US agricultural production is exported), only 0.4 % of the Japanese exports, and a record of 45 % of the New-Zealand exports. In any country, the rural population represents much more than the people employed in the agricultural sector.

The following table summarizes the share of the agricultural sector in the main economic indicators in some industrialized countries:

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	GDP	Employment	Imports	Exports
European Union	3	5	7.7	7
USA	1.7	2.6	4	6
Japan	1.7	9	12	0.4
New Zealand	5.6	8.1	5	45

1.2.2 The agricultural policies

In industrialized countries, the agricultural sector has traditionally been supported by public

policies. In the mid-80s, however, political and economic concern started to increase about the real

justification of these policies, and about their costs. At this point, the sector began to be liberalized,

albeit to different degrees in the various countries. Liberalization has been very sharp in New Zealand,

and almost non-existent in Japan. The European Union and the USA are somewhere in-between the two

extremes. Liberalization measures have consisted, in all the countries, in reducing the level but also the

kind of support provided to the agricultural sector. Before examining the liberalization measures, a brief

description of the agricultural policy instruments is presented.

1.2.2.1 Some agricultural policy instruments

There are many alternatives criteria for classification of these instruments. The one retained

here considers the level of intervention in the production and distribution system. Using this approach,

instruments are listed according to whether they are imposed directly at the farm level, or at some other

point in the domestic market, or at the national frontier[1].

At the farm level, we distinguish:

- deficiency payments, that are a variable production subsidy paid per unit of output to compensate

for the shortfall (deficiency) between the average market price and a higher, pre-announced guaranteed

price;

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[1] It is the criteria also retained by Colman and Young (1989) when they present agricultural policies in developing countries
(p.269).

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- input subsidies, which apply per unit of variable input used (a cheap credit offered for the purchase of the input would have the same effect);

- investment grants, which are subsidies for investments in medium and long run capital (such as machinery, irrigation);

- production or acreage quotas, that impose limits on total production or acreage of a crop;

- compulsory food requisition, that force producers to sell minimum quantities of their production to public trading organization, at below market prices;

- land retirement or set aside schemes, that offer payments to producers who accept to reduce the acreage planted with some crops.

At the domestic market level, we distinguish:

- public trading and marketing boards, that place a floor price in the wholesale market by purchasing commodities to farmers at a pre-announced "intervention price". The marketing boards then manage the stocks of agricultural products and organize the sales to consumers;

- food subsidies to consumers, almost non-existent in industrialized countries;

- public investment in agricultural infrastructure.

At the frontier level, we distinguish:

- import tariffs, levies or duties;

- export subsidies or taxes;

- import quotas;

- non-tariff barriers.

With agricultural liberalization policies implemented since the 1980s, the level and the diversity of the use of these instruments has changed.

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1.2.2.2 Evolution of the level of support

There are several indicators of agricultural support developed by OECD research teams. The main one is the PSE, which stands for Producer Subsidy Equivalent, or Producer Support Estimate. This is an indicator of the monetary value of gross transfers to agricultural producers resulting from agricultural policies in a given year. Both transfers from consumers of agricultural products (through domestic market prices) and transfers from taxpayers (through budgetary or tax expenditures) are included. Five categories of agricultural policy measures are included in the OECDs calculations of PSEs:

- measures that transfer money to producers by affecting producer and consumer prices simultaneously (market price support);

- measures that transfer money directly from taxpayers to producers without raising consumer prices (direct payments to producers);

- measures that transfer money to producers by lowering inputs costs;

- measures that reduce costs to the agricultural sector as a whole and are not received directly by producers (general services);

- other measures, the main elements of which are funded by state or provincial governments, and certain tax concessions (other support).

The overall monetary value of PSE depends on the size and structure of a country's agricultural sector, as well as on the monetary unit used. Hence, it is useful to have a more neutral indicator, in order to compare support across countries, commodities and time. This indicator can be the support expressed as a percentage of gross farm receipt (% PSE), which shows the amount of support to farmers, irrespective of the sectorial structure of a given country. It can also be the support expressed as a percentage of GDP (% TSE, or Total Support Estimate). The % PSE shows the impact of agricultural policy on producers' income, while the % TSE shows the weight of agricultural policy on the whole economy.

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The evolution of these two indicators is shown in the following graphs, that compare the level of protection now and 15 years ago in selected OECD countries:

Total support estimate, % GDP
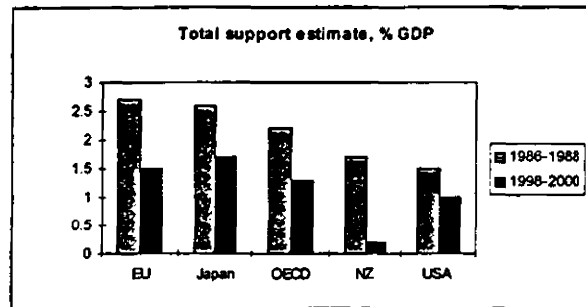
In 2000, "for OECD as a whole, total support to agriculture, as measured by the TSE, amounted to 327 billion $, or 1.3 % of GDP, compared to an average of 2.2 % in the 1986-1988 period" (OECD, 2001, p.13).

Producer support estimate, % of gross farm receipts
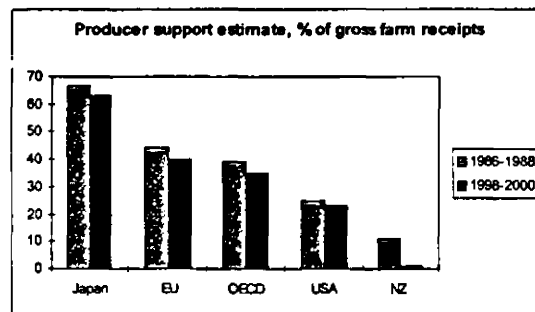
It can be noticed that, in the whole OECD group, the level of protection, whether measured as a share of the farmers receipts (% PSE) or as a share of GDP (% TSE), has decreased in the last 15 years. This evolution shows the positive impact of agricultural liberalization policies on the level of market-orientation of the sector. However, it can be noticed that, in the whole OECD group, agricultural support still accounts for 1.3 % of GDP, and represents 35 % of the farmers' gross receipts.

In the selected OECD countries, New Zealand is the one which has liberalized the most its agricultural sector. Indeed, in New Zealand there was a protectionist policy until the early 1980s, when

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subsidies to agriculture accounted for about 40 % of total budget deficit. Therefore, strong measures had to be taken. In 1984, market price support was eliminated, and all forms of assistance were drastically reduced. As the assistance to agriculture sharply declined, farm production fell, profitability of farm business declined, farmers became increasingly indebted and net farm income as well as farmland prices sharply declined. The European Union and the USA have followed the same kind of evolution regarding their level of agricultural support, mainly due to compliance with WTO agreements. In Japan, the agricultural sector is still very much protected, mainly for political reasons.

It has to be noticed that the Producer Support Estimate is reported here on relative terms. However, when assessed on absolute terms, the ranking of the countries changes. Indeed, an OECD study (2000) reports that, in the USA, the PSE per agricultural worker reached 21 000 USD in 1999, while it amounted to "only" 17 000 USD in the EU. Thus, contrary to commonly held beliefs, agricultural support per farmer is higher in the USA than in European Union.

As could be expected, the two main indicators of agricultural support (% TSE and % PSE) do not rank countries in exactly the same way. This is logically explained by the fact that the % TSE takes into account the weight of the agricultural sector in the overall economy, while the % PSE does not.

Other ways of measuring the level of agricultural protection in the OECD countries exist. One of them is the producer nominal protection coefficient (NPCp), which measures the ratio between the average price received by producers and the border price, both at farm gate level. The following graph shows the evolution of this indicator in the last 15 years in selected OECD countries:

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Producer nominal protection coefficient

Japan | EU | OECD | USA | NZ
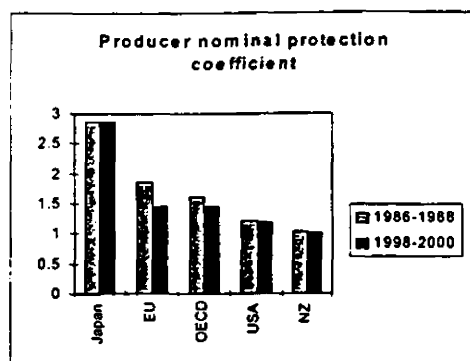
□ 1986-1988
■ 1998-2000

For the whole OECD area, this indicator decreased from an average of 1.61 in the 1986-1988 period to an average of 1.46 in 1998-2000. This indicates "an improvement in market orientation with an increased share of farm receipts generated at world prices compared with that created by government intervention" (OECD, 2001, p.22). But it also shows that gross farm receipts are still 46 % higher than they would be if entirely generated at world prices. With a producer nominal protection coefficient of 1, New Zealand can be seen as fully market oriented. With a nominal protection coefficient of about 2.87, agriculture in Japan has a very low degree of market orientation, since the average price received by Japanese producers is about 3 times the world market price. In the European Union, the average price received by agricultural producers is 45 % higher than world price, while it is 19 % higher in the USA. However, this indicator only provides information on the level of market support, and does not take into account any other support directly increasing the farmer's income.

It should be noticed that, when assessing the level of support, domestic prices are often compared to a theoretical price level, which is assumed to emerge in a fully liberalized situation. And, obviously, there is no consensus on the level of this full liberalization price level. Indeed, many variables are affected by agricultural sector liberalization, such that it is hardly possible to reach a unique conclusion. This is therefore one of the limits of the analysis of support levels, although it does not affect the international comparisons of support.

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Finally, the level of support per farmer or per hectare shows the difference in the structure of the agricultural sectors in the countries studied.

Producer support estimate per farmer, in 1998-2000, in USD

Producer support estimate per hectare, in 1998-2000, in USD
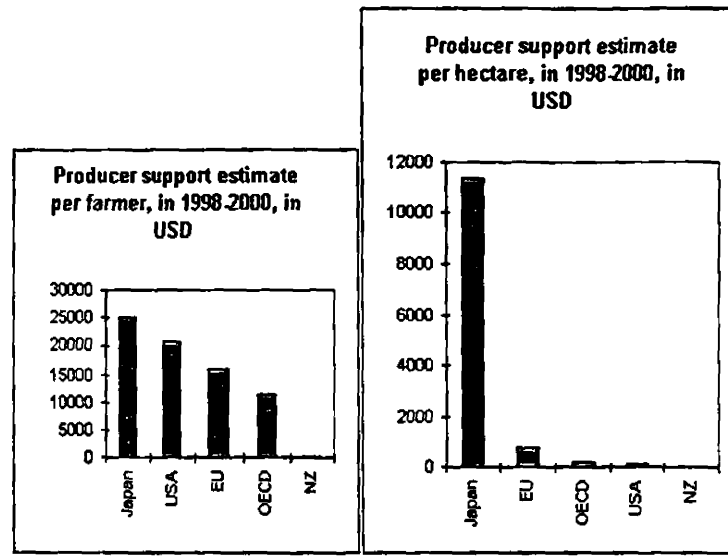
In Japan, the level of producer support estimate per hectare is much higher than in the other countries studied, while the level of producer support estimate per farmer is only slightly higher. It reveals that the Japanese agriculture uses much less land than the other. On the other hand, the reverse observation for the USA shows that the American agriculture is less labor intensive than the European one, since its level of PSE per farmer is higher than it is in Europe, whereas the American % PSE is lower than the European one.

All these different indicators have shown the same kind of evolution of the OECD agricultural sectors towards a stronger market orientation, even if full liberalization is still far from being reached. However, in all OECD countries, not only did the level of agricultural protection change, but so did the distribution of the share of each agricultural policy instrument.

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1.2.2.3 Evolution of the instruments of support

With agricultural liberalization, the distribution of support between instruments has changed. In the European Union, market price support represented 84 % of PSE in 1987, and shrunk to 52 % in 1997. Deficiency payments were almost non-existent before the CAP reforms in 1992, and already represented 17 % of PSE in 1997. The same range of evolution can be noticed for direct payments, with an even stronger increase, since they represented 31 % of PSE in 1997[2].

The same evolution can be noticed for the whole group of OECD countries. Between 1987 and 1996, the share of market price support in total PSE decreased from 65 % to 59 %. At the same time, the share of direct payments increased from 17 % to 23 % (source: OECD, 1998, p.59). This evolution makes agricultural support more visible, since it becomes increasingly funded through taxes and less so through price distortions: A direct tax replaces an indirect one. This replacement of market price support by direct payments is part of the liberalization policy, since direct payments are supposed to be only a transitory measure, and are assumed to be eliminated as well later on.

Japan is an exception in the OECD area, since its level and distribution of support has changed little over the last two decades. Indeed, direct price support policy, reinforced by border protection measures, have been the main instruments of agricultural policy, representing, in 1993, 83 % of total agricultural support. "The low productivity associated with the small scale of farming operations in Japan has required price support to be set at high levels in an attempt to achieve the policy objective of farm income parity with non-farm workers. [...] As a consequence of these policies, Japanese consumers pay among the highest food prices in the world" (OECD, 1995, p.34). Moreover, Japan has not followed the same trend as most of the other OECD countries that used to provide relatively high support for agriculture: In Japan, the high proportion of market price support in total agricultural support has been fairly stable in recent years, while it has fallen in most other countries as a result of a shift to direct payments during the last decade.

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[2] In 1991 in France, direct payments per farm amounted to 22 000 FF. In 2000, they represented 137 000 FF. In terms of net revenue, they often now represent up to 2/3 of the net revenue of French farms (Roger, 2000).

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A broader typology of agricultural policy instruments would show the same kind of evolution. Indeed, another way of distinguishing policy instruments regards their impact on price distortions and the market-orientation of the sector. For instance, an OECD report (2001) distinguishes "payments based on historical entitlements, input constraints and farm income", "payments based on inputs used", "payments based on area planted or animal number", and "market price support and payments based on output". According to this classification, the evolution of the agricultural support in OECD countries is the following:

Composition of producer support estimate (%)
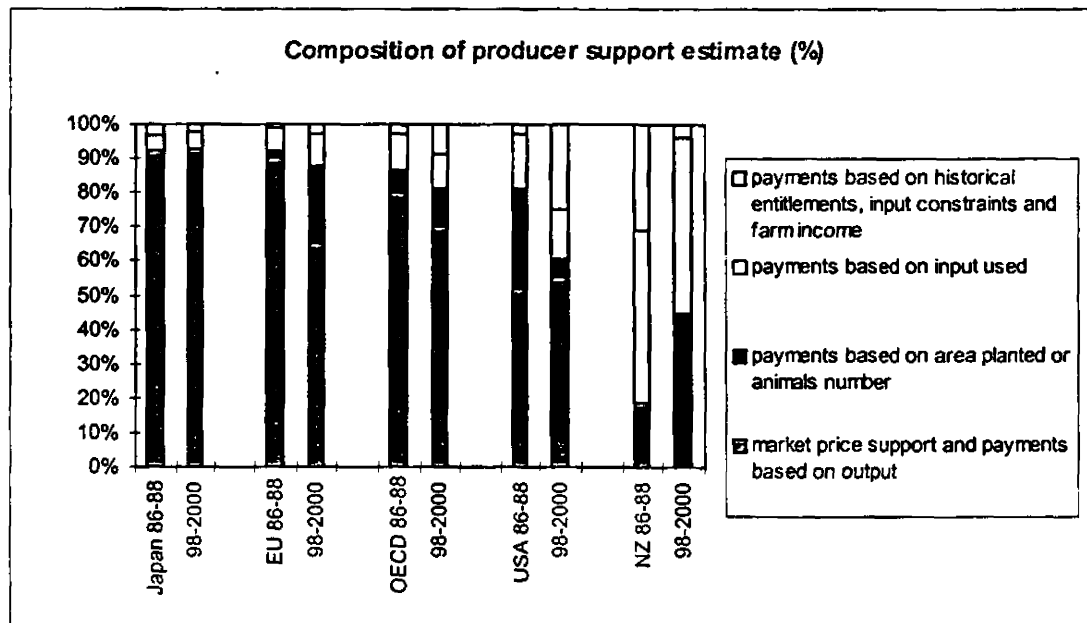
We can notice a decrease in the share of market price support and payments based on output in the European Union, New Zealand, and the OECD area as a whole. However, the share of this particularly distorting instrument is constant in Japan, and even increases in the USA. In the European Union and New Zealand, these payments based on output are mainly replaced by payments based on area planted or number of animals (this instrument is used to orient the productions types), and, to a smaller extent, by payments based on inputs used, which usually respond to environmental concerns.

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In the USA, the policy is different, since the evolution has mainly consisted in replacing headage payments by payments based on past entitlements, input constraint and on overall farm income. Payments based on past entitlements "are made without obligation to plant or produce any specific commodity, are not linked to current production and are therefore potentially less production and trade-distorting than other major forms of support to producers. Payments based on overall farming income act as income safety nets and are potentially much more equitable, and better targeted and tailored to farmers income needs than payments based on past entitlements" (OECD, 2001, p.21). Since the data available do not permit to distinguish between these two instruments, it is difficult to tell whether the American support has become more or less equitable than before.

The graph also shows that, in Japan, the composition of support has remained almost constant over the period, as previously noted using the other typology of support instruments.

We have seen that agricultural instruments have evolved towards a weaker link between production and support, since a large share of agricultural support has switched from price support towards direct payments. This evolution has some balanced consequences that are briefly presented now.

1.2.2.4 Towards decoupled instruments ?

The evolution of agricultural support towards less production-based support (and, hence, towards more direct payments) is named "decoupling", and is supposed to generate less distortions: Decoupled measures consist in supporting farmers in a way that does not, or at least as little as possible, distort production, consumption and trade. Decoupled measures have even been accepted in the WTO agreement as entering into the "green box", which reveals their non-distortionary aspects[3].

Truly decoupled instruments may be difficult to identify. For instance, it is often argued (cf, inter alia, Buckwell, 1997) that the main goal of direct payments, at least in the short run, is to replace price

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[3]In the WTO negotiations, there is a classification of agricultural policy measures according to their degree of distortion creation and, hence, according to their need of dismantlement. The "green box" gathers instruments considered as fully decoupled, which have no or very little effect on productions and exchanges. The cost of these instruments is only borne by tax-payers. The "green box" instruments are exempted from internal support diminishing commitments. On the contrary, coupled instruments, as support prices, enter into the "red box", and their level has to diminish. Finally, the "blue box" gathers partly-decoupled instruments: They are still accepted provided they are linked to production reduction commitments.

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support. Therefore, in terms of overall trade distortions, these two instruments might have rather similar effects, and the decoupled aspect of direct payments might be false. Moreover, according to Berthelot (2001), direct payments are distorting on a world level since only rich countries (with a well developed tax system) can afford them, while market price support is more easily implementable in any country.

Decoupled measures and the development of direct payments can also lead to a problem of support identification. Indeed, direct payments are included when measuring agricultural support. However, one of the goals of direct payments is to remunerate environmental and rural development services, which cannot be remunerated through the market because they mainly concern public goods for which no market exists. Therefore, this remuneration should not be included into the agricultural support calculations. A better way of measuring agricultural support would be to measure final trade distortions, and to avoid any intermediate measure of support. Indeed, with the increase of the use of direct payments, it would become more difficult to distinguish between protection of the domestic agricultural sector and remuneration of environmental and social services through an intermediate measure of support. To this extend, the development of decoupled instruments might lead to false conclusions regarding the evolution of farm support.

It has been noticed that agricultural policies had evolved in roughly the same way in many OECD countries. In order to get a clearer view of this evolution, the next section presents the European Common Agricultural Policy (CAP), its objectives, instruments, results, and the reforms that have been implemented in recent years. Many of the statements made about the CAP could be applied, with minor modifications, to other OECD countries.

1.2.3 Mechanisms of the Common Agricultural Policy

This section presents the European agricultural policy before the implementation of any liberalization measures. The objectives of the policy are first reviewed, the instruments aiming at

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reaching these objectives are presented, and the results are finally assessed. It is shown how these results have led to the necessary implementation of reforms.

1.2.3.1 Objectives of the CAP

In the Treaty of Rome, which laid the foundation of the European Union and came into force on 1st January 1958, the special position of agricultural policy was recognized in a separate article. Indeed, the implementation of the Common Agricultural Policy was, from an administrative point of view, an important step in the process of European unification. Article 39 of the Treaty of Rome describes the goals of the CAP as:

- to increase agricultural productivity and to ensure a fair level of wealth for people working in this sector;

- to stabilize agricultural markets;

- to guarantee food supply security, which, in other words, means increasing agricultural production in order to reach self-sufficiency;

- to guarantee reasonable food prices to consumers.

To achieve these objectives (which can also be seen as constraints of the agricultural policy), several instruments are needed; they are presented now.

1.2.3.2 Main instruments of the Common Agricultural Policy

Although many instruments have been implemented, only the three main instruments are presented in details here: Market price support, deficiency payments and direct payments. They correspond to the largest share of support.

Market price support

Market price support consists in artificially raising domestic agricultural prices, which become higher than international market prices, for both consumers and producers. For instance, in the pre-

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reformed CAP, domestic prices of agricultural products benefiting from market price support were, on average, 40 % higher than international prices. Market price support is achieved through administrated prices, exports subsidies and tariffs. Indeed, it becomes necessary to tax imports and to subsidize exports, otherwise competition with non-European producers would be unsustainable for European farmers. For some specific crops, price support policies are combined with production quotas and / or land set-aside in order to try to limit production. In the European Union, production quotas were particularly strong for milk. These complementary instruments appeared progressively in the CAP history, in order to deal with international constraints.

Market price support is usually used for products which are produced in large quantities and regionally dispersed. Although this kind of support has declined since the 1980s in all OECD countries, it still remains the main agricultural instrument used. For instance, in the European Union, it represented 84 % of PSE in 1986-1988 and "only" 52 % in 1996-1998 (in absolute value the decrease is even larger considering the fact that the level of PSE has decreased as well, from 46 to 39 % of world price) (source: OECD, 1999). The reasons for the decrease in the use of market price support are both productive and distributive: This instrument is more distorting than other kinds of support, because it is less visible. Moreover, it is the least suitable instrument for targeting specific groups of farmers with income transfers. Indeed, the distribution of transfers through price support is very similar to that of output, hence it is not redistributive at all on the supply side. On the demand side, the main drawback of market price support is that lower income consumers pay a disproportionate share of transfers relative to their income, since they consume proportionally more agricultural products (they are usually inferior goods).

Deficiency payments

Deficiency payments are subsidies per unit of output, equal to the difference between a target price (usually the one fixed by market price support) and the market price. This instrument provides direct support to farmers' income, without affecting the price paid by consumers, which is assumed to follow world market fluctuations. Deficiency payments are usually used for products whose production is

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limited and highly localized. Otherwise, administrative costs, and hence distributive leakages, may be too high, as deficiency payments require implementation and supervision at farm level.

On the supply side, they suffer the same distributive drawback as market price support, since the larger the production, the larger the deficiency payments received. On the demand side, their distribution effects depend on how progressive or regressive the taxation system is.

Direct payments

Direct payments consist in direct income support and are conditional on the quantities of factors owned and on their use, but are independent of current or future production. For instance, payments can favor extensive productions in poor areas. Land set-aside schemes is another example of direct payments, since producers are offered payments to reduce the acreage allocated to a certain use. Direct payments can also be based on an invariable production volume (corresponding to the estimated output in the non-intervention situation, or to the past individual or regional average output, for instance), but farmers are not required to produce this level to receive the payment. For distributive reasons, direct payments often have a ceiling.

Direct payments are the most suitable instrument for transferring income to specific groups of farmers. Their use has increased significantly in the last decade, to represent 31 % of total Producer-Subsidy-Equivalent in OECD countries in 1997. In France, the average direct payments received by a farm have been multiplied by 5 between 1991 and 2000.

However, direct payments have quite high administrative costs, as they take place at farm level. It is for this reason that they were initially limited to marginal or localized productions. On average, direct payments are more equally distributed than market price support and output, but the difference is still quite modest. This reflects the continuing strong link between most direct payments and output or factors of production.

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Less commonly used agricultural policy instruments

- input subsidies (on fuel or fertilizer, for instance);

- insurance or storage at a price lower than the market price;

- concessional credit, equivalent to interest subsidies;

- research and training;

- transport concessions.

All these instruments have been implemented over 30 years in the European Union (from the 1960s to the 1990s). Their results are now examined, according to the main objectives they were given.

1.2.3.3   Results of the CAP

To evaluate the results of the CAP, the CAP situation has to be compared with the initial goals of the policy. Success in three of the goals is easily monitored: Productivity, self-sufficiency, and evolution of farmer's well-being.

The evolution of agricultural productivity

In the EU, over the period 1970-1987, the average growth rate of total factor productivity (TFP) was higher in the agricultural sector than in the manufacturing sector, unlike in the USA and in Japan, as is shown in the table below:

TFP average growth rate between 1970 and 1987, in % per year:

country	agriculture	manufacturing
USA	1.5	1.6
Japan	-0.2	4
EU	3.4	2.1

source: Bernard and Jones, 1996. p.138, and author's computations.

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These figures show the success of the CAP regarding the modernization of the European

agricultural sector. The rise in the agricultural TFP was mainly due to an increase in labor productivity,

reflected in the decrease in the number of agricultural workers while agricultural output increased.

This evolution of productivity in the agricultural sector has logically led to a positive evolution of

the self-sufficiency situation of the European Union.

The self-sufficiency objective

The European Common Agricultural Policy over-achieved its objectives regarding self-sufficiency[4],

and the EU generated surpluses in many agricultural commodities, which had to be stocked in order to

maintain market prices. This surplus problem has been most serious for dairy products, cereals, beef,

sugar and wine. Maintaining huge stocks was not possible in terms of either physical storage costs

or interest charges on the value of the stock. For instance, stocks cost 3 700 millions ecus in 1991

(equivalent to 6.1 % of EU budget)[5]. Hence, it has been necessary to find some means of disposal. They

have consisted in:

- Subsidizing the exports: This has been the cause of much concern in other exporting countries,

since subsidized European exports have undercut other exporters on the world market;

- Increasing domestic utilization, by subsidizing the use of surplus products (mainly milk and

wheat) as livestock food;

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[4]Self-sufficiency ratios in the European Union for some representative products from 1968 to 1993 (a self-sufficiency ratio below 100 means that the country is not self-sufficient and has to import the product, and vice versa for a self-sufficiency ratio above 100):

	1968	1993
cereals	86	126
sugar	82	135
beef	93	107
all agricultural products	22	76

The European Union became a net exporter for many agricultural products in the early eighties (source: Folmer, Keyzer et alii, 1995, p.40).

[5]However, this statement has to be put into perspective since, in the 1980s, stocks of many agricultural products in the United States were close to a year's consumption (cf Lewis, Feenstra and Ware, 1989, p.159).

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- Providing food aid to developing countries;

- The remainder was kept in stock in order to avoid dumping on international markets or because prices were expected to rise in the future. However, some stocks have also been discarded as they could not be kept for too long.

There is no doubt that the CAP reached its self-sufficiency objective. However, the objective of improving the farmers' well-being was not so successfully met. Indeed, while the CAP managed to increase globally farmers' income, its policy has also led to some new distributive drawbacks.

Distributive drawbacks of the CAP

Regarding income distribution, the CAP faced the same problems as other agricultural policies in industrialized countries. First, in all OECD countries, agricultural support is unequally distributed among farmers, and is often concentrated on a small number of commodities, in certain regions and on large farms, thereby accentuating income disparities. Indeed, since the bulk of agricultural support in OECD countries is provided in the form of market price support, distribution of support is not far from that of output: The largest farms (which are usually also the most prosperous ones) are thus the main beneficiaries of support policies. Despite the existence of payments targeted to smaller farms, their share in total support is still too small to influence significantly the overall distribution. This leads to a positive relationship between farm income and support. In this sense, support is inequitable: In the European Union, the top 25 % of farms in terms of gross sales receive 68 % of total support and represent 72 % of output (OECD, 1999). These farms are generally characterized by both higher household incomes and higher net worth than those of the average consumer and tax-payer who finance these transfers. To this extent, the CAP has not reached its objective of ensuring a fair level of wealth for the farmers.

Another distributive problem faced by the Common Agricultural Policy is that, like any other kind of support, agricultural support may suffer some leakage, if some income gains accrue to groups other than the intended beneficiaries. An OECD study estimates that "only about 25 % of the money spent on producer support actually finds its way into the producer's pocket" (OECD, 1999). Indeed, the support

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is either capitalized into asset values, particularly land, or is transferred up or down the food chain to inputs suppliers or processors and distributors. This problem is one of the reasons why payments not linked to production may be a more effective means of providing support to farmers that really need it, although not costless when administrative and taxation costs are taken into account.

For these reasons, inter alia, some reforms of the European agricultural policy were implemented. They broadly resemble the agricultural policy reforms implemented in other OECD countries.

1.2.4   The CAP reforms

This section presents the reasons that led to the decisions of reforming the CAP; it explains the objectives of the reforms, how they were implemented, and their results.

1.2.4.1   Reasons for the reforms

At the beginning of the 1990s, reforming the CAP became unavoidable for three main reasons:

- A purely internal reason: As the European Union had become a net exporter of agricultural products since the 1980s, exports subsidies accounted for much more than imports taxes. Hence, the CAP was less and less self-sufficient, its budget had become far too high, and drastic measures had to be taken to reverse the situation. The highest point was reached in 1985 when CAP accounted for 73 % of European budget.

- A purely external reason: Compliance with the Uruguay Round Agreement obligations compelled the European Union to liberalize its agricultural sector. Indeed, the Uruguay Round cycle of international trade negotiations was the first one to include the agricultural sector into the negotiations. One goal of these negotiations was to reduce trade barriers and subsidies on agricultural products, in order to reduce distortions on world agricultural markets. In fact, agricultural policies in developed countries have led to over-production and protectionism, which may have contributed to the world

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price decline and instability observed during the last four decades for many agricultural products[6].

Concretely, agricultural liberalization measures aim to restore progressively the equality between border and domestic prices, and producers' and consumers' prices. This integration of the agricultural sector into the global liberalization trend ended up in 1994 by the signature of the Marrakech Agreements. They compel industrialized countries to reduce the level of agricultural domestic support by 20 % from their 1986-1988 level, to reduce the value of subsidized exports by 36 % from their 1986-1990 level, and to reduce the global level of protection (including non-tariff barriers, which have to be completely eliminated) by 36 % in 6 years (between 1994 and 2000). The European Union signed these agreements after several years of negotiations, and therefore had to apply them.

- Finally, a reason that is both internal and external: The enlargement of European Union towards East European countries in the near future compelled the CAP to evolve. Since income levels are lower in these countries than in the EU, so are agricultural prices (in 1995, agricultural prices were 40 to 80 % lower in East European countries than in the EU). Hence, East European consumers would be unable to afford the high CAP support prices unless wages rose, which would in turn affect the competitiveness of the non-farm sector. Moreover, for East European farmers, the CAP prices would be a bonanza that could not be justified politically. Last, applying the pre-reformed CAP to East European countries would be financially unbearable since East European countries still have a much larger agricultural sector than the EU[7].

1.2.4.2 Objectives and implementation of the reforms

Given the reasons just presented, and given the shape of the European agricultural policy, the main objective of the CAP reforms adopted in 1992, 1998 and 2000 was to lower the level of agricultural price support, so that domestic prices become closer to international ones. This was expected to reduce

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[6]However, this evolution is also due to other factors: Price decline may be due to productivity gains in the agricultural sector, while price instability may be explained by specific features of the sector, such as low elasticity of demand and risk considerations due to the time gap between production decisions and sales for instance.

[7]The agricultural sectors in the Central and Eastern Europe countries that are in the first adhesion plan:

surpluses and to freeze agricultural expenditures between 1999 and 2006, so that the agricultural budget stays at its 1999 level of 40.5 billion Euros (48 % of the European Union budget, down from 73 % in 1985). Moreover, changing from a price support scheme to payments to farmers shifts the funding burden from consumers to tax-payers, and may be fairer, both on the production and the consumption side: On the production side, it would lead to a fairer distribution of support; on the consumption side, it would lead to a fairer distribution of the cost of agricultural policies.

In practice, the CAP reforms have led to two main changes in policy: A change in the instruments used, and a change in the funding of the agricultural policy.

Changes in the instruments used

The main aim of the CAP reforms has been to reduce the price support level (with a maximum of 30 % for cereals, oilseeds and beef). A part of the losses of the producers is compensated for by deficiency payments. Another compensation scheme consists in direct aids to producers who have volunteered to practice a more extensive agriculture; these compensatory payments are linked to a fixed factor such as land. This new system is supposed to be less distortionary, since it is "decoupled" (: not, or less, linked to production). Moreover, the compensation measures (deficiency and direct payments) are supposed to be transitory. However, the question of their level and duration is not very clearly stated in the reform agenda. Regarding their level, they are "fixed with reference to (high) EU prices determined by past policies". Therefore, they should not last forever, and "should be offered only on decreasing amounts

data for 1995	Agricultural gross value added in % of GDP	Agricultural employment in % of global employment
Czech Republic	5.2	6.3
Estonia	8.1	13.1
Hungary	6.2	8.0
Poland	7.6	26.9
Slovenia	5.0	7.1
EU15	2.4	5.3

source: Gower and Redmond 2000, adapted from p.90.
The adhesion of the first group of countries in the EU "will increase EU population by 16.7 % but add another 22.5 % to the EUs agricultural land and 31 % to the EUs arable land." (Gower and Redmond 2000, p.91).

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and for a limited period of time"(Henrichsmeyer and Witzke, 2000, p.96). Otherwise, compensatory payments would not solve many of the distributive problems linked to price support. They would only allow to reduce the CAP expenditures, since the change in the instruments used leads to an evolution of the funding of the CAP. This evolution is examined in the next section.

Changes in the funding of the CAP

The CAP reforms have led to changes in its funding, regarding its distribution between European and national levels, and between consumers and tax-payers.

The common financial responsibility has always been one of the principles of the CAP, meaning that expenses incurred as a result of the CAP are financed at the European level. Following this rule, deficiency payments are fully financed by the EU as well. However, their implementation requires more administration at the individual farm level than the price support scheme. Hence it leads to a greater national influence on the system. This more decentralized system should be more efficient and fairer as it should deal more easily with heterogeneous situations, and be directed to specific target groups (lower income people). Moreover, although the common financial responsibility remains an important principle in the reformed CAP, each country may have to participate more in the policy funding since the CAP will become less self-funded via import levies. Indeed, since these levies will decrease with the decrease in the domestic support price, national participation may have to increase.

The changes in the funding of the CAP induced by the reforms has also an influence on the distribution of funding between consumers and tax-payers. Indeed, the reformed CAP is increasingly financed by government expenditures (direct transfers) instead of being funded by consumers (high food prices). It makes the support for agriculture more "visible", but it also makes its funding potentially fairer, since it becomes based on tax-payers' income and no longer on agricultural consumption levels. Industrialized countries have sufficiently well developed tax systems to be able to raise money for a new purpose without entailing significant deadweight losses, and on an income basis (cf Munk, 1997).

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The first CAP reform decision was adopted in 1992, so its results can already be analyzed, in order to see whether it led to the expected consequences.

1.2.4.3 Results of the CAP reforms

The results of the CAP reforms are examined according to three criterions: The evolution of the farmers' income, of the production surpluses, and the respect of the budgetary constraints. The choice of these three criterions responds to some implementation constraints. Indeed, if the farmers' income suffers too much from the reforms, they would hardly be implementable, for political lobbies reasons. If the results of the reforms are not visible in the European Union budget, stronger measures would be adopted. Therefore, the results studied are some important ones, although many other criterions could have been presented.

The mean European agricultural income increased slightly after 1992 (with, however, all the inequalities a mean result can hide), whereas it had previously been stagnant, or, before 1988, even decreasing. It suggests that the recent compensatory payments have been more efficient than the previous market price support to reach the objective of farm income support. This evolution legitimates a partial compensate of the farmers for the price support decrease. Indeed, the Agenda 2000 CAP reform has adopted a regressive payments scheme, with compensation ranking from 50 to 80 % of the previous level, according to the products. However, small farmers could be entirely compensated.

The surpluses of agricultural products decreased after 1992: For cereals, the surplus declined from 44 million tons in 1992 (equivalent to 0.075 % of the EU production) to 26 million tons in 1995 (0.05 % of the production). For beef, it shrunk from one million tons in 1993 (52 % of the EU production) to 82 000 tons in 1995 (4.3 % of the production). It shows that an agricultural support less linked to production levels is very efficient to decrease surpluses, and, consequently, to reduce the cost of its management. Indeed, the CAP budgetary commitments were respected after 1992, as the share of the CAP in the EU budget decreased from 73 % in 1985 to 48 % in 2000. This evolution can be seen in the following graph, which represents the EU budget and agricultural expenditures as percentages of the EU GDP:

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The EU expenditures
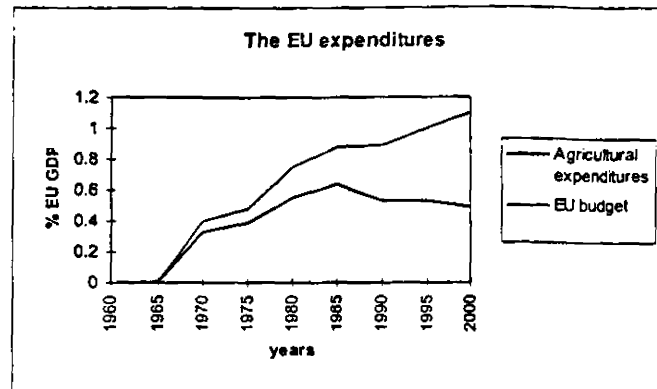
On the three criterions chosen, the reforms were thus particularly successful. However, even with the CAP reforms, domestic European agricultural prices are still well above world levels and liberalization measures still have to go on in order to comply with international agreements. This may have some serious consequences for farmers.

We have discussed the global links between the agricultural policies and the evolution of the agricultural sector in some OECD countries. The next part focuses on the particular link between agricultural policy and income distribution, inside the farm sector and between this sector and the rest of the society. This link raises the issue of the changing definition of farmers.

1.3 Income distribution and the changing definition of a farmer

From a political economic point of view, if the farmers' average income becomes equal or even larger than the average income of the whole population, there is no longer any justification for agricultural policy to try to increase farmers' income. And, in fact, in all OECD countries, an increase in the farmers' income has been observed so that it converges to that of the rest of the society. However, this rise in farmers' income is mainly due to an increasing share of non-farm income in farm households' income. This raises the issue of the boundary between a farmer and a non-farmer. The

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comparison between the farmers' and non-farmers' incomes depends greatly on who is regarded as a farmer. In the European Union, one main feature is still that those who own the land are mainly those who work on it. Hence, land ownership seems to be a good means of distinction between farmers and non-farmers when comparing their well-being.

Moreover, agricultural development and policies in OECD countries are increasingly linked to rural development. Indeed, far fewer farmers are needed to cultivate the land, but many people live in rural areas. This new feature, added to the fact that more and more farmers have off-farm activities in their neighborhood, means that agricultural policy has an increasing impact on the non-farmer population. In other words, the farmer and non-farmer populations become more and more linked. For instance, about one third of the total OECD population lives in rural areas (which represent more than 90 % of the national territory in OECD countries) and, in many countries, rural areas contribute more than half of total employment (OECD, 1998, p. 23). In the more specific case of France, it is notable that, in 1990, only 10 % of rural households were active agricultural households -and 11 % were retired agricultural households- (source: Mendras, 1995).

This can lead to a constant political weight of the agricultural sector, since the rise in the rural population might partially (or even more than partially) compensate for the reduction in farm population. However, farmers and rural non-farm population may have some conflicts of interest regarding agricultural policy; for instance, the rural non-farm population is usually more sensitive to environmental issues than the farm population.

This section first compares the well-being of farmers and non-farmers. It then analyzes the impact of changes in the agricultural sector on income distribution.

1.3.1 The farmers' well-being compared to the rest of the society

Farmers used to be poorer than the rest of the society, and this is still the case, on average, in developing countries. However, in industrialized countries, this has become less and less true. In fact, a

relationship seems to exist between the economic development of a country, the share of its agricultural sector and the relative well-being of farmers compared to the rest of the society: The more developed the country, the smaller is its agricultural sector, and the richer are its farmers compared to the rest of the society.

The main goals of agricultural policies in OECD countries were set up several decades ago, at a time when the agricultural sector was far more important than it is nowadays and farmers were significantly poorer than the rest of the society. Since these features are no longer true, the goals of agricultural policies should evolve together with the society, or, in other words, they should take into account the evolution of the ratio between the farmers' and non-farmers' well-being. When speaking about well-being, wealth and income have to be distinguished. Indeed, even if farmers' households receive a smaller income than the rest of the society, they often own more assets than average.

The next two paragraphs hence consider farmers wealth and income.

1.3.1.1 The farmers' households wealth

Farmers have a particular status compared to the rest of the society, since they often own the business in which they work. Hence, even if their income is lower than average, their wealth (consisting in farm buildings, land, and other specific assets) might be higher than average. Gardner (2000, p.1062) reports that, in the United States, "very few farm households (in the neighborhood of 1 %) are poor under the triple criterion of low income, consumption and net worth". Indeed, Hill (2000, p.310) remarks that farmers "are frequently holders of wealth which is substantial and typically above that of non-farmers. In the USA in 1986, the average farm equity of farm operator households whose incomes fell below the poverty line was substantially above the all-households average net worth. Among the farm households in poverty, more than half [...] had an average farm equity (net worth) over 3 times the national all-households average".

These examples focus on the USA, but they could be extended to most OECD countries, where the majority of farmers own the land they cultivate, as well as the farm buildings they use. Hence, even

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if farmers earn less than the average income, assessing their well-being is not so easy because of the value of their wealth. And, before drawing any conclusion, it is worth looking precisely at the evolution of farmers' income with respect to the rest of the society.

1.3.1.2 The farmers' households income

Farmers' income has been catching up the non-farmers' one over the last 4 decades in all OECD countries. Consequently, since the beginning of the 1990s, farm households' income has become comparable or even sometimes higher than average income.

Hill (2000, p.215) displays some data that show how farmers' income has caught up with that of non-farmers in the USA:
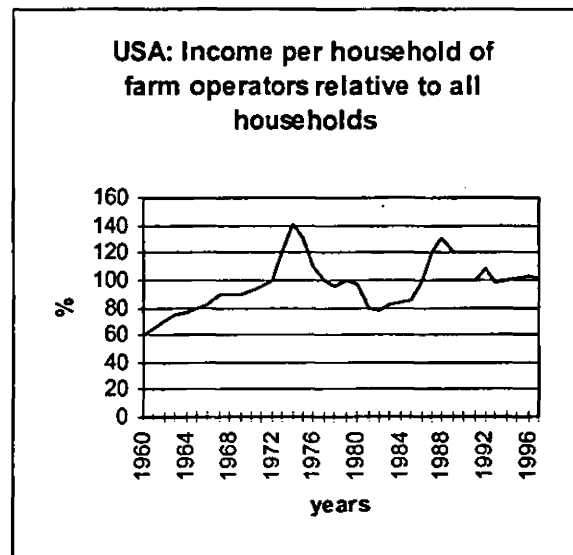
Hill remarks that the evolution of the farmers' / non-farmers' income ratio is due to an increase of the farmers' income faster than the increase of the non-farmers' income. Indeed, Gardner (2000, p.1060), examining more recent US data, remarks that "the average income of farm household has grown in the 1990s to exceed that of the average non-farm household: 59 700 $ for farm-operator households compared to 51 900 $ for the US average household in 1998". This evolution can also be noticed in

Japan, where "the incomes of farm households have risen [...] and the disparity between average farm and non-farm household incomes has been eliminated in recent years" (OECD, 1995, p.38).

In the European Union, the trend is globally the same, and Hill (1996a, p.39) notices that "agricultural households enjoy, everywhere in the EU except Portugal, a level of disposable income per household above or close to the all-households average".

However, this positive evolution has to be moderated in two ways: First, one has to be cautious with the household income criterion. Indeed, in all OECD countries, a farm household tends to be larger and to consist of more generations than the national average[8]. This leads to per capita results different from household results. For instance, in Japan, "while the average level of total household income in the farm sector is higher by 30 % than that of the non-farm sector, [...] farm households earnings, on a per earner basis, are slightly lower than those of wage and salary earners as a whole, because of the larger number of earners of farm households compared with urban households" (OECD, 1995, p.23). Munk (1997) presents the relative income of farmers as "the income per person employed in agriculture relative to the income per person employed in the economy as a whole". Building this index on data from the OECD and the EU Commission, he concludes that, over the period 1980-1990, the European relative income of farmers represented only 36.4 % of the income of the rest of the society. And the ratio was 41.4 % for OECD as a whole, and 64 % in the USA. Munk also notes that "the countries with the greatest disparities between agricultural incomes and non-agricultural incomes tend to provide the highest levels of assistance." However, he does not deepen the analysis to investigate the causality of this relationship.

The second moderating argument to bring to the positive evolution of farm income compared to non-farm income regards the composition of farm income. Indeed, more and more farmers also have non-farm activities, and these off-farm activities are mainly the ones that have allowed farmers' income to catch up with the rest of the society. For instance, an OECD study (1998, p.47) dealing with all the OECD countries emphasizes that, "when income derived from non-farm sources is taken into account,

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[8] In Eurostat (1986, 1990) Family Budgets-Comparative Tables, the average numbers of persons per household were as follows (all households, followed by households headed by farmers and agricultural workers): Belgium 2.9, 4.2; Germany 2.4, 4.3; Spain 3.6, 4.3; France 2.7, 3.4; Netherlands 2.7, 4.2 (reported by Hill, 1996a, p.39).

farm households seem to have average disposable income (i.e. after tax) on a par with the average of all households". However, when the purely agricultural income is compared to the income of the other sectors, it usually remains lower.

These new features of the agricultural sector point to the need for a more precise description of the role of off-farm activities and non-farm incomes for farm households.

1.3.2 Impact of agricultural sector changes on income distribution

The new features of the agricultural sector, by many means, alter the distribution of income between farmers and non-farmers, and also among farmers themselves. The first reason for this is the development of off-farm activities among farmers. Besides, agricultural liberalization also has an impact on agricultural income distribution. Finally, all these changes lead to an evolution of the definition of a farmer.

1.3.2.1 Increase of off-farm work among farmers

In all OECD countries, a common trend can be noticed regarding the development of off-farm activities among farmers. Some differences can however be noticed: "The larger and more diverse the non-agricultural rural sector, the more likely it is that farm households will be able to obtain a non-agricultural employment to help to maintain or increase household incomes. Likewise, the more dependent a region's economy is on farming, [...] the less likely the operator is to work off-farm as the lack of alternative opportunities for the employment of farmers labor in the region provides an incentive for farmers to expand their farms to achieve fuller employment and higher incomes" (OECD, 1998, p.29).

There are two main ways of taking into account the importance of off-farm work among farmers: By comparing the working hours spent on the farm to total working time, or by comparing the income earned on the farm to total income. In terms of working time, it can be noted that, "in the EU 12, of the

15 million people working in agriculture in 1993, only one-quarter worked full-time" (OECD, 1998, p.44). Regarding the USA, in 62 % of the farm households, the farm operators primary occupation is not farming. In Japan, over 84 % of commercial farms are classified as part-time, meaning that one or more household members are engaged in jobs other than farming. In terms of income earned, the feature is even more salient: European farm households who earn their main income from off-farm activities are often referred to as *marginal agricultural households.* "They represented in 1987, and for the EU 12, 62 % of the holdings, but, on average, they received only less than 10 % of their total income from agriculture" (Hill, 1996a). The importance of off-farm income can also be gauged by the fact that, while farmers' income has increased in the European Union for the last decade, net farm income has steadily decreased since 1996 by approximately 3 % each year. This shows that farmers earn an increasingly large share of their total income from off-farm jobs (OECD, 2000). For the USA, Hill (2000, p.254) notes that "off-farm income is important as an income source, accounting for 89 % of household income of farm operator households in 1995. Within this total, wages and salaries contributed 53 %, off-farm business income 13 %, interest and dividends 8 %, and other off-farm sources 16 %. Farming only provided 11 %. And only 20 % of farm operator households in the 1990 and the 1992 survey received more from their farm than their off-farm sources". In Japan, the average share of off-farm income in total farm family income was 62 % in 1993 (OECD, 1995, p.15).

We have seen that farmers' income has recently increased mainly because of the development of non-farm income. However, the income distribution between farmers remains a current issue that has not been eliminated by the evolution of the farmers' / non-farmers' income ratio. In fact, this issue has even become more salient with the development of off-farm activities among farmers.

1.3.2.2 Income distribution between farmers

In the European Union, "income disparities among agricultural households are wider than among households in general. Consequently, adequate average incomes among agricultural households may be consistent with greater relative proportions of farm households that fall below a given poverty

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line" (Hill, 1996c, p.87)[9]. This characteristic of the farm sector has even been stressed by the development of non-farm income among farmers. Indeed, in all OECD countries, the richest farmers are part-time farmers, whose total income increases thanks to non-farm income. And, in the European Union, the "lowest total incomes are associated not with the smallest farms and those generating the smallest incomes from farming but with those somewhat larger, typically those which are too large to be operated on a part-time basis but too small to generate an adequate income from farming to support a household" (Hill, 1996b, p.160).

In the USA, the same features can be observed: "The total incomes of farm operator households are more unequally distributed than are households in general in the USA. A higher proportion of farm operator households were below the poverty line than all US families (21.9 % and 10.7 % respectively) and also more were recipients of very high incomes (6.3 % and 4.3 %)" (Hill, 2000, p.258). More precisely, it can be noted that, in 1999, US farm households headed by operators whose primary occupation was farming had an average household income of 55 000 $, compared with 70 000 $ for farm households headed by operators whose primary occupation was off-farm. Hill (2000, p.254) notes that, in the USA, "the households with the highest incomes not only have substantial incomes from farming (and produce nearly half of all agricultural output) but they also have the greatest average incomes from off-farm sources."

In Japan, the farmers who earn "more than 50 % of income [...] from non-farm jobs have the highest incomes. By contrast, average incomes of full-time farm households have been consistently lower than both part-time farm households and urban households" (OECD, 1995, p.23).

Finally, it has to be noted that, in almost all OECD countries, "the share of part-time farmers is higher than the share of farmers with other gainful activities. This raises the question of the existence or extent of disguised unemployment among farm households" (OECD, 1998, p.45). Indeed, for some farmers, farm work on only a part-time basis may be more suffered than wanted, and they may want to

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[9] Indeed, everywhere in the European Union, excepted Ireland, Germany and the Netherlands, there are proportionally more poor people in the agricultural population than in the whole population. For instance, Hill (1996c) reports that, in 1988, 31 % of Italian farmers were below the poverty line, compared to 23 % of the whole population; in France, there were 25 % of farmers compared to 16 % for the whole population.

work more in-farm but the lack of inputs other than labor may impede them from this, and they lack job opportunities off-farm.

There is little doubt that there exists a relationship between the development of off-farm activities and income inequalities among farmers. But the evolution of income distribution between farmers is also linked to the recent evolution of agricultural policies in industrialized countries. The next paragraph presents the different links, direct or indirect, wanted or unwanted, between agricultural policies and income distribution in the farm sector.

1.3.2.3 Impact of agricultural policy reform on income distribution

The evolution of the farm sector is characterized by a change in some income distribution features: There is an increase in farmers' income compared to the rest of the society, an increase in the share of off-farm activities, and an evolution of income inequalities between full-time and part-time farmers. The main links between income distribution features and agricultural policy measures seem to be threefold:

- Agricultural policy has an impact on income distribution in the farm sector;

- and, since the sector is evolving, the policy has also to evolve in order to take into account the new features of the sector;

- finally, because the agricultural sector is evolving, its responses to agricultural policy evolve as well.

The first part of the link, going from agricultural policy measures to the evolution of the sector, would follow several routes: First of all, agricultural liberalization measures "will affect relative costs and profitability of the resources used in agriculture and would set in motion a dynamic adjustment process. Resources with higher value in alternative uses will be the first to be withdrawn from agricultural production. In this way, it could be expected that the brunt of adjustment would be borne by hired labor and borrowed capital rather than family labor " (OECD, 1998, p.72). It would also be borne by land, the price of which would decrease since it has limited alternative uses. However, it is difficult

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to draw straightforward conclusions about the extent of this link and the influence of policy reforms on off-farm activity, since it would imply perfectly isolating one effect from another. Indeed, Benjamin and Guyomard (1994, p.81) argue that the CAP reform, and, more precisely, "the reduction in cereals price and the (land) set-aside would induce a decrease in the (agricultural) reservation wage, hence an increase in the probability of off-farm participation. On the other hand, the receipt of the compensatory payment would have a negative impact on the probability of off-farm work participation. Therefore, the total effect is indeterminate."

The other part of the link between agricultural policies and the evolution of income distribution would go from the new features of the agricultural sector to desirable changes in policy. The development of off-farm activities probably prevents a large number of farmers from migrating to non-farm jobs. But it also necessitates the implementation of adapted agricultural policies. Indeed, most of the existing policies aim to increase the agricultural income of farmers, who are defined as working exclusively on a farm. Since this framework is no longer the most common one in OECD countries, agricultural policies need to evolve in order to take into account the larger integration of farmers into the rest of the economy. Moreover, the simple goal of increasing farmers' income is no longer justifiable since their total income is now on the same level as the average income of the whole society. Agricultural policies should hence be more targeted to specific farmers.

Finally, the new features of the sector lead to different responses from farmers to policy reforms. Indeed, "engagement in off-farm work can have an important role during agricultural policy reform, cushioning farm households from income pressures which emerge from reform of agricultural policies. Many farm households, particularly in more remote rural areas, are dependent on a single or very limited farm production sources for their incomes. By enabling farm households to diversify their income sources, pluri-activity can contribute to diversification and lower exposure to farm-sector events" such as policy reforms (OECD, 1998, p.44). A more extreme point would take the reverse part of the proposition and argue that the development of part-time farming would give scope for a stronger

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reduction in price support with less need for equivalent compensation by direct payments since there is a lower dependence on farm earnings.

These three links occur simultaneously, and it is therefore difficult to identify which link is the most salient, or which is the one that happens first. Moreover, the impact of agricultural policy reforms on income distribution also depends on inputs ownership. Indeed, agricultural sector liberalization has an influence on the remuneration of the inputs used in the sector. Therefore, depending on who owns these inputs, different income distribution implications can occur. It is hence necessary to have a clear statement about the recent trends in the use and ownership of agricultural inputs in OECD countries.

1.3.2.4 Use and ownership of agricultural inputs

The impact of agricultural policy on the income of the agents through their inputs ownership mainly passes through labor and land. Indeed, since land is not (or hardly) mobile, its remuneration depends a lot on agricultural policies. As for labor, it is mobile but its movements have important social consequences, either in terms of off-farm work of farmers, or in terms of farmers fully moving to the non-farm sector. Therefore, the influence of agricultural policies on labor is likely to lead to important income distribution consequences. The capital input is not studied because its remuneration does not depend (or very little) on agricultural policies, since it is mobile (at least in the mid-term) from one sector to another, and since agricultural sector has a very small weight in industrialized economies.

Therefore, the impact of agricultural policy on income distribution changes with the identity of the owners of labor and land used in the farm sector. A distinctive feature of farm labor in OECD is the preponderance of family labor. In 1990, the share of family labor in French farms was 91 %. And the figure is more or less the same for all OECD countries, with an extreme case in Japan, where non-family labor represents only 0.5 % of farm labor (source: OECD, 1998). Regarding agricultural land ownership, direct ownership by land-user is the rule in almost all OECD countries. For instance, in the European Union, more than 2/3 of agricultural land is owned by its users, and this is increasing[10]. For the majority

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[10]Three countries in the European Union are an exception to this trend: They are France, Belgium and the UK, where direct

of European countries, the letting of private land outside the farm family is of minor importance, and "the tenancy is predominantly a short-term device used for intergenerational succession" (Ravenscroft et al., 1999, p.10). The fact that agricultural land is mainly owned by its users is, to a large extent, linked to the legal context of land ownership. Indeed, the use of land is usually highly regulated, and farm land can be switched, in the short run, to another use only with difficulty. However, this feature is less salient in the USA, where about 45 % of cropland is rented.

Given all these features of the agricultural sector, we can now try to give a definition of an agricultural household that would represent the recent evolution of the sector.

1.3.2.5 The changing definition of an agricultural household

The persons who are referred to as farmers do not represent the same reality now and some decades ago. Indeed, in most OECD countries, an agricultural household is traditionally defined as a household "where the main income of the reference person (usually the individual with the largest income) comes from independent activity in agriculture (that is, from self-employment as a farmer)" (Hill, 1996 a, p.34). However, according to this narrow definition, the number of agricultural households in all OECD countries "is substantially smaller than the number of households where there is some income from farming, and generally smaller than the number of agricultural holdings" (Hill, 2000, p.268). This feature obviously represents the development of off-farm activities by farm households. It shows that the traditional definition of a farm household became too narrow, since it excludes many households that are associated with agricultural holdings but where agriculture is not the main source of income (or occupation) of the holding head. In order to take into account these "marginal agricultural households" as agricultural households, a broader definition has to be considered. It would include all the households where any of its members earns some income from agriculture.

Therefore, before analyzing the impact of agricultural policy reforms, it is necessary to clearly define who is a farmer, and to answer the following question: Is a farmer someone working on a farm,

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ownership is decreasing, and no longer represents the majority of agricultural land.

even very little, and with other off-farm activities ? Or is he someone whose main income comes from agricultural activities ? The answer to these questions has important consequences for the evaluation of the liberalization policies. Indeed, "if assistance for income support is to be directed at those who derive most of their income from farming, it means that many households who operate holdings will be deemed to fall outside the sphere of interest of agricultural policy. This will mainly involve the smallest holdings" (Hill, 1996b, p.160). This is one of the reasons why the evolution of the European agricultural sector makes an adaptation of the agricultural policy necessary, otherwise it will become ever more unfair. Indeed, "the general low income dependence of small farms on farming, coupled with their relatively small volumes of output, imply that the present system of income support is highly inefficient in terms of welfare transfer. Under current commodity support regimes, a very high proportion of transfers accrue to a relatively small proportion of farmers - those who are the largest producers." (Hill, 1996b, p.160).

Considering the evolution of off-farm activities of many farmers households, and the land ownership features of the European Union, two specifications of an agricultural household appear relevant in order to study the distributive impact of agricultural policy. They are the following:

- An agricultural household is a household which owns some land. It can split its working time between farming and non-farming activities, it will remain an agricultural household, provided a small amount of resources (in input) continues to be dedicated to the agricultural sector. This definition would take into account marginal agricultural households. With this definition, the proportion of farmers (agricultural households) in the society would not change in the short run with agricultural policy. Indeed, land-owners would take some time before deciding to sell their land. And it is realistic to think about land-owners as always dedicating some part of their labor (and hence as always earning some income) to (from) the agricultural sector. When the sector is liberalized, it may become less profitable to work in it, and land-owners may dedicate more work-time to off-farm jobs. Nevertheless, they would still be regarded as farmers[11]. We now turn to the second way of defining a farmer.

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[11] It is realistic to assume that they will not totally abandon on-farm work. Indeed, once farmers, people usually only stop farming because they grow old or face bankruptcy.

- An agricultural household is a household which allocates (the main part of) its labor to the agricultural sector. It corresponds to the traditional definition, where an agricultural household is a household whose head earns the main part of his income on the farm. Following this definition, the proportion of farmers (agricultural households) in the economy evolves with agricultural policy, since some resources (inputs) are moved from the agricultural sector to other sectors when the agricultural sector is liberalized. Indeed, someone who reduces his work-time on a farm to increase his work-time in off-farm jobs may, according to this definition, stop being a farmer and become a non-farmer.

The first definition seems to be more realistic nowadays, since the large majority of the farmers in OECD countries are part-time farmers but still own the land they work on. However, many agricultural policy measures are still designed for a context in which agricultural households dedicate all their work-time to farming. Hence, some agricultural measures might now be unsuitable.

1.4 Conclusion

This chapter has shown that the evolution of agricultural policies in many OECD countries is towards less public intervention. This evolution of the policies is, at the same time, a cause and an effect of the evolution of the farm sector towards farmers being less and less full-time farmers. This evolution has been presented in this chapter for industrialized countries. The last chapter of the thesis shows that this evolution also occurs in developing countries. In industrialized countries, this trend is mainly due to the fact that less and less labor is needed in the agricultural sector and that off-farm jobs are often better remunerated. However, part-time farmers remain linked to the sector by land ownership and other cultural features. This evolution makes necessary to change the way to think about and to define a farmer in industrialized countries. It also makes necessary to change the agricultural policy instruments. It is actually what is done in the European Union, with the reforms of the Common Agricultural Policy. On an income distribution perspective, the results of these liberalization measures change according to the definition given to a farmer. Indeed, depending on whether a farmer is defined as someone working

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full or part time in the agricultural sector, different instruments will have different effects on his welfare. Therefore, agricultural policy has to adapt to the evolution of the farm sector, but it also has to define precisely to whom it is directed. The next two chapters study how the effects on income distribution of different liberalization policies change when a farmer is defined more or less realistically as working exclusively in the agricultural sector or only partially.

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Chapter 2

A model of agricultural liberalization in the European Union

2.1 Introduction

The first chapter has presented the reforms of the European Common Agricultural Policy which took place in the 1990s. The present chapter gives a quantitative assessment of the welfare consequences of these agricultural liberalization measures in the European Union. It is done in a two-sector neoclassical general equilibrium model. The welfare of two representative agents (farmer and non-farmer) is assessed in terms of permanent consumption, and is compared when different agricultural policies are implemented, for different definitions of a farmer. Indeed, as presented in the first chapter, according to the reality one wants the "farm households" to represent, the results of agricultural policy reforms change. The model developed in this chapter permits to identify the best agricultural instruments and their sequencing of implementation according to the objectives of the society. It shows that, even though the number of European farmers is small, the debate over whether it is justifiable to compensate them for liberalization measures in their sector, and how it should be done, is not only a political and social problem, but an economic one as well.

The next section of this chapter very briefly presents a literature review of the models assessing welfare consequences of the agricultural sector liberalization. Section 3 develops the specifications of the model built to answer our issues, while section 4 describes how it is solved. Section 5 explains the different scenarios of liberalization studied. Sections 6 describes the results given by the model and section 7 concludes.

2.2 A brief literature review

Models used to assess the consequences of agricultural sector liberalization can be distinguished according to their technical features or according to their results (these two things are in fact often linked). General equilibrium models study the impact of agricultural liberalization on the whole economy. Partial equilibrium models are only applied to the agricultural sector, or to one agricultural product, and consider the other sectors' characteristics as exogenous. Many models are multi-countries general equilibrium models[12]. Some mono-country models also exist, and often focus on large developing countries[13]. Models applied to industrialized countries are usually partial equilibrium models[14]. Some of these models have results in favor of a complete agricultural liberalization, claiming that it will ensure a net gain for all countries. Others show that liberalization may be harmful to developing countries, or to some social groups, at least in the short run. Last, some models have results showing that liberalization would not change significantly what is considered as the main issue of agricultural world markets: Price volatility, which is regarded by the authors of these models as endogenous[15].

Models' results depend on their technical specifications, so one has to be cautious when interpreting these results. For instance, many of the models stating that liberalization is welfare improving are partial equilibrium models: By construction, agricultural price policy decreases global welfare by increasing distortions. Even if some social groups lose out on agricultural liberalization, they can be compensated for by the gains obtained by other social groups in the same country[16]. Models stating that some countries or some social groups may lose out on agricultural liberalization are both

[12]cf, for instance, Harrison, Rutherford and Tarr (1995), Francois, Mac Donald and Nordstrom (1994) or Goldin, Knudsen and van der Mensbrugghe (1993).

[13]cf, for instance, Anderson (1998), Warr (1997), Islam and Thomas (1996) or Martin and Winters (1996).

[14]cf Henrichsmeyer and Witzke (2000), Parry (1999), Roger (1999), OECD (1998), Folmer and Keyser and al.(1995), Moschini and Sckokai (1994).

[15]This literature argues that any nonlinearity in supply or demand functions may lead to chaotic prices or quantities series, even in a deterministic model (cf Burton 1993, Chavas and Holt 1993, Boussard 1996). Hence, liberalization would not change this feature.

[16]These statements are developed, inter alia, by Bale and Lutz (1979), Sarris and Freebaim (1983), Miranda and Helmberger (1988), Anderson and Tyers (1993).

partial and general equilibrium ones. However, for partial equilibrium models, only dynamic ones arrive at these kinds of conclusions[17]. These models show that agricultural policy may be, in some cases, welfare improving, mainly by reducing price volatility.

In this literature, very few general equilibrium models have been specifically applied to industrialized countries. In fact, Chambers (1995) notes that, "although farm programs are ubiquitous, relatively little formal analysis has been devoted to their incidence upon the rest of the economy. And even though studies of agricultural pricing policies in developing countries routinely account for general equilibrium interactions, any analysis that has been done for developed countries has been largely restricted to single-sector, partial equilibrium analysis based upon the comparison of Harberger triangles" (p. 318). In fact, even though the agricultural sector is small in industrialized countries, the development of a general equilibrium model would appear to be useful since the links between agricultural and non-agricultural sectors are important: Agricultural sector liberalization may induce income effects on the whole economy, as a result of resource reallocation across sectors. Moreover, agricultural sector liberalization has an impact on government budget, since agricultural policies often weigh more heavily in governments' budgets than one might expect given the percentage of farmers in labor force.

2.3 Presentation of the model

2.3.1 General presentation of the economy

The model represents the European Union in a general equilibrium framework that allows all the feedbacks and indirect effects of agricultural policies to be taken into account. Indeed, in industrialized countries, agricultural policy mainly aims at redistributing income from consumers or tax-payers to agricultural producers, therefore all the facets of the economy are concerned. Countries

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[17]cf Chauveau and Gordon (1988), Zwart and Blandford (1989), Scandizzo (1992), Warr (1997) and Anderson (1998).

are not distinguished inside the European Union since we are interested into agricultural policies (which are the same in all EU countries) and into the definition of the farmers (which does not depend on countries). Therefore, the European Union is represented as a large open economy, and the rest of the world is not modeled. Since the studied economy is open, there is room for trade policy, such as export subsidies or import taxes. And since it is a large economy, interest rate and relative prices are endogenously determined. Indeed, the market clearing value of the agricultural relative price (when there is no government intervention) serves as a benchmark in the simulations of the changes in agricultural policy: It is used as a proxy of world price. Indeed, since the European Union is a large exporter of agricultural products, it plays an important role in world markets.

The model is made up of two sectors: Each one produces an aggregate homogenous good. One sector represents the agricultural part of the economy (sector 1), whereas all the other activities are aggregated in the non-agricultural sector (sector 2). The non-agricultural good is taken as numeraire. In each sector, a representative producer-consumer is modelled: He produces only one product but consumes both. Each representative agent represents a group of persons: The representative agent named as "farmer" represents all the farmers of the society, while the representative agent named as "non-farmer" represents all the non-farmers of the society. The agricultural sector is studied as a whole, rather than distinguishing between specific crops. This is justified by the fact that the elasticity of substitution between different agricultural products is much higher than the elasticity of substitution between agricultural and non-agricultural products in the agents' consumption. Although this simplification removes a part of the complexity of agricultural policies, it allows for a more general view of the agricultural sector and policies. The resulting model is simpler than it would have been if different groups of agricultural products had been included, and it is easier to understand the links between different effects of a policy. Since only one agricultural good is considered, this good is assumed to be a normal one. Therefore, Giffen effects are excluded. Endowments are assumed to be exogenous; they regard only inputs, not produced goods. Leisure is not taken into account in the model, and hence so nor are labor supply decisions in each household.

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European stylized facts show that the European domestic price of agricultural products is between 20 and 40 % higher than world price. This price wedge between the market clearing price and the exogenous price set by agricultural policies (or between the world price and the domestic price), can be either due to price support scheme or to tariffs or quotas (the quota case is not specifically studied here since it has been shown that, in a Walrassian equilibrium, it is always possible to find a tariff equivalent to a quota[18]). It is assumed that only the home country taxes imports and subsidizes exports. Therefore it is abstracted from any retaliation behavior. It is also assumed that economic policy only consists in acting in the agricultural sector, so that the domestic price of the non-agricultural good is the same as its world market price. It is assumed that all goods are mobile internationally, while inputs are not, and that there is no international ownership of input. Therefore, the possibility of international capital transfers to fund temporary imbalances in trade is ruled out. All these assumptions, more or less realistic, are justified by our goal of studying agricultural policy effects on income distribution. Therefore, the features of the European economy with little link with this issue are not modeled here.

The market clearing condition in the agricultural sector is:

$$Y_1 = C_1 + NX_1 \tag{2.1}$$

Since agricultural price depends on agricultural policy, it is exogenous and hence does not play its role of connection between supply and demand. Therefore, some surplus (net exports) NX_1 may exist (it is a surplus and not a deficit because the agricultural price is set at a level higher than the market clearing one). This surplus represents the difference between domestic production (Y_1) and domestic consumption (C_1); actually this difference is not necessarily exported, and can be kept in stock. However, in both cases, there is a cost for the domestic government, representing either the export subsidy or the stock cost (it is assumed for simplicity that these two costs are equal).

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[18] cf Sumner 2000, Alston, Carter and Smith 1993. However, tariff and quota are not equivalent when considering income distribution, that might be different in the two cases due to the appropriation of the quota rent. The quota case is not taken into account in this paper but should be developed in further analysis.

It is assumed that all investments are in non-agricultural goods, leading to the following market clearing condition in the non-agricultural sector: (δ represents the depreciation rate of capital)

$$Y_2 = C_2 + \dot{K} + \delta K + NX_2 \qquad (2.2)$$

The non-agricultural production (Y_2) has to be equal to the consumption of non-agricultural goods (C_2), the net exports of agricultural products (NX_2) and the investments ($\dot{K} = \frac{\partial K}{\partial t}$ represents the increase of capital over time, and δK represents the renewal of depreciated capital).

A flexible exchange rate is assumed, and the trade balance is:

$$pNX_1 + NX_2 = 0 \qquad (2.3)$$

for p representing the relative price of the agricultural product.

The government budget constraint is:

$$(p - p_w) NX_1 + \tau Y_1 + NT = 0 \qquad (2.4)$$

This equation means that the agricultural net exports (NX_1) are subsidized at a rate equal to the wedge between domestic (p) and world price (p_w). These subsidies are funded by negative net transfers (equivalent to net taxes) coming from the agents ($NT > 0$ is a net transfer from the government to the agents; if $NT < 0$, it is a tax paid by the agents to the government). These taxes are also used to subsidize agricultural production at the rate τ.

2.3.2   The supply side

Production technologies in each sector are represented by Cobb-Douglas functions. This is of course a limitation since it assumes that the elasticity of substitution between the inputs is 1. However, the choice of a Cobb-Douglas technology may be a valuable first approximation of a problem. This approximation is actually quite widespread in the agricultural economics literature dealing with welfare questions, and seems to lead to little difference in results compared to those obtained with

estimated functional forms [19]. The obvious advantage of a Cobb-Douglas specification is that it allows for simplifications in computations and calibrations.

Both sectors are assumed to exhibit constant returns to scale. In the case of the non-agricultural sector, this is justified by the fact that it is made of so many different sectors that, on average, there are constant returns to scale. Many agricultural economists also agree on this assumption for the agricultural sector in the long run [20]. In fact, it has been suggested that lack of economies of scale and constant returns to scale are the primary reason why firms in agriculture are smaller than firms in industry. Moreover, one can observe that, in the same country, a large number of farms of different sizes can coexist for a long time within a common economic environment. Considering the aggregate agricultural output, the unit cost of production hence seems to be quite independent of the output size[21].

The same technological trend is incorporated in the two production functions and it is assumed to have the same growth rate in both sectors. Indeed, over the last twenty years, in the most advanced countries, agricultural factor productivity (output per unit of input) has been increasing faster than productivity in the rest of the economy (cf Ruttan and Hayami, 1985; Antonelli and Quadrio-Curzio, 1988, introductory chapters). This may reflect the fact that the agricultural sector had to catch up with the rest of the economy in terms of productivity. As this catch-up cannot last for decades, it is assumed in this model that this adjustment is finished, and therefore that there is a common technological factor Z in both sectors. Moreover, this simplification could be justified by the assumption of investment-embodied technological change (cf Solow, 1960; Hercowitz, 1998): The main part of technological change goes through new investments, no matter in which sector they take place. Hence, sector-specific technological change (disembodied) is of minor importance.

Technological change is assumed to be Harrod-neutral, meaning that it is labor and land-augmenting: Technological change raises the output in the same way as an increase in labor or land.

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[19]cf Newbery (1987, p.13).

[20]cf Johnson and Ruttan (1994, p.692).

[21]cf Boussard (1988).

This kind of neutrality of the technological change is needed in neo-classical growth model in order to stay consistent with the existence of a steady state.

The law of motion of the technological change Z is represented by:

$$\frac{\dot{Z}}{Z} = h$$

where $\dot{Z} = \frac{\partial Z}{\partial t}$

In steady state, all the variables only grow at the rate of this technological progress. Hence, in order to get the value of the steady state variables, some new variables have to be defined as the initial ones divided by the technological trend Z, such that the new variables become stationary in the steady state situation.

Agricultural production function uses capital (K_1), labor (L_1) and land (T). The non-agricultural production uses only capital (K_2) and labor (L_2). Capital and labor are perfectly mobile across sectors (which is justified at least in the long run), and are assumed to be always fully employed (unemployment does not enter into our concern of evaluation of the agricultural policies). Land is an immobile fixed factor assumed to be fully used, at least at the sector level (it may be mobile between farms, however). Its value is calibrated in order to get a realistic value of the agricultural / non-agricultural productions ratio. The capital is the only accumulable input because it is abstracted from demographic growth (since it is quite small in industrialized countries). In both sectors, capital is assumed to depreciate at the same rate δ.

The agricultural production function has the following shape:

$$Y_1 = F(ZL_1, K_1, ZT) = (ZL_1)^\alpha (K_1)^\gamma (ZT)^{1-\alpha-\gamma} \tag{2.5}$$

$0 < \alpha < 1$

$0 < \gamma < 1$

$0 < \alpha + \gamma < 1$

The non-agricultural production function is:

$$Y_2 = G(ZL_2, K_2) = (ZL_2)^\beta (K_2)^{1-\beta} \tag{2.6}$$

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$$0 < \beta < 1$$

2.3.3 The demand side

The same intertemporal utility function is defined for both representative agents:

$$U^i = \int_0^\infty \exp\left(-\rho t\right) \left[\mu \ln C_{1t}^i + (1 - \mu) \ln C_{2t}^i\right] dt \qquad (2.7)$$

for i: A or NA (farmer or non-farmer);

μ represents the share of agricultural products in consumption; $0 < \mu < 1$.

ρ is the rate of time preference, which is assumed to be the same for both representative agents.

The arguments of the utility function are the consumption levels of agricultural (C_1) and non-agricultural goods (C_2), since it is assumed that the agents do not value leisure. The same utility function is used for both representative agents. Indeed, in industrialized countries, it is difficult to distinguish between farmers and non-farmers according to their consumption level of agricultural and non-agricultural aggregate goods: It has been shown in the first chapter that a European farm household is not poorer than an average household of the society. Regarding utility function, instead of a distinction between farmers and non-farmers, a more relevant distinction would be between "rich" and "poor", whether farmers or not, as the "poor" consume relatively more agricultural goods than the "rich"[22]. However, the "poor" in Europe are usually not "poor enough" to justify such a distinction, as their relative consumption of agricultural goods is not very different from that of the "rich". So, only one type of utility function is defined.

The budget constraint of each agent is such that the present value of consumption and investment equals the present value of income, i.e. wealth. Each agent receives (or pays) some net transfers from (to) the government. These are assumed to be lump-sum transfers and not to depend on wealth or income of the agents. This simple framework is coherent with the goal of assessing welfare modifications between farmers and non-farmers, without distinguishing different level of income or wealth inside each group.

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[22]The "poor" are usually defined as people whose income is below poverty threshold, i.e. below half the whole society median income. As food demand is quite inelastic to income, it represents a larger share in "poor" budget than in "rich" one.

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The agents receive a remuneration from renting their inputs (labor, capital and land). Each agent owns some assets A_i (i = A, NA, standing for "farmer", "non-farmer") made up of capital used in agricultural and / or in non-agricultural sectors; hence we have, for all t:

$$A = K = K_1 + K_2 = A_A + A_{NA} \tag{2.8}$$

for K_1 = capital used in the agricultural sector

K_2 = capital used in the non-agricultural sector

A_A = capital (asset) owned by the farmer

A_{NA} = capital (asset) owned by the non-farmer.

$\dot{A}=\dot{K}$ is needed for all t. However, $\dot{A}_A$ may be different from $\dot{K}_1$, as well as $\dot{A}_{NA}$ may be different from $\dot{K}_2$. It means that the capital owned by the farmer may be growing at a different rate than the capital used in the agricultural sector (and reciprocally for the non-farmer and the non-agricultural sector), since farmers and non-farmers do not necessarily invest in their own sector. Indeed, since the remuneration rate of capital is the same in both sectors, households are indifferent between the two sectors when investing. It has already been noticed that, in the European Union, it is meaningless to distinguish between farmers and non-farmers according to their wealth. Hence, the assets A_A and A_{NA} are initially fixed such that, in the reference situation without government intervention, the per capita permanent consumption levels are equal. This assumption is justified by the fact that the aim of the paper is to study the wealth (and hence the welfare) distribution evolution after a change in agricultural policy. Hence, to evaluate these changes, it is more convenient to start from an initial situation where wealth per capita is fairly distributed.

We have seen in the first chapter that the agents can be defined in two ways: A farmer can be someone owning the land, even if he works very little in the farm sector; or he can be defined as someone working exclusively in a farm. And reciprocally for a non-farmer. The next two sections distinguish these two cases.

2.3.3.1 The agents are only defined according to their inputs ownership

In this case, the distinction between farmers and non-farmers only consists in the fact that farmers own the land, while non-farmers do not. It is assumed that the number of farmers and non-farmers in the society is constant in the short-run. Each of the two representative agents is endowed with an amount of labor corresponding to the share of its group in the labor force. Therefore, it is assumed that this labor ownership distribution is constant over time. As the total amount of labor in the model is normalized to 1 and since demographic growth is not taken into account, it is assumed that the farmer owns 4 % of labor ($L_A = 0.04$) while the non-farmer owns 96 % ($L_{NA} = 0.96$). These figures represent the actual share of farmers and non-farmers in European labor force. Net transfers are distributed among agents according to their fixed weight in the society as well. Hence, the net transfers received (or paid) by farmers (NT_A) are such that $NT_A = L_A * NT = 0.04\ NT$, and, for non-farmers, we have: $NT_{NA} = L_{NA} * NT = 0.96\ NT$. The same distribution is assumed for wealth: $A_A = L_A * A = 0.04\ A$, and $A_{NA} = L_{NA} * A = 0.96\ A$.

The growing share of farmers having a part-time job in the non-agricultural sector is represented by the fact that the labor used in the non-agricultural sector (L_2) is not necessarily owned by the non-farmer (L_2 is not necessarily equal to L_{NA}, neither L_1 and L_A). Since it is much more likely to observe "farmers" working off-farm rather than "non-farmers" working in the agricultural sector, it is likely to observe: $L_2 > L_{NA}$ and $L_1 < L_A$.

In this context, the farmer's intertemporal budget constraint is:

$$\int_0^\infty \exp\left(-\rho t\right)\left[NT_A\left(t\right) + \varpi\left(t\right)L_A + q\left(t\right)T + r\left(t\right)A_A\left(t\right)\right]dt \qquad (2.9)$$

$$= \int_0^\infty \exp\left(-\rho t\right)\left[\dot{A}_A\left(t\right) + \delta A_A\left(t\right) + C_2^A\left(t\right) + p\left(t\right)C_1^A\left(t\right)\right]dt$$

for $A_A\left(0\right) = A_{A0}$

and the non-farmer's one is:

$$\int_0^\infty \exp(-\rho t)\left[NT_{NA}(t) + \varpi(t) L_{NA} + r(t) A_{NA}(t)\right] dt \qquad (2.10)$$

$$= \int_0^\infty \exp(-\rho t)\left[\dot{A}_{NA} + \delta A_{NA}(t) + C_2^{NA}(t) + p(t) C_1^{NA}(t)\right] dt$$

for $A_{NA}(0) = A_{NA0}$

for r, ϖ and q: rental rates of capital, labor and land respectively;

ρ = rate of preference for the present;

for p = relative price of the agricultural product.

From these intertemporal budget constraints, we get the permanent consumption (PC) streams of the agents, actualized at the interest rate.

For the farmer:

$$PC_A = A_A + \frac{\varpi}{r} L_A + \frac{q}{r} T + \frac{NT_A}{r} \qquad (2.11)$$

For the non-farmer:

$$PC_{NA} = A_{NA} + \frac{\varpi}{r} L_{NA} + \frac{NT_{NA}}{r} \qquad (2.12)$$

The whole society permanent consumption is defined as the sum of the two agents' permanent consumption levels:

$$PC = PC_A + PC_{NA} \qquad (2.13)$$

We now turn to the other definition of the agents, and examine what it changes in the determination of their permanent consumption streams.

2.3.3.2 The agents are defined according to the sector in which they work

In addition to the previous definition where the farmers' group was defined as the land owners, they are now more restrictively defined as the group of persons working exclusively in the agricultural sector (and reversely for the non-farmers, as the persons working exclusively in the non-agricultural sector). The permanent consumption level of the farmers' group becomes:

$$PC_A = A_A + \frac{\varpi}{r} L_1 + \frac{q}{r} T + \frac{NT_A}{r} \qquad (2.14)$$

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The fixed number of farmers in the society (L_A) is replaced by a variable number of persons working in the agricultural sector (L_1). Since in this definition a farmer is someone working in the farm sector, its labor is represented by the labor used in the agricultural sector (L_1). As a consequence of this new definition of the agents, the definition of net transfers changes as well:

$$NT_A = L_1 * NT \tag{2.15}$$

And the amount of asset owned by the farmers becomes:

$$A_A = L_1 * A \tag{2.16}$$

And the same applies to the non-farmers' group; their permanent consumption level becomes:

$$PC_{NA} = A_{NA} + \frac{\varpi}{r}L_2 + \frac{NT_{NA}}{r} \tag{2.17}$$

for

$$NT_{NA} = L_2 * NT \tag{2.18}$$

$$A_{NA} = L_2 * A \tag{2.19}$$

If a farmer becomes a non-farmer, he sells his land to other farmers, so land remuneration remains inside the farmers' group. Hence permanent consumption levels of the whole groups of farmers or non-farmers is not affected by this transaction, since land remuneration is always part of the farmers' group income. Proceeds of land sale received by a farmer when he becomes non-farmer are not taken into account because it is assumed that each farmer only owns a small amount of land, and its sale represents only a small portion of the agent's income. When a farmer becomes a non-farmer, he keeps his asset A, therefore the asset ownership of one group of agents (farmers or non-farmers) is always represented by the share of this group in the labor force times the global level of asset in the economy.

Since the model has now been fully described, its resolution is presented in the next section.

2.4 Resolution of the model

Before solving the model, some normalizations are done such that the main endogenous variables get divided by the technical change, in order to obtain their steady state value. The model can then be

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solved analytically for steady state. As suggested by some stylized facts, it is assumed that one sector (the non-agricultural) is always more capital-intensive than the other (the agricultural); the steady state is therefore ensured to be stable and uniquely determined (cf Uzawa, 1962, p.40). Practically, the model is first solved for its competitive equilibrium, which allows to give the optimal resources allocation between the two sectors and the two agents. The model is then solved for the social planer program, which gives the global level of capital and consumption in the economy. The model is finally calibrated for the values of the European economy and liberalization scenarios are run.

2.4.1 Some definitions and normalizations

$$k_1 = \frac{K_1}{L_1 Z}, \quad k_2 = \frac{K_2}{L_2 Z}, \quad k = \frac{K}{LZ} \tag{2.20}$$

$$y_1 = \frac{Y_1}{L_1 Z}, \quad y_2 = \frac{Y_2}{L_2 Z} \tag{2.21}$$

$$y_1 = f\left(k_1, \frac{T}{L_1}\right) = (k_1)^\gamma \left(\frac{T}{L_1}\right)^{1-\alpha-\gamma} \tag{2.22}$$

$$f_1\left(k_1, \frac{T}{L_1}\right) = \frac{\partial f\left(k_1, \frac{T}{L_1}\right)}{\partial L_1} = f\left(k_1, \frac{T}{L_1}\right) - f_2\left(k_1, \frac{T}{L_1}\right) k_1 - f_3\left(k_1, \frac{T}{L_1}\right)\frac{T}{L_1} \tag{2.23}$$

$$f_2\left(k_1, \frac{T}{L_1}\right) = \frac{\partial f\left(k_1, \frac{T}{L_1}\right)}{\partial k_1} \tag{2.24}$$

$$f_3\left(k_1, \frac{T}{L_1}\right) = \frac{\partial f\left(k_1, \frac{T}{L_1}\right)}{\partial\left(\frac{T}{L_1}\right)} \tag{2.25}$$

$$y_2 = g(k_2) = (k_2)^{1-\beta} \tag{2.26}$$

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$$g_1(k_2) = \frac{\partial g(k_2)}{\partial(L_2)} = g(k_2) - g_2(k_2) \tag{2.27}$$

$$g_2(k_2) = \frac{\partial g(k_2)}{\partial(k_2)} \tag{2.28}$$

$$c_1^A = \frac{C_1^A}{LZ}, \quad c_2^A = \frac{C_2^A}{LZ} \tag{2.29}$$

$$c_1^{NA} = \frac{C_1^{NA}}{LZ}, \quad c_2^{NA} = \frac{C_2^{NA}}{LZ} \tag{2.30}$$

$$\lambda = \Lambda ZL, \quad \phi = \Phi ZL, \quad \psi = \Psi ZL \tag{2.31}$$

$$L_A + L_{NA} = L_1 + L_2 = L = 1 \tag{2.32}$$

$$\Leftrightarrow k = L_1 k_1 + L_2 k_2 \tag{2.33}$$

2.4.2 The competitive equilibrium problem

Solution to the maximization problem of consumers and producers is uniquely determined by the first order conditions and the transversality conditions. Indeed, since preferences are concave and technologies are convex, second order conditions for an interior solution are always satisfied. In order to study the impact of agricultural policy on endogenous variables, these variables must be expressed as functions of the policy instruments p, τ and of the parameters. The model is first solved for a situation where there is no government intervention, which allows the market clearing price to be determined.

The values of the variables are then determined in other situations in which the price becomes higher than the market clearing price and in which there is a subsidy to production.

2.4.2.1   The production side

$$Max \ \Pi_1 = (1+\tau)\, pF\left(ZL_1, K_1, ZT\right) - \varpi L_1 - rK_1 - qT \tag{2.34}$$

$$Max \ \Pi_2 = G\left(ZL_2, K_2\right) - \varpi L_2 - rK_2 \tag{2.35}$$

The first order conditions gives:

$$(1+\tau)\, pf_3\!\left(k_1, \frac{T}{L_1}\right) = q \tag{2.36}$$

$$(1+\tau)\, pf_1\!\left(k_1, \frac{T}{L_1}\right) = \varpi = g_1(k_2) \tag{2.37}$$

$$(1+\tau)\, pf_2\!\left(k_1, \frac{T}{L_1}\right) = r = g_2(k_2) \tag{2.38}$$

Since capital and labor are mobile between the two sectors, their marginal productivity after implementation of the agricultural instruments need to be equal.

2.4.2.2   The consumption side

For the farmer

$$Max \ U_A\left(C_1^A, C_2^A\right) = \int e^{-\rho t}\left[\mu \log C_1^A + (1-\mu)\log C_2^A\right] dt \tag{2.39}$$

st

$$\dot{A}_A = (r - \delta)\, A_A + \varpi L_A + qT + NT_A - pC_1^A - C_2^A \tag{2.40}$$

The first order conditions give:

$$\frac{\mu}{C_1^A} = \Lambda p \tag{2.41}$$

$$\frac{1-\mu}{C_2^A} = \Lambda \tag{2.42}$$

$$\frac{\dot{\Lambda}}{\Lambda} = \rho - r + \delta \tag{2.43}$$

for Λ : shadow price of the asset accumulated by the farmer.

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For the non-farmer

$$Max\ U_{NA}\left(C_1^{NA}, C_2^{NA}\right) = \int e^{-\rho t}\left[\mu \log C_1^{NA} + (1-\mu)\log C_2^{NA}\right] dt \qquad (2.44)$$

st

$$\dot{A}_{NA} = (r - \delta) A_{NA} + \varpi L_{NA} + NT_{NA} - pC_1^{NA} - C_2^{NA} \qquad (2.45)$$

The first order conditions give:

$$\frac{\mu}{C_1^{NA}} = \Phi p \qquad (2.46)$$

$$\frac{1-\mu}{C_2^{NA}} = \Phi \qquad (2.47)$$

$$\frac{\dot{\Phi}}{\Phi} = \rho - r + \delta \qquad (2.48)$$

for Φ : shadow price of the asset accumulated by the non-farmer.

2.4.3 The social planner program

$$Max \int_0^\infty e^{-\rho t}\left(U_A\left(C_1^A, C_2^A\right) b + U_{NA}\left(C_1^{NA}, C_2^{NA}\right)(1-b)\right) dt \qquad (2.49)$$

for b: weight of the farmers, 1-b: weight of the non-farmers

subject to the market clearing conditions:

$$C_1^A = F\left(ZL_1, K_1, ZT\right) - C_1^{NA} - NX_1 \qquad (2.50)$$

$$\dot{K} = -\delta K + G\left(ZL_2, K_2\right) - C_2^A - C_2^{NA} - NX_2 \qquad (2.51)$$

The Hamiltonian of this program is:

$$H = e^{-\rho t}\left(U_A\left(F\left(ZL_1, K_1, ZT\right) - C_1^{NA} - NX_1, C_2^A\right) b + U_{NA}\left(C_1^{NA}, C_2^{NA}\right)(1-b)\right) \qquad (2.52)$$

$$+ \Psi\left(-\delta K + G\left(Z\left(L - L_1\right), \left(K - K_1\right)\right) - C_2^A - C_2^{NA} - NX_2\right)$$

for Ψ : shadow price of capital accumulation.

The first order conditions of the Hamiltonian are directly expressed for the variables divided by the technological trend:

$\frac{\partial H}{\partial C_2^A} = 0 \Leftrightarrow$

$$\frac{b(1-\mu)}{c_2^A} = \psi \tag{2.53}$$

$\frac{\partial H}{\partial C_2^{NA}} = 0 \Leftrightarrow$

$$\frac{(1-b)(1-\mu)}{c_2^{NA}} = \psi \tag{2.54}$$

$\frac{\partial H}{\partial \Psi} = \dot{K}$ and 2.31, 2.42 and 2.47 gives:

$$\frac{\dot{k}}{k} = -\delta + \frac{g(k_2)(1-L_1)}{k} - \frac{1-\mu}{k}\left(\frac{1}{\lambda} + \frac{1}{\phi}\right) - \frac{nx_2}{k} - h \tag{2.55}$$

$-\frac{\partial H}{\partial K} = \dot{\Psi} \Leftrightarrow$

$$\frac{\dot{\psi}}{\psi} = \rho + \delta + h - g_2(k_2) \tag{2.56}$$

$\frac{\partial H}{\partial L_1} = 0$ gives:

$$\frac{b\mu}{c_1^A} f_1\left(k_1, \frac{T}{L_1}\right) - \psi g_1(k_2) = 0 \tag{2.57}$$

$\frac{\partial H}{\partial K_1} = 0$ gives:

$$\frac{b\mu}{c_1^A} f_2\left(k_1, \frac{T}{L_1}\right) - \psi g_2(k_2) = 0 \tag{2.58}$$

2.4.4 The steady state

The model is solved for its 20 endogenous variables:

$k_1, k_2, k, L_1, L_2, y_1, y_2, r, \varpi, q, c_1^A, c_2^A, c_1^{NA}, c_2^{NA}, \lambda, \phi, \psi, nt, nx_1, nx_2$

Using the 20 equations representing the heart of the model:

The two production functions (equations 2.22 and 2.26), the labor normalization (equation 2.32), the 5 FOC on the production side (equations 2.36, 2.37 and 2.38), 4 FOC on the consumption side (equations 2.41, 2.42, 2.46 and 2.47), the 2 market clearing conditions (equations 2.50 and 2.51), 4 FOC of the social planner program (equations 2.55, 2.56, 2.57 and 2.58), the trade balance (equation 2.3) and the government budget constraint (equation 2.4).

The model is first solved analytically, and some values are then applied to the parameters. The detailed route to solve the model is presented in the appendix A, and the values of the parameters are presented in the next section.

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2.4.5 Values of the parameters

The model period is one year, and all parameter values are reported in yearly terms. The stylized facts of the European society show that the share of food in households' expenditure (μ) seems to have an asymptotic level close to 16 % (cf INSEE, 2000 a, b, c). Although the share of food is higher than the share of agricultural products in households' consumption, food is considered here to be roughly equivalent to agricultural products. According to the stylized facts, the growth rate of the technological trend (h) is set to 1.15 %. The rate of preference for the present (ρ) is the same for both agents and is set to 3 %, while the depreciation rate of capital (δ) is set to 10 %, as is usually done in the literature. Hence we have:

δ	ρ	h	μ
0.1	0.03	0.015	0.16

On the production side, the stylized facts show that, in the agricultural sector, the share of labor income is around 60 % (α), the share of capital is around 20 % (γ), and the share of land is also 20 % ($1 - \alpha - \gamma$). Stylized facts also show that the share of labor income in the non-agricultural sector is around 2/3 (β) and the share of capital is around 1/3 ($1 - \beta$). Hence we get:

α	β	γ
0.6	0.67	0.2

Assuming slightly different factor shares does not significantly change the results of the scenarios of the model.

When the model is solved for these values of the parameters, it gives values of the steady state variables that reflect the corresponding quantities of the European data (agricultural production represents between 2 and 8 % of total GDP, according to the agricultural policies implemented, and the agricultural labor force accounts for 1 to 4 % of total labor force).

These values of the parameters are applied to the analytical solution of the model, and some liberalization scenarios can then be run.

2.5 Agricultural liberalization measures

Changes in endogenous variables values are studied while different agricultural policy reforms are implemented: The suppression of a price support scheme, its replacement by production subsidies and by some lump-sum transfers to agricultural producers. These measures are actually the ones implemented in the CAP reforms and presented in the first chapter. More precisely, changes in endogenous variables are first examined for the situation when the price support scheme is eliminated and nothing else is implemented to compensate the farmers for (however, if this scheme leads to an increase of the global welfare of the society, some direct payments could be given to farmers, depending on political considerations). This would be a complete one-step liberalization measure. Afterwards, a more progressive measure is studied, in which the price support scheme is first replaced by deficiency payments so that farmers keep the same production price. In a second step, this deficiency payments scheme is removed as well, and possibly replaced by direct payments.

In these scenarios, the welfare changes of the agents are assessed through changes in their permanent consumption levels, expressed as a share of their initial levels. This method follows Lucas (1987, chapter 3, p.20-31) and limits discussion to changes affecting consumption of goods-in-general, and hence abstracts from issues involving changes in the proportion of each good in total consumption. The rate of change of permanent consumption is assessed using the chain-weighting method (Steindel, 1995): Permanent consumption nominal levels are computed by using initial and final situations' prices. Change rates are then computed for the two kinds of permanent consumption nominal levels. The change rate used in the chain-weighting method is the average between these two change rates. If, after the implementation of a new policy, permanent consumption increases for the whole society, it means that the tested measures can pass the Kaldor (1939) test: Social efficiency can potentially be improved, as one agent's gains can be used to compensate the other agent's losses so that everyone's welfare is increased. Whether this compensation scheme (under the form of direct payments) is implemented or not mainly depends on political considerations.

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The next sections present a detailed examination of the scenarios representing the studied liberalization measures.

2.5.1 First scenario: Elimination of the price support level

In the initial situation of this scenario, the domestic relative price of the agricultural product is 40 % higher than its market price. The domestic price is the same for producers and consumers, therefore consumers directly pay for farmers' income supplement. As the price is not competitive and hence does not allow market to clear, there are some surpluses. They are either exported thanks to a government-funded subsidy, or they are kept in stock. The export subsidy is equal to the wedge between the domestic and the world market price. As a first approximation, the cost of the stock is assumed to be equal to this wedge as well. The liberalization measure consists in decreasing the internal agricultural relative price so that it reaches (or at least moves closer to) the world market price. In the final situation, the domestic price has decreased by 40 %, and hence exports do not need to be subsidized any longer. The scenario thus consists in studying the reaction of all the endogenous variables when the agricultural price decreases by 40 %.

2.5.2 Second scenario: Deficiency payments instead of price support

It may be quite unsustainable (from the farmer's point of view, and hence from a political point of view as well) to implement directly a complete liberalization of the agricultural sector, as in the first scenario. In the present scenario, some deficiency payments compensate (temporarily) the farmers for a 40 % decrease in price support. Deficiency payments are modeled as a subsidy applied to production at a rate τ. Hence, before the reform, the situation is the same as the initial situation in the previous scenario, with a domestic agricultural price 40 % higher than the market clearing one. In the reformed situation, the price decrease by 40 %, but, in order to compensate farmers for liberalization of

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their sector, they receive a 40 % subsidy to production[23]. Hence, when these measures are implemented, the main funding burden of the agricultural policy shifts from consumers to tax-payers, who now pay for deficiency payments, whereas they previously paid only for surplus subsidies (more precisely, for net export subsidies and stock management). Taxes in the initial situation of this scenario were thus far less important than they are in the final situation, since taxes have now to fund the whole production subsidies, whereas they previously funded only the part of the production which was not consumed.

The government can also choose to implement a partial compensation program, so that deficiency payments do not compensate entirely the fall in the agricultural relative price ($\tau = 0.2$ for instance, instead of 0.4). This is referred to as the "second bis" scenario.

2.5.3 Third scenario: Reduction in the level of deficiency payments

This scenario can be thought of as the continuation of the previous one: Price support scheme was first replaced by deficiency payments (second scenario), which are then eliminated (third scenario), so that the sector becomes fully liberalized. In the initial situation of this scenario, consumers pay a price p equal to the world market price. Producers, on the other hand, receive a higher price $(1 + \tau)p$, with $\tau = 0.4$. The scenario consists in assessing how the endogenous variables react when τ decreases to 0, when deficiency payments are eliminated as well. If only a partial compensation scheme was implemented in the second scenario ("second bis" scenario), the third scenario consists in going from this partial compensation situation to a fully liberalized situation (it is referred to as the "third bis" scenario).

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[23]On a strictly accounting point of view, this 40 % production subsidy leads to an over-compensation of farmers for the losse of the 40 % excess sale price they used to get. However, on a political point of view, these two instruments can be considered to be equivalent. In any cases, values given to policy instruments should be put into persective, since the goal of the analysis is more to give qualitative results in terms of direction of the changes rather than purely quantitative results.

2.5.4   Summary of the scenarios

The agricultural policies studied in the model can be summarized in the following diagram (p_w stands for the world price of the agricultural product, or its market clearing price):
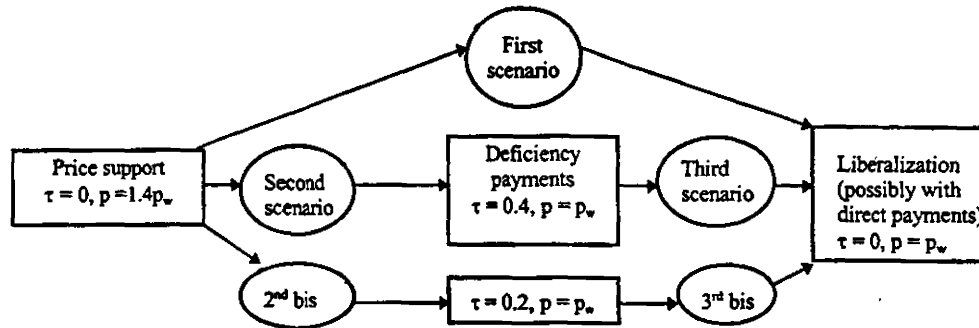
Full liberalization scenarios are the first and the third ones, since they allow the economy to go from a regulated situation to a totally liberalized one. On the contrary, the second scenario only represents either a change in the regulation instrument, or a partial liberalization (in the case of the "second bis"scenario). The scheme summarizes the policies actually implemented in the CAP reforms: A decrease (or elimination) of the price support, its replacement by other instruments (deficiency payments) assumed to be less distortionary, and the implementation of support specifically targeted to some farmers (direct payments).

The reaction of the endogenous variables to these scenarios are presented in the next section.

2.6   Results of the model

The results are presented as the percentage change in the endogenous variables when going from the initial to the final situations of a scenario. Only steady state situations are compared. Indeed, when the agricultural policy changes, the model shows that the endogenous variables jump from one steady state to another, without following any transition path. This behavior of the variables is explained

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simple functional forms chosen (logarithmic utility functions and Cobb-Douglas production functions) and by the fact that the model does not take into account any expectation behavior, therefore agents are always surprised by changes in agricultural policy.

Changes in production variables are presented in the next paragraph, and they are followed by the presentation of changes in welfare variables. A ranking of liberalization policies and a summary of the results follow. Appendix B presents quantitative results synthetically.

2.6.1 Results regarding production variables

Many results are common to the first, third and third bis scenarios, meaning that, no matter the form the agricultural liberalization takes, no matter the definition of an agricultural household retained, there are some constant consequences of agricultural liberalization:

- The use of labor decreases in the agricultural sector, while it symmetrically increases in the non-agricultural sector. If the share of labor force used in the agricultural sector before liberalization represented slightly more than 4 %, it reaches a level of slightly less than 1 % in the complete liberalization case (first and third scenarios). This represents a decrease of 81 % in the agricultural workers' population, and an increase of 3.7 % of the non-agricultural workers' population. Whatever the form of the agricultural support (price support or deficiency payments), this evolution is the same. And, logically, the stronger the liberalization, the larger the decrease in the share of labor used in the agricultural sector (in the second bis scenario, a 40 % price support is replaced by a 20 % production subsidy, and the labor used in the agricultural sector decreases by "only" 54 %).

- The non-agricultural production increases, while the agricultural one decreases; they both follow the evolution of labor used in each sector. Indeed, since the capital/labor ratio in each sector stays constant (because these two inputs are mobile), the capital used in each sector follows the same evolution as the labor used in each sector, and hence the production levels.

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- The quantity of capital in the economy increases, by 0.8 % in the full liberalization cases, and slightly less in the partial liberalization cases. It shows the positive impact of agricultural liberalization policy on the whole economy.

- The nominal remuneration of labor and capital stays constant: Since these inputs are mobile between the two sectors, their remunerations cannot be affected by agricultural policy, since they have to be always equal to the marginal productivity of the inputs in the non-agricultural sector, which is not affected by agricultural policy.

- The land remuneration decreases by up to 81 % of its initial level when the agricultural sector is fully liberalized. It is not affected by change in agricultural policy instrument, from price support to deficiency payments, since global support level stays constant. Logically, the stronger the liberalization, the larger the decrease in land remuneration. This result conforms with the literature on the topic: "Since land is in fixed supply, the result (of a protected agricultural sector) has been a steady inflation in land values and rents.[...] By removing, or, at least, scaling down price support, it might be expected that this trend would go into reverse" (Potter and Goodwin, 1998, p.289).

- In all liberalization scenarios, agricultural surplus and net taxes logically decrease. The agricultural surplus also decreases when price support scheme is replaced by deficiency payments (second scenario): It is then due to the fact that agricultural production stays constant (because the price received by producers stays the same) while demand increases since consumer price decreases.

We now turn to the evolution of the variables directly affecting the welfare of the agents, namely the permanent consumption levels.

2.6.2 Results regarding welfare variables

Comparison of outcomes of the model for different scenarios give results for the society as a whole, but also for each agent, depending on the definition of the agents. They are reviewed successively.

2.6.2.1 Evolution of the whole society welfare

The global outcome of the reforms consists in an increase of the whole society permanent consumption in all scenarios (excepted in the third bis one), from 0.11 % in the third scenario to 1.13 % in the first scenario. In any definition of the agents, the evolution of the permanent consumption levels of both agents' group follows the same directions: The farmers' group loses some permanent consumption in all the liberalization scenarios (first, second bis, third and third bis), and gains in the second scenario when price support is replaced by deficiency payments. On the other hand, the non-farmers' group gains in all the scenarios, whatever is the definition of the agents retained. In the full liberalization scenarios (first and third ones), gains of non-farmers are sufficient to compensate farmers for their losses, so that global welfare increases. It also increases in the second scenario, meaning that deficiency payments are preferred to price support scheme by the whole society (they are actually preferred by each agent as well). The global welfare decreases in the third bis scenario because the non-farmers' gains are so small that they cannot compensate for the losses of the farmers, despite the small number of farmers in the society.

These results are only global results regarding the society as a whole. They assume that the distribution of welfare changes between the two agents is not valued in itself, and that redistribution schemes aiming at compensating for the losers of the policy would be implemented. However, it is realistic to assume that these compensation schemes are not always fully and / or successfully implemented. Distribution of welfare changes between the agents is then important, since, with incomplete compensation, the losers would have incentives to try to block the reforms. The next section presents the distribution of welfare changes between the two agents.

2.6.2.2 Decomposition of the welfare evolution between the agents

When examining welfare evolution between the two agents, the definition given to each agent is important. However, the model shows that, when looking at each whole group (the farmers' group,

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the non-farmers' group), the different definitions of the agents only have an impact on the magnitude of the changes, not on their direction. On the contrary, when looking at the per capita results (per farmer, per non-farmer), differences arise in the direction of the changes as well. For instance, when a farmer is realistically defined as someone who owns the land and can allocate his labor in both sectors, the farmers' group suffer less from liberalization than when he is defined as someone working exclusively in the farm sector: When price support scheme is eliminated (first scenario), the land owners' group would lose 23 % of its initial permanent consumption, while the agricultural sector workers would lose 81 % of it. At the same time, the non-farmer group benefits less from liberalization policies: Still in the first scenario, the non-land-owners' group would gain 2.6 % of their initial consumption versus 6.4 % for the non-agricultural workers. This divergence in the magnitude of the results is due to the fact that, when a farmer is defined as someone working exclusively in the agricultural sector, the permanent consumption of the farmers' group is affected not only through the remuneration of land (q, as in the other definition of the farmer) but through some quantities as well (through L_1, contrary to the other definition).

As for per capita results, they depend dramatically on the definition of the agents, even for the direction of their changes: When the farmer can allocate his labor in both sectors but still remains a farmer because he owns the land, liberalization policy does not change the number of farmers in the society in the short run. Hence, since permanent consumption of the whole group decreases, per capita permanent consumption decreases by the same amount. On the contrary, when the number of farmers decreases with agricultural liberalization (because a farmer is someone who works exclusively in the agricultural sector), then the per capita permanent consumption slightly increases (because permanent consumption of the whole group decreases less than the number of persons working in the agricultural sector). Hence, if the farmer is defined as someone allocating all his labor to the agricultural sector, his per capita permanent consumption increases when the sector is liberalized (by 1.84 % in the first scenario, and by 0.99 % in the third one). However, if the farmer is defined more realistically as someone allocating only a share of his labor to the agricultural sector, liberalization leads to a decrease of his per capita permanent consumption (-23 %).

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Despite these divergences, some global conclusions can be drawn on the relative advantages of agricultural instruments and on the best sequencing of reforms.

2.6.2.3 Ranking of the policies

For both agents (and for whatever definition of them), it is better to implement deficiency payments instead of price support if the agricultural support has to be maintained (the second scenario increases the welfare of both agents). This is due to the fact that deficiency payments generate less agricultural surplus than price support. Hence, even though the taxes needed to fund deficiency payments are equivalent to the previous excess in price paid by consumers, the agents do not have to pay for export subsidies (or stock management) in the deficiency payments situation.

However, in a longer-term perspective, the agricultural support would have to be eventually eliminated. It is then better to liberalize directly from a price support situation than from a deficiency payments one (the global permanent consumption increases by 1.13 % in the first scenario and by only 0.11 % in the third scenario). This is due to the fact that the elimination of deficiency payments (represented by the third scenario) logically has some negative effects on the farmers' group permanent consumption (it decreases between 24 and 81 %, according to who is regarded as a farmer), which are hardly compensated for by the very small gains of the non-farmers (their permanent consumption increases between 1.5 and 5.1 %). On the contrary, when the price support scheme is eliminated, the losses of the farmers are almost the same, while the gains of the non-farmers are larger, therefore the whole society gains are larger. Hence, on an economic point of view, a one-step liberalization process should be preferred to any other transitional policy, and the agricultural price support should be directly eliminated. However, the choice between the two agricultural policy instruments (price support or deficiency payments) and between a one-step or a two-step liberalization program may be as political as economic, and the conclusions of the model may have to be moderated

Nevertheless, since liberalization policies are assumed to be unanticipated in the model, a two-step liberalization scheme (price support replaced by deficiency payments, which are afterwards

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eliminated) eventually leads to the same results as a one-step liberalization scheme (elimination of the price support). For instance, the whole society permanent consumption increases by 1.13 % in the first scenario. This is roughly equivalent to the sum of the changes in the second and third scenarios (1.01 and 0.11). Therefore, the differences between the two policies (or the two instruments) depend very much on the time passed between the two steps of the policy: The shorter the time-period, the more similar the two policies.

2.6.3 Summary of the results

Whatever form the full liberalization of the agricultural sector takes, and whatever definition of an agricultural household is retained, liberalization of the agricultural sector eventually leads to an increase in the whole society permanent consumption. Permanent consumption increases for the non-farmers, either for their whole group or for each of them, in all the studied scenarios. Permanent consumption decreases for the whole farmers' group in all the liberalization scenarios. However, the evolution of the permanent consumption per farmer depends on who is regarded as a farmer. If, as it may be more realistic to assume, a farmer can allocate his labor in both sectors, then the agricultural liberalization decreases the permanent consumption per farmer. On the contrary, if a farmer is someone who allocates all his labor to the agricultural sector only, then its liberalization increases the per farmer permanent consumption.

If complete agricultural liberalization is not implemented in one step, it has been shown that, whatever definition of an agricultural household is retained, fully replacing price support scheme by deficiency payments increases the whole society permanent consumption, as well as the permanent consumption of each agent. This means that if, for political reasons, the agricultural sector support has to be maintained for some time, it seems better to implement deficiency payments instead of keeping a price support scheme. However, considering that the agricultural sector has eventually to be fully liberalized, it is better, for the whole society and for each agent, to liberalize directly from the price

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support scheme instead of implementing some transitory deficiency payments whose elimination would eventually have consequences as dramatic as the elimination of the price support scheme. Nevertheless, while eliminating price support scheme, a redistribution scheme should be implemented in order to compensate the farmers for their losses. Indeed, considering that the European reality is better represented by farmers also working off-farm, the model concludes that farmers would lose from any liberalization scenario. Given the small number of farmers in the European society and the large gains the liberalization of the agricultural sector give to non-farmers, this redistributive scheme could be quite easily implemented, at least from an economic point of view (the political aspect of the problem may be an issue, however). This redistribution scheme would take the form of direct payments provided to the farmers such that the welfare of both kinds of agents increases. Logically, direct payments (net transfers) are more efficient than market price support or deficiency payments, since they are less distorting and can be better targeted.

The fact that the results of the model differ in magnitude and directions in the two definitions of the agents should draw attention to the evolution of the farmers' group in the European Union. According to the way a farmer is defined (working exclusively on farm or owning the land), different agricultural policies might be preferred to reach different objectives. Hence, before choosing an agricultural policy, the targeted population has to be clearly identified: Only the full-time farmers, usually richer and exploiting larger farms; or also the persons working part-time on a farm, with a risk of transforming a sectorial policy into a social policy. In addition to the necessity of a clear definition of the targeted population, another way the CAP needs to evolve is in the definition of new objectives, such as clearly focusing on environment protection. Indeed, it has been shown that agricultural policy has a dramatic influence on land price, and hence on its use.

2.7 Conclusion

The model developed in this chapter has shown that the farmers's welfare, assessed on an intertemporal basis, decreases dramatically when agricultural support measures are eliminated. Therefore, this model, which takes investment into account, reaches conclusions close to the ones of many other models which do not display any dynamic features, giving more strength to these conclusions. It shows that the negative impact of agricultural liberalization on farmers lasts over time. It can be because the initial effect is very large, so that it is transmitted to the following periods, or because the negative effect is spread over several periods. Since the variables jump from one steady state to another, the first explanation seems more likely. A more complex model (which would take into account uncertainty for instance) would permit to better explain this feature, although it would also make more difficult to clearly establish the impact of policies on variables.

The main conclusion reached by this model is that farmers should be compensated for the losses they suffer during agricultural liberalization, since they lose a significant part of their permanent consumption. The issue of the level, the duration and the form this compensation should take is salient: It has been shown that deficiency payments should be implemented only if the compensation is expected to last for a long time (however, a more precise model would be needed to identify how long is "a long time"). Otherwise, direct payments, taking the form of net transfers to farmers (ideally according to their wealth level or to some other objectives of environment protection for instance), should be preferred. In the CAP reforms framework, deficiency payments are implemented with no explicit time limit. They should therefore be replaced by direct payments, or their duration should be clearly ended.

All the results of the model have to be put into perspective by its limits. One of those regards the fact that distortions are not taken into account in the implementation of the policies, and particularly when collecting taxes. However, these distortions would be equivalent for all instruments, and hence this limit of the model does not change the relative value of each instrument: Direct payments should always be preferred to any other agricultural instrument.

Many conclusions reached in this chapter change dramatically with the definition given to the agents, and particularly the conclusions relative to the distribution of welfare changes between the agents. Since the definition of the agents represents the evolution of the European population, the model shows that the European agricultural policy may have to change its goals, according to whom it is really targeted.

Although it now seems obvious that farmers in industrialized countries should no longer receive subsidies for purely historical or political reasons, this model has shown that they should be compensated for their losses when their sector is liberalized. This compensation is possible because the whole society gains from agricultural liberalization. It is therefore desirable to liberalize the agricultural sector, from both an internal and an external point of view. On the internal side, because the European agricultural sector has evolved a lot during the last two decades, and the former CAP is no longer adapted. On an external point of view, because, inter alia, European agricultural support (as the support by any other industrialized countries) may have negative effects on world markets, impeding some developing countries from expanding their agricultural sector. The effects of agricultural sector liberalization in developing countries is studied in the next chapter.

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APPENDIX A   Resolution of the model

From 2.48 in steady state:

$$r = \rho + \delta + h \tag{A.59}$$

From 2.56 in steady state:

$$k_2 = \left(\frac{1 - \beta}{\rho + \delta + h} \right)^{\frac{1}{\beta}} \tag{A.60}$$

From 2.23, 2.24, 2.27, 2.28, 2.57, 2.58 and A.60:

$$k_1 = \frac{\gamma \beta}{\alpha (1 - \beta)} \left(\frac{1 - \beta}{\rho + \delta + h} \right)^{\frac{1}{\beta}} \tag{A.61}$$

From 2.33:

$$L_1 = \frac{k_2 - k}{k_2 - k_1} \tag{A.62}$$

From A.60, A.61 and A.62:

$$L_1 = -\alpha \frac{\left(\frac{1 - \beta}{\rho + \delta + h} \right)^{\frac{1}{\beta}} (1 - \beta) - k (1 - \beta)}{(\alpha \beta + \gamma \beta - \alpha) \left(\frac{1 - \beta}{\rho + \delta + h} \right)^{\frac{1}{\beta}}} \tag{A.63}$$

From 2.32 and A.63:

$$L_2 = \frac{\left(\frac{1 - \beta}{\rho + \delta + h} \right)^{\frac{1}{\beta}} \gamma \beta - \alpha k + \alpha k \beta}{(\alpha \beta + \gamma \beta - \alpha) \left(\frac{1 - \beta}{\rho + \delta + h} \right)^{\frac{1}{\beta}}} \tag{A.64}$$

From 2.38, A.61 and A.63:

$$k = \left(\frac{1 - \beta}{\rho + \delta + h} \right)^{\frac{1}{\beta}} - T (\alpha - \alpha \beta - \gamma \beta) \left(\frac{\left(\frac{1 - \beta}{\rho + \delta + h} \right)^{\frac{\alpha}{\beta}} (\beta)^{1-\gamma}}{\gamma^\gamma \alpha^\alpha (1 - \beta)^\alpha} \right)^{\frac{-1}{-1+\alpha+\gamma}} \left(\frac{r}{(1 + \tau) p} \right)^{\frac{-1}{\alpha + \gamma - 1}} \tag{A.65}$$

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Solving the non-agricultural market clearing equation 2.55 in steady state for $\left(\frac{1}{\phi} + \frac{1}{\lambda}\right)$ using A.65 gives:

$$\frac{1}{\phi} + \frac{1}{\lambda} = \frac{\left(\frac{1-\beta}{\rho+\delta+h}\right)^{\frac{1-\beta}{\beta}} \gamma\beta}{(1-\mu)(\alpha\beta+\gamma\beta-\alpha)} - nx_2 - \left[\frac{\alpha(\rho+\delta+h)}{(1-\mu)(\alpha\beta+\gamma\beta-\alpha)} + \frac{\delta+h}{1-\mu}\right]$$

$$* \left[\left(\frac{1-\beta}{\rho+\delta+h}\right)^{\frac{1}{\beta}} - T(\alpha - \alpha\beta - \gamma\beta)\left(\frac{\left(\frac{1-\beta}{\rho+\delta+h}\right)^{\frac{\beta}{\beta}}(\beta)^{1-\gamma}}{\gamma^\gamma \alpha^\alpha (1-\beta)^\alpha} \frac{\tau}{(1+\tau)p}\right)^{\frac{1}{-1+\alpha+\gamma}}\right] \quad \text{A.66}$$

From 2.22, 2.41, 2.46, 2.50, A.63 and A.61:

$$\frac{1}{\lambda} + \frac{1}{\phi} = \frac{p}{\mu}T(\gamma\beta)^\gamma (\rho+\delta+h)^{\frac{\beta}{\beta}}(1-\beta)^{\alpha-\frac{\beta}{\beta}} \alpha^\alpha \left(\frac{\left(\frac{1-\beta}{\rho+\delta+h}\right)^{\frac{\beta}{\beta}}(\beta)^{1-\gamma}}{\gamma^\gamma \alpha^\alpha (1-\beta)^\alpha} \frac{\tau}{(1+\tau)p}\right)^{\frac{-\alpha-\gamma}{1-\alpha-\gamma}} - \frac{p}{\mu}nx_1$$

$$\text{A.67}$$

The next steps of the resolution of the model are done using the values of the parameters, in order to make the substitutions easier. The route followed consists in equalizing the two previous expressions of $\left(\frac{1}{\lambda} + \frac{1}{\phi}\right)$, using the trade balance equation (2.3). It gives nx_1 as a function of the parameters and the policy instruments. From the trade balance equation (2.3), we get nx_2. From the government budget constraint (2.4), we get the value of the net transfers as a function of the world price p_w and of the policy instruments p and τ:

$$nt = (p_w - p)nx_1 - \tau y_1 \quad \text{A.68}$$

The market clearing price is such that $x_1 = 0$ for $\tau = 0$. The value of T is fixed such that the ratio of the two production levels is realistic. We then get values for all the endogenous variables.

APPENDIX B   Change in variables

scenarios	1st	2nd	2nd bis	3rd	3rd bis
ΔL_1	-81.4	0	-53.8	-81.4	-59.9
ΔL_2	3.7	0	2.4	3.7	1.2
Δk	0.8	0	0.5	0.8	0.3
Δq	-81.4	0	-53.7	-81.4	-59.8
Δpc	1.13	1.01	1.05	0.11	-0.09

When the farmers are the persons working in the agricultural sector:

scenarios	1st	2nd	2nd bis	3rd	3rd bis
Δpc_A	-81.1	0.85	-53	-81.25	-59.74
Δpc_{NA}	6.37	1.19	4.68	5.12	1.61
Δpc_A per capita	1.84	0.84	1.56	0.99	0.28
Δpc_{NA} per capita	2.57	1.19	2.18	1.37	0.38

When the farmers are the persons owning the land (changes for each group or for each individual are the same):

scenarios	1st	2nd	2nd bis	3rd	3rd bis
Δpc_A	-22.97	0.83	-14.87	-23.61	-9.57
Δpc_{NA}	2.57	1.02	2.18	1.53	0.38

Chapter 3

A model of agricultural liberalization in a developing country

3.1 Introduction

Less developed countries are strongly affected by agricultural liberalization measures currently implemented all over the world. In fact, the agricultural sector in developing countries has traditionally been highly regulated. Therefore, liberalization measures induced by structural adjustment programs have a strong impact on the structure of the sector. Moreover, the agricultural sector in developing countries employs a large share of the labor force and contributes to a large part of GDP. Consequently, any change in agricultural policy is very likely to lead to dramatic economic and social consequences.

Traditionally, agricultural policy in the majority of developing countries has consisted in taxing the agricultural sector, either directly (taxes on production or on exports) or indirectly (with a price fixed by the government at a level lower than the market one). Although the literature about the consequences of agricultural liberalization leads to diverse conclusions, almost no country can now afford not implementing the liberalization measures recommended by international institutions. Therefore, it is crucial to assess the welfare consequences of the agricultural sector liberalization measures and the effects of different policies on the livelihood of the rural poor and of the rest of the society.

Most of the models that already exist on this topic are computable general equilibrium models and sectorial partial equilibrium models[24]. Computable general equilibrium models require a lot of data, and hence are usually applied to large developing countries. In fact, in large countries, data are more easily available and time-consuming modelling is worth doing since domestic agricultural policy has

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[24]For multi-country general equilibrium models, cf Scandizzo 1992 (static model) or Harrison and al. 1995, Francois and al. 1994 or Goldin and al. 1993 (dynamic models). For one-country general equilibrium models, cf De Janvry and Sadoulet (in Goldin and Knudsen, 1990), Warr (1997) and Anderson (1998). For partial equilibrium models, cf Bale and Lutz 1981 (static model of one country), Anderson and Tyers 1991 and 1993 (static models of several countries), Chauveau and Gordon 1988 or Zwart and Blandford 1989 (dynamic models).

an impact on the whole region. Regarding partial equilibrium models, they are badly adapted to the study of less developed countries, where the agricultural sector represents a large part of the economy, and where the agricultural policy has an impact on the whole economy. In fact, De Janvry et al. (1992, p.430) argue that the use of general equilibrium model when studying agricultural liberalization in developing countries is justified by the fact that the changes in the prices of the agricultural products are "sufficiently large that they can be expected to have significant macroeconomic effects and hence affect all the other prices in the economy". Moreover, they argue that, in the developing countries' case, policy modelling finds its "usefulness in the systematic lack of comparable data over time that would allow to separate ex-post the impact of policy instruments. For this reason, recourse is made to simulation of policy impacts in such models, either to retrace historical effects in duly calibrated models or to explore alternative scenarios" (De Janvry et al. 1992, p.447).

For these reasons, the analysis developed in this chapter presents a general equilibrium model which assesses the impact on income distribution of the removal of different agricultural instruments. However, our analysis is different from the already existing ones because it emphasizes the importance of the definition given to the agents (by considering farmers' off-farm labor and landless agricultural workers), and it takes into account the fact that some agricultural production is not marketed but is home-consumed (the agricultural policy then has no direct impact on this kind of production). Moreover, our analysis introduces some dynamical features through investment variables. However, the model developed in this chapter remains simple because it is not applied to a specific country but to a theoretical representative country. An agricultural household model is first presented by itself, in order to understand the links between marketed and non-marketed agricultural production, referred to as "cash crop" versus "food crop": Marketed agricultural production brings some cash to farmers, while non-marketed agricultural production is used by farmers for family food consumption only. This agricultural household model is then integrated into a general equilibrium model representing the agricultural and non-agricultural sectors. We then get a three-sector general equilibrium model, since the agricultural production is divided between food crop and cash crop.

The main results of the model show that agricultural liberalization is positive for the global welfare of the society, although some groups, both urban and rural, suffer from it. Moreover, agricultural liberalization changes the productive structures of the economy, and should hence be undertaken progressively and cautiously.

The remaining of the chapter is organized as follows: Section 2 presents the evolution of the status of the farmers (with the development of off-farm work) and the evolution of agricultural policies in some developing countries. A modeled analysis of liberalization measures is then presented: Section 3 presents the agricultural household model, while the general equilibrium model and its results are described in section 4. Conclusion follows in section 5, and the appendixes present the details of the models.

3.2 Evolution of the agricultural sector in some developing countries

3.2.1 Choice of some "representative" developing countries

The models studied in this chapter develop an analysis applied to a "representative" country. This simplification aims at drawing conclusions on the economic impact of agricultural policies, without taking into account the social and historical context in which they take place. The "representative country" analysis allows a focus on the economic side of the reforms. However, to give more reality to the type of economy studied, let us think of it as a small country, among the poorest in the world, where agriculture accounts for a very large part of the economy. For instance, Laos or Cambodia in South East Asia, and Tanzania or Uganda in South Saharan Africa would enter into this category. In fact, their GDP per capita was between 260 (Cambodia) and 310 USD (Uganda) in 2001[25]. Poverty[26] hits around 40 % of the population, and it is much higher in rural areas (87 % of the Laotian poor live

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[25] World Bank Development Report, 2002.

[26] Poverty is defined as a level of income 50 % lower than the median adjusted disposable personal income.

in rural areas, and 99 % of the rural poor live in farm households[27]). In these countries, agriculture contributes to around 50 % of GDP and employs around 80 % of labor force. The table below presents some economic indicators for countries which enter into the category we are interested in (data are for 2001; source: World Bank, 2002):

	HDI rank (out of 174)	GDP per capita ($)	% agriculture in GDP	% male labor force in agriculture	% rural population
Laos	140	290	53	77	78
Cambodia	137	260	51	71	78
Tanzania	156	280	46	80	74
Uganda	158	310	45	84	87

HDI stands for Human Development Index, while PPP stands for Purchasing Power parity.

In this kind of countries, the agricultural sector is made of domestically marketed crops and of one or two main export crops. For example, in Laos and Cambodia, this export crop mainly consists in wood; in Tanzania, of cotton and coffee; in Uganda, of coffee. Even the domestically marketed production is often very little diversified.

3.2.2 Evolution of the farm sector

In developing countries, one of the main changing features of the farm sector in the recent years has been the rise of off-farm activities. It has led to an evolution of the inequalities between farmers and non-farmers, and to changes in the impact of agricultural policies.

3.2.2.1 Development of off-farm activities

More and more farmers have off-farm activities, leading to an important share of non-farm income in rural income. For instance, Reardon and al.(2000) report an average share of 42 % of non-farm income in total rural household income in Africa, 40 % in Latin America and 32 % in Asia. Moreover,

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[27] World Bank country report, 2000.

since "non-farm activities are monetized to a much larger extent than is agricultural production, non-farm earnings constitute an even larger share of cash income" (Hagblade and al., 1989, p.1177).

3.2.2.2 Reasons for the development of off-farm activities

Malchow-Moller and Svarer (2001) summarize the reasons for an agricultural household to allocate labor to the non-farm sector. It can be a response to:

- Imperfect input markets (land and capital): "If households are restricted in their access to land and capital, i.e. if markets cannot be used to freely adjust inputs in accordance with economic incentives, households with small endowment of land and capital must seek employment off the farm" (Malchow-Moller and Svarer, 2001, p.5);

- Imperfect credit market, which prevents the purchase of inputs. In this case, off-farm labor can provide both the needed income and the liquidity to buy farm inputs. A negative relationship between land and off-farm labor might then emerge, since land is usually used as collateral;

- Uncertainty of agricultural income which causes households to diversify income ex-ante and react to negative shocks ex-post by participating in off-farm activities. Off-farm labor is then used as a means of managing farm-income risk.

Imperfect markets and uncertainty features are not integrated in our models, in order to simplify the results and to focus on the direct links between agricultural policy and welfare. However, the development of off-farm work, which is an important stylized fact of the recent years in developing countries, is represented in the models developed in this chapter. Therefore, the important simplification consists in not taking into account the reasons for the development of off-farm labor, but in taking this new form of labor into account, as the difference between total labor time of the household and labor time actually used in the farm.

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3.2.2.3 Non-farm activities and income distribution

The impact of non-farm income on wealth inequality is not clear. Indeed, it exists evidence of "non-uniform effects of non-farm income on rural income inequality (and of) a U-curve relationship, where the share (of non-farm income) is relatively high for small farms and the poorest households, declines in the middle income and / or landholding range and then rises at the higher end of landholding and incomes" (Reardon and al., 2000, p.272). This idea of a U-curve is explained, inter alia, by Wiggins and al. (2001): They remark that there exists a "dual nature of diversification: For the poor, taking on additional petty activities was a way to escape extreme poverty and destitution" (Wiggins and al., 2001, p.11). On the contrary, "the better-off were able to depend on one or two sources for the bulk of their income. [...] Diversification was thus not necessarily something pursued or valued in itself. It was a by-product of the struggle for decent livelihoods for households that lacked the education or capital to enter better-rewarded activities" (Wiggins and al., 2000, p.20). This view is confirmed in another empirical study by Malchow-Moller and Svarer (2001): They find that "agricultural off-farm work is negatively correlated with marketed share. That is, individuals from households that market a larger share of their crops participate less in off-farm work. It indicates that off-farm work is traded-off against cash crop production as a means of generating liquidity" (Malchow-Moller and Svarer, 2001, p.19).

Our analysis focuses on very poor and rather egalitarian countries where off-farm labor is very likely to be a necessity rather than a choice. We can then consider that our study is located on the left-hand side (close to the origin) of the U-curb described earlier.

3.2.3 Agricultural policies in developing countries

Agricultural policies in developing countries have very often consisted in agricultural taxation, either directly or indirectly. The reasons usually invoked for agricultural taxation and its forms are presented now.

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3.2.3.1 Reasons invoked for agricultural taxation

Many developing countries tax agriculture, either because it is their direct goal, or because it is an indirect way of protecting the manufacturing sector. The main reasons invoked for turning the terms of trade against agriculture can be divided into efficiency reasons aiming at enhancing the whole economic growth and equity reasons aiming at providing aid to some social groups.

According to efficiency reasons, agricultural taxation aims to:

- Transfer resources to non-agricultural sectors, often supposed to have higher total factor productivity growth rate than agriculture; however, all the literature does not agree on this assertion;

- Promote the efficiency of agricultural production: The farms able to survive the negative agricultural policy are supposed to be the most efficient ones;

- Easily generate revenues for the government. In fact, the relatively inelastic aggregate agricultural supply argues for relatively heavy taxes. However, "agricultural commodities face unstable and unpredictable world prices, and taxes on primary commodities are likely to yield revenues that fluctuate even more strongly than these commodity prices. Indeed, the government may well feel that the farmer should be shielded from the full effect of world market price instability, in which case the tax, being the difference between a volatile external price and a less volatile internal price, will be more unstable than the international price" (Newbery and Stern, 1987, p.179). This is obviously a shortcoming of governments using agricultural taxes as a source of revenue.

According to equity reasons, agricultural taxation aims to:

- Subsidize low-income consumers. Indeed, agricultural taxation also consists in imposing a domestic price of the agricultural product lower than the equilibrium price, for both producers and consumers. Cheap agricultural products then act as a food subsidy replacing direct income subsidy often difficult to implement in developing countries. It is mainly directed at the poor city-dwellers, since they have to buy all the food they consume, which is not the case for the rural poor, who can consume a share of their own production. However, it has to be reminded that, in the whole developing world,

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slightly more than 70 % of the poor live in rural areas[28]. Therefore, an artificially low agricultural price is not necessarily the best way to help the larger number of poor people. Nevertheless, such a policy can be mainly explained by the fact that urban poor often have more political power than rural poor in developing countries because "more spatially concentrated and visible forms of urban poverty are likely to generate new pressure on governments to respond" (Ravallion, 2001, p.1). Therefore, although rural population is urbanizing very quickly, and, as a consequence, urban poverty is growing as well, rural poverty may persist longer than urban one. In this context, imposing cheap agricultural products is not always the best way to help the poorest share of the population, at least in little urbanized countries as the ones we are referring to.

- Redistribute income inside the agricultural sector, considering that the chief beneficiaries of higher agricultural prices are the largest farmers. Therefore, lower agricultural prices are supposed to provide more equity among farmers.

However, most of these reasons are often only an excuse to tax the agricultural sector, in order to easily provide income for the government. In fact, since the agricultural sector is the most important one in developing countries, taxing it is the easiest way for governments for raising funds, that will be used in more or less efficient and equitable ways.

3.2.3.2 Forms of agricultural taxation

Agricultural taxation can be explicit or implicit. In fact, a large part of the tax burden on agricultural producers is due to implicit taxes, mainly through overvalued exchange rates acting as a tax on exports, in countries where exports mainly consist of agricultural products. However, our analysis focuses on explicit taxes, modeled in terms of agricultural instruments. Among explicit taxes, only production taxes are analyzed; income and wealth taxes are not studied. Indeed, in developing countries, direct taxes on agents' wealth are often difficult to implement since the government does not have the statistical and operational facilities needed to develop a coherent tax system.

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[28] cf, for instance, Ravallion, 2001, p.1.

Direct and indirect production taxes are distinguished. We will classify as direct taxes on the agricultural sector the marketing taxes, on domestic or foreign trade, paid by the agricultural producers when they market their products. When levied on foreign trade, they mainly consist in export taxes. When levied on domestic trade, they can be levied by local governments on farmers who bring their products to urban markets, either at the point of entry into an administrative province or in an organized market center. Therefore, only cash crops marketed through formal channels are subject to this marketing tax, and not the whole agricultural production. This makes a big difference in most developing countries, where a part of food production is often consumed on the farm or marketed locally and informally. This feature justifies our distinction between cash crops and food crops in the models.

Another way of taxing agricultural production more indirectly consists in imposing the use of marketing boards for some agricultural products. Marketing boards are public administrations that have the monopoly on the purchase of certain goods from farmers and their sale to consumers. Therefore, governments set the food prices received by farmers and paid by consumers. The official goal of marketing boards is to stabilize domestic prices in order to ensure food security. Concretely, they are supposed to accumulate money surpluses when the international price is higher than the fixed domestic price, and to redistribute these surpluses when the international price becomes lower than the fixed domestic price. But surpluses are often used to other purposes, and, often, almost no money remains to farmers when the international price decreases. However, farmers still have to sell all their production directly to marketing boards, at low prices. In the majority of developing countries, marketing boards represent the main tax burden on the agricultural sector. Since domestic price is set at a level lower than the international level, exports have to be taxed (or imports subsidized). Therefore, marketing boards are not only a domestic marketing instrument, but they also have foreign trade implications.

In addition to classical drawbacks of any indirect tax, there is a specific negative effect of marketing boards as they exist in many developing countries, which often leads to a vicious circle: With artificially low prices for agricultural products, farmers can hardly survive, and many have to migrate to cities, increasing urban unemployment and poverty. In these developing countries, more than

half of urban consumption is made of food products. So, to avoid demonstrations and riots in cities, governments have to artificially maintain the price of agricultural products at a low level. It is therefore very difficult to exit this vicious circle[29].

Eliminating marketing boards and the tax on marketed production has been the goal of many structural adjustment programs in the recent years. It is the impact of their elimination on welfare that is studied in the remaining of the chapter.

3.2.4 Agricultural liberalization measures and their expected effects on welfare

Within the situation just presented, the main agricultural liberalization measures consist in:

- Eliminating the state take-over of the marketing and distribution system, in which agricultural prices were fixed by government at a level often between 30 and 40 % below international market price, leading to an implicit consumption subsidy and production tax. Agricultural prices should reach a level higher than previously, and, eventually, the world level;

- Eliminating the tax on agricultural production (usually between 20 and 30 % of market price).

These measures would reduce the explicit anti-agricultural bias. Measures affecting the implicit anti-agricultural bias (acting on the exchange rate for instance) are beyond the scope of our analysis.

The liberalization scenarios studied in the models are now presented. They are extreme and could hardly be implemented in a single step, considering the weight of the agricultural sector in developing countries. However, they are useful to give hints on their respective effects.

3.2.4.1 First scenario: Elimination of marketing boards

The first scenario studied in the models presented in this chapter consists in eliminating the marketing boards. Therefore, the domestic price of the agricultural product increases up to the world market price and exports are not taxed anymore (or imports are not subsidized anymore). In the models,

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[29] cf Cohen, 1997, p.21-22, for a deeper development of this idea.

it is assumed that the agricultural price increases by 30 %. In this scenario, there is no direct tax on agricultural production.

If the price of the agricultural product increases, there is an income effect affecting both agents, that may lead to a decrease in global consumption. Moreover, due to the substitution effect, an increase of the relative consumption of non-agricultural goods compared to agricultural goods is expected. In addition to these direct effects, an indirect effect is likely to occur through the level of the net transfers received by the agents from the government. In fact, if the domestic agricultural price increases, net exports cannot be taxed any longer, leading to a decrease in government's revenues. This is likely to lead to a decrease in the amount of net transfers going from the government to the agents. Finally, there is an additional effect regarding the farmer only, namely the profit effect: When the price of the agricultural product increases, farmer's income increases as well, leading to a more uncertain global effect of the measure, overall considering the large number of farmers in the society.

3.2.4.2 Second scenario: Elimination of the production tax

The second scenario studied consists in eliminating the tax on agricultural production, considering that there is no marketing boards. The initial tax on agricultural production is assumed to be of 23 %, such that the global effect for producers be the same as the removal of marketing boards. Indeed, for each agricultural product sold, agricultural producers received a price equal to $p(1 + \tau)$. When marketing boards are removed, it is assumed that p increases by 30 %, while the tax rate τ remains equal to 0. Therefore, global price $p(1 + \tau)$ increases by 30 %. In order to be able to compare the two scenarios, the global price $p(1 + \tau)$ has to increase by 30 % as well when the tax is eliminated. If the tax rate τ was initially set to 23 % ($\tau = -0.23$), the global price $p(1 + \tau)$ increases by 30 % when τ becomes equal to 0. In this scenario, the price paid by consumers stays constant.

When the tax is eliminated, there is a direct positive profit effect for farmers, whose profit, and, consequently, income, increases. There is also an indirect negative effect for the two agents through a likely decrease in the level of net transfers. In fact, since the agricultural sector is no longer taxed, the

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income of the government decreases, and hence the level of net transfers received by the agents. This decrease in the level of net transfers is larger in this scenario than it was in the first scenario. Indeed, in the current case, taxes used to applied to the whole agricultural production while they applied only to exports in the first scenario.

The tax elimination is therefore likely to be negative for non-farmers, and its effect is uncertain for farmers, depending on the relative weight of the two effects going in different directions (profit effect and net transfers effect).

In short, initial situations of the two scenarios can be summarized by the two following cases:

- Agricultural producers have to sell their production to marketing boards, where consumers also have to buy them. Therefore, producers and consumers face the same price, which is lower than the equilibrium one.

- Agricultural producers have to pay a tax on their production, and therefore they receive a price lower than the equilibrium price; consumers pay the equilibrium price.

The evolution of the social welfare is studied when liberalization is implemented in these two cases. The models in which these scenarios take place are now presented. The household model is first studied, and next comes the general equilibrium model is which the household model is integrated.

3.3 The household model

Before presenting the household model developed to fit our concerns, the literature on the topic is briefly reviewed.

3.3.1 A brief literature review

In the traditional analysis of demand and supply, two separate sets of economic agents, consumers and producers, are defined. However, in developing countries, the main form of economic

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organization is represented by the agricultural household, where the dichotomy between consumers and producers is less appropriate. Indeed, an agricultural household is defined as a household producing agricultural goods, for sales on market or for its own consumption. Such a household often consumes at least a portion of the output of its productive activities. Moreover, household's labor is often an important input into the production process of the farm. Hence, in the agricultural household, production and consumption activities take place within the same economic unit. Individuals make simultaneous decisions about production (level of output, demand for factors, choice of technology) and consumption (labor supply and commodity demand). This mixture of the economics of the firm and of the household is a characteristic of the situation of most families in developing countries.

The literature has shown that, with complete markets, production decisions of the household are separable from its consumption decisions in a two-step decision-making process[30]: First, the utility-maximizing household chooses to maximize profit from the farm and then maximizes utility subject to a standard budget constraint which includes the value of these profits. This is the reason why the agricultural household model is said to display the "separation property". It means that production decisions are independent from the households consumption choices (endowments or preferences) and from its labor supply decisions. Production decisions depend only on prices and technology. However, the converse is not true, and the recursive character of the household model appears: "The production decisions determine profits, a component of household income, which in turn influence consumption and labor supply choices. This one-way relationship is known as the profit effect" (Colman and Young, 1989, p.158). It "is transmitted through the value of full income associated with profit maximization. In particular, if there is a change in the price of the agricultural product, this will lead to adjustments in labor usage on the farm and to a change in farm profits. The latter, since farm profit is a component of household income, will in turn induce changes in the level of consumption of home product, purchased market good and leisure (and hence the households own labor supply)" (Colman and Young, 1989,

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[30]cf, for instance, Barnum and Squire, 1979, a and b; Benjamin, 1992; De Janvry and al., 1991 and 1992; Lau and al., 1978; Lopez, 1984; Sadoulet and al., 1998; Singh and al., 1985 and 1986; Skoufias, 1994.

p.161). For the farmer, the profit effect (on the production side) might compensate the income and substitution effects (on the consumption side) when the price of the agriculture product increases in case of liberalization of the sector. Therefore, farmers' consumption might increase when the price of the agricultural product increases.

However, in many developing countries, the separation property does not hold, mainly because markets are not complete. De Janvry and al. (1991) remark that, "in general, markets exist, but they selectively fail for particular households, making the corresponding commodity a non-tradable for that household. [...] Strictly speaking, a market fails when the cost of transaction through market exchange creates disutility greater than the utility gain that it produces, with the result that the market is not used for transaction.[...] The definition of market failure is thus not commodity specific but household specific" (p.1401). Indeed, for many households, lack of infrastructure prevents them from selling a part of their production on a market, and they keep it for their own consumption. For these households, there is a market failure for this commodity. In this context of market failure, separation property breaks down because the price of non-traded goods becomes endogenous to the household decision making process. Production decisions can then depend on the endowments and preferences of the household, and hence become linked to consumption decisions. Such a situation constitutes one explanation to the fact, often highlighted by governments in developing countries, that farmers are not responsive to price incentives, therefore reducing the effectiveness of agricultural policies. Indeed, "selective market failures for labor and / or food severely constrain peasants abilities to respond to price incentives and other external shocks and force them to shift the burden of adjustment on the non-traded product (food) and factor (labor) which the household controls" (De Janvry and al., 1991, p.1401).

The model developed in this chapter takes into account a missing market for food crop, which is consumed only inside the household. The goal is therefore to study the effect of agricultural liberalization measures on an agricultural household who does not sell all its production.

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3.3.2 Description of the model

This section presents a farm household producing two kinds of agricultural products: A food crop and a cash crop. The food crop is non-tradable, in the sense that there is no market for it. Therefore, all the household production of food crop is consumed in the household, and it represents the whole consumption of it (there is no food crop bought on the market). Hence, food crop is not directly subject to agricultural policy. The farm household also produces a cash crop, which is sold on the market and is therefore subject to agricultural policy. Cash crops represent either exports or domestically marketed products. All the farm cash crop is sold on the market, and the farm household can also buy some cash crops. Finally, the farm household consumes manufactured goods, bought on the market. The farm household also invests, and all investments consist in manufactured goods. Several agricultural products are included into the general terms "cash crops" and "food crops". It is assumed that, if the household hires some non-family labor for farm activities, this labor has the same productivity as family labor. Last, the household is assumed to be a unitary decision maker, meaning that intra-household relationships are not studied: Final authority for decision making may be diffused throughout the entire household[31].

Let us define:

C_C: consumption of cash crop by the farm household;

C_F: consumption of food crop by the farm household;

C_2: consumption of manufactured good by the farm household;

E: leisure;

Y_C: production of cash crop by the farm household;

Y_F: production of food crop by the farm household.

The farm household has some inputs endowments, in labor ($\overline{L}$), in land ($\overline{T}$) and in capital (K). The model represents the short run since endowments of labor and land are assumed to be fixed (hence migration and demographic growth are not taken into account, but off-farm labor is). On the contrary, the

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[31]Collective and bargaining models where households are not required to make unitary decisions are described, inter alia, by Chiappori (1992 and 1997), Apps and Rees (1997) and Browning and Chiappori (1998).

level of capital is allowed to grow with investment. The three inputs can be used in the household's cash or food crops activities. Labor and capital can also be used in off-farm activities, consisting in working in other families' cash crops or in manufactured goods' production. Labor and capital then get the same remuneration as when they are used in the household's own cash crop production. The land market is assumed to be poorly developed and, therefore, the land owned by the household can only be used in its own productive activities. In other words, it means that the household allocates its land endowment between its food and cash crops production until the marginal productivity of land becomes the same in the two activities. Hence, for the household, the land market is missing, and there is no external price for land entering into the household' land allocation decisions. The household is price taker for the cash crop, the manufactured good, labor and capital. The manufactured good is regarded as the numéraire.

Let us define:

ϖ : remuneration of labor (exogenous);

r : remuneration of capital (exogenous);

L_C : household's labor used in cash crop;

L_F : household's labor used in food crop;

L_O : household's labor used in off-farm activities if $L_O > 0$ and hired labor if $L_O < 0$;

K_C : household's capital used in cash crop;

K_F : household's capital used in food crop;

K_O : household's capital used in off-farm activities if $K_O > 0$ and hired capital if $K_O < 0$;

T_C : household's land used in cash crop;

T_F : household's land used in food crop.

The farm household solves the following program:

$$\underset{C_F, C_C, C_2, E}{Max} \ U(C_F, C_C, C_2, E) \tag{3.1}$$

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The arguments of the utility function refer to aggregates, both over household members and over the agricultural cycle. Thus, both the distribution rules within the household and the role of seasonality are ignored.

The utility maximization program is subject to a cash constraint:

$$pC_C + C_2 + \dot{K} + \delta K \leq (1 + \tau)pY_C + \varpi L_O + rK_O + NT \qquad (3.2)$$

Since the food product is not monetized in any market, its consumption and production do not enter into the cash constraint. The household spends money when buying cash crop products and manufactured products for its consumption or investment. The household receives money from the sales of its cash crops (taxed at the rate $\tau \leq 0$), from the remuneration of its inputs used off-farm, and from a possible net transfer (NT) from the government. This variable is exogenous to the model. If L_O or K_O are negative, it means that the household hires some inputs, and therefore needs to remunerate them. Remuneration of land, labor and capital used in the household production of cash crops does not explicitly appear in the cash constraint since it is represented through the value of the production. And neither does the remuneration of the inputs used in food crop production, since this production takes place only inside the household structure, and therefore is not monetized.

The utility maximization program is also subject to the following quantities constraints:

$$\overline{T} \geq T_C + T_F \qquad (3.3)$$

This constraint means that total household's endowment of land is used in household's cash and food crops.

$$\overline{L} \geq L_C + L_F + L_O + E \qquad (3.4)$$

It means that total household's endowment of time ($\overline{L}$) is used in household's cash and food crops labor, in off-farm labor and in leisure.

$$K \geq K_C + K_F + K_O \qquad (3.5)$$

Household's endowment of capital is used in household's cash and food crops and in off-farm activities.

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$$Y_F(L_F, K_F, T_F) \geq C_F \qquad (3.6)$$

Since there is no market for food crop, household's production has to be at least equal to household's consumption.

In optimum, all these constraints are strictly binding. An additional constraint requires that all quantities are positive and that all inputs used in food crop production are family inputs. Therefore, it gives:

$$L_F \leq \overline{L}, \quad K_F \leq K, \quad T_F \leq \overline{T}$$

In the comparative analysis of different liberalization scenarios, only steady state situations are examined, where $\dot{K} = 0$. Hence, we go on with this value of $\dot{K}$ in the resolution of the model.

Taking into account all the previous constraints, the Lagrangian for this program is:

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\begin{aligned}
L = \ & U(C_F, C_C, C_2, E) + \pi \left[Y_F(L_F, K_F, T_F) - C_F \right] + \qquad (3.7) \\
& \lambda \left[(1 + \tau) p Y_C \left(L_C, K_C, \overline{T} - T_F \right) + \varpi \left(\overline{L} - L_F - L_C - E \right) + r \left(\overline{K} - K_F - K_C \right) \right] \\
& + \lambda \left[NT - p C_C - C_2 - \delta K \right]
\end{aligned}
$$

where λ is the shadow price of capital accumulation and π is the shadow price of food crop. These shadow prices indicate the price that the household would be willing to pay to have the corresponding constraint relaxed by one unit. Shadow prices can, therefore, serve as indicators of the internal perception of the severity of the constraint imposed on the farm household. Land and food crop are non-tradable commodities, therefore they do not have any exogenous price in the model. However, in the decision process of the household, non-tradable commodities have endogenous shadow prices which play a similar role to tradeable's prices. Therefore, any change in market prices has a direct impact on household's behavior, as in a separable model, but it also has an indirect impact through changes in the value of the shadow prices.

Simple values are now given to the functions, in order to get algebraic values for the endogenous variables: Utility function is represented by a logarithmic function, while both production functions are

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represented by Cobb-Douglas functions.

$$U(C_F, C_C, C_2, E) = \eta \ln C_F + \varepsilon \ln C_C + \sigma \ln E + (1 - \eta - \varepsilon - \sigma) \ln C_2 \qquad (3.8)$$

$$Y_C(L_C, K_C, T_C) = (L_C)^\alpha (K_C)^\beta (T_C)^{1-\alpha-\beta} \qquad (3.9)$$

$$Y_F(L_F, K_F, T_F) = (L_F)^\gamma (K_F)^\varphi (T_F)^{1-\gamma-\varphi} \qquad (3.10)$$

No technological change is taken into account by simplification because we are only looking at steady state situations.

The model is solved for the 17 following unknowns:

$$L_F, L_C, L_O, K_F, K_C, K_O, K, T_F, T_C, Y_F, Y_C, C_C, C_2, C_F, E, \pi, \lambda,$$

using the 17 following equations:

- normalizations of the three inputs (equations 3.3, 3.4 and 3.5);

- two production functions (equations 3.9 and 3.10);

- two market clearing conditions (equations 3.2 and 3.6);

- 10 first order conditions of the Lagrangian, which are presented below, in the resolution of the model.

3.3.3 Resolution of the model

3.3.3.1 Algebraic resolution

$\frac{\partial L}{\partial C_C} = 0 \Leftrightarrow$

$$C_C = \frac{\varepsilon}{\lambda p} \qquad (3.11)$$

$\frac{\partial L}{\partial C_2} = 0 \Leftrightarrow$

$$C_2 = \frac{1 - \eta - \varepsilon}{\lambda} \qquad (3.12)$$

$\frac{\partial L}{\partial E} = 0 \Leftrightarrow$

$$E = \frac{\sigma}{\lambda \varpi} \qquad (3.13)$$

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$$\frac{\partial L}{\partial C_F} = 0 \Leftrightarrow$$

$$C_F = \frac{\eta}{\pi} \tag{3.14}$$

$$\frac{\partial L}{\partial L_F} = 0 \Leftrightarrow$$

$$\gamma (L_F)^{\gamma-1} (K_F)^{\varphi} (T_F)^{1-\gamma-\varphi} = \frac{\lambda \varpi}{\pi} \tag{3.15}$$

$$\frac{\partial L}{\partial K_F} = 0 \Leftrightarrow$$

$$\varphi (L_F)^{\gamma} (K_F)^{\varphi-1} (T_F)^{1-\gamma-\varphi} = \frac{\lambda r}{\pi} \tag{3.16}$$

$$\frac{\partial L}{\partial K} = 0 \Leftrightarrow$$

$$\lambda = \frac{\delta}{r} \tag{3.17}$$

$$\frac{\partial L}{\partial L_C} = 0 \Leftrightarrow$$

$$\alpha (L_C)^{\alpha-1} (K_C)^{\beta} (T_C)^{1-\alpha-\beta} = \frac{\varpi}{\lambda p (1+\tau)} \tag{3.18}$$

$$\frac{\partial L}{\partial K_C} = 0 \Leftrightarrow$$

$$\beta (L_C)^{\alpha} (K_C)^{\beta-1} (T_C)^{1-\alpha-\beta} = \frac{r}{\lambda p (1+\tau)} \tag{3.19}$$

$$\frac{\partial L}{\partial T_F} = 0 \Leftrightarrow$$

$$\frac{\lambda (1+\tau) p (1-\alpha-\beta)}{\pi (1-\gamma-\varphi)} (L_C)^{\alpha} (K_C)^{\beta} (T_C)^{-\alpha-\beta} = (L_F)^{\gamma} (K_F)^{\varphi} (\overline{T} - T_C)^{-\gamma-\varphi} \tag{3.20}$$

The step-by-step route to solve this model is presented in the appendixes C and D. The last manipulations are quite heavy to handle without numerical values of the parameters of the production and utility functions, so they are now assigned some values.

3.3.3.2 Values of the parameters

The values of the parameters reflect the productive and preferences features of the kind of economies studied. They allow to reproduce the global features of the economies, such as the share of food crops in total agricultural production for instance. In the literature on developing countries[32], the share of labor remuneration in the agricultural sector usually represents 60 % of total factor remuneration, while the share of capital represents 15 %, and 25 % remains to the land. Of course, these

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[32] cf, for instance, Ruttan and Hayami, 1985, p.100 and 144; or Coxhead and Warr, 1995, p.40-42).

shares only represent some approximations, but they give an idea of income distribution between the production factors. It is assumed, according to the stylized facts of the agricultural sector in developing countries, that relatively more capital is used in cash crops compared to food crops. It is also assumed that the share of land in both types of crops is the same. Therefore, the adjustment is done through the share of labor, which has to be higher in food crops than in cash crops. Still according to the stylized facts, it is assumed that food and cash crops display the same weight in the agricultural sector. Therefore, the productive features of the whole agricultural sector are the average of the two sub-sectors. With these assumptions, we get the following values of the share of the inputs:

	Labor	Capital	Land
Food crops	0.7	0.05	0.25
Cash crops	0.5	0.25	0.25
Whole agricultural sector	0.6	0.15	0.25

As for the utility function, the values of the parameters are taken from the literature on the topic. In particular, De Janvry and al. (1991, p.1410) and Singh and al. (1986, p.125) give some useful estimations. Adapted to our model, they give the following decomposition of the household's utility weights:

Food crops	Cash crops	Manufactured goods	Leisure
0.4	0.25	0.2	0.15

Depreciation rate of capital is assumed to be 10 % in both crops, and the rate of preference for the present is set to 3 %. We then get the following values of the parameters:

α	β	γ	φ	η	ε	σ	ρ	δ
0.5	0.25	0.7	0.05	0.4	0.25	0.15	0.03	0.1

These parameters are used in the values of the endogenous variables found earlier (cf appendixes C and D for their precise values). We can then get quantitative results on the influence of agricultural liberalization measures on household' behavior.

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3.3.4 Results of the model

Effects of liberalization measures are analyzed by studying the likely evolution of the endogenous variables when different policies are implemented. Since the model only represents one agricultural household, many variables remain exogenous. In order to minimize the sources of approximation and keep a view of the issue as general as possible, as few values as possible are given to these exogenous variables. Therefore, a general quantitative assessment of the status of the economy before and after liberalization can hardly be obtained in this model. However, the direction and the magnitude of the change of each endogenous variable can be assessed through the value of its partial derivative with respect to the agricultural policy instruments, p and τ. These values are reported in the appendix E, and the changes in the household's production and consumption variables are described in the next sections.

3.3.4.1 Changes in production variables

By changes in production variables is meant changes in production levels and in use of the inputs. These changes are the same in the two scenarios, since the global price received by producer is the same in the two scenarios, only the instrument used to act on this price changes. Agricultural liberalization leads to the development of cash crops activities. On the contrary, production of food crop decreases. These evolutions have an impact on inputs allocation: Some family labor is shifted from off-farm to cash crops, while the amount of labor used in food crops activities remains constant. At the same time, some land is shifted from food crops towards cash crops. However, the pace of this transfer occurs at a decreasing rate while the agricultural liberalization becomes stronger. It means that a lot of food crops land becomes cash crops land at the first steps of liberalization, but if liberalization goes on, less and less food crops land is transformed into cash crop land, insuring the permanence of some food crop production in the long run. Agricultural liberalization also increases the amount of capital used in cash crops activities.

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3.3.4.2 Changes in consumption variables

The shadow price of food crops increases at the same constant rate in the two scenarios, while the price of cash crops increases only in the first scenario. Consequently, the share of food and cash crops in household consumption decreases in the first scenario, when marketing boards are removed, because prices of the two goods increase. In the second scenario, when the production tax is removed, only the share of food crops consumption decreases, while the share of cash crops consumption remains constant. Indeed, the cash crops' price stays constant while the food crops' price increases. In the two scenarios, the share of manufactured goods' consumption remains constant.

All these statements only regard relative consumption levels of different goods, and no conclusion is done on absolute levels of consumption. These questions will be better answered in a general equilibrium model than in a partial model.

3.3.4.3 General results on income distribution

Expressions of endogenous variables (cf Appendix D) also show their reaction when other exogenous variables (not only agricultural policy instruments) are changed. It is particularly interesting, in our case, to examine how they react when household's endowment changes, in order to draw conclusions on income distribution. For instance, it can be noticed that the level of capital owned by the household increases with the quantity of land owned, but decreases with labor endowment. It clearly reveals the fact that land is one of the main wealth factor, while labor is not. It is also of interest to note that the more land endowment a household owns, the more of it is allocated to cash crops and the larger the cash crop production is. Obviously, this feature is exactly reverse for food crops. Once again, it reveals the fact that land is an indicator of a household's wealth, since the richest farm households do not produce (or very little) food crops. Finally, it is remarkable that the amount of labor used off-farm decreases with land endowment: The poorest households sell proportionally more labor outside the

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family activities, reinforcing the idea of landless households selling their labor. All these observations confirm what has been shown in the previous description of farm sector in developing countries.

3.3.5 Conclusion of the household model

This simple model has shown that agricultural liberalization might exacerbate some features already existing in the sector, by widening the gap between food and cash crop producers. Indeed, food crop sector expands dramatically with agricultural liberalization, leading to more land and labor (family labor and hired labor) being used in cash crops sector. Therefore, it is likely to observe increased inequalities in the agricultural sector, since the ability to switch from food crops production to cash crops production depends to a large extent on inputs endowment: The more capital or skilled labor a household owns, the easier it is to grow cash crops instead of food crops.

Nevertheless, it has to be kept in mind that the conclusions reached with a household model are partial because they obviously represent only an isolated agricultural household, without taking into account the relationships of the agricultural sector with the whole economy. These relationships can only be taken into consideration in a general equilibrium model. Therefore, the following section presents a general equilibrium model close to the one presented in the second chapter: A farmer and a non-farmer produce and consume in an economy with an agricultural and a non-agricultural sectors. However, the agricultural sector is now itself divided into food and cash crops, leading to a three-sector / two-agent general equilibrium model. This new specification permits to better take into account the specific features of a developing country, by integrating the agricultural household model just presented into a more global model that takes into account the non-agricultural sector of the economy as well.

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3.4 The general equilibrium model

This model is made up of three sectors, the agricultural cash and food crops sectors and the non-agricultural sector. There are two representative agents, the farmer and the non-farmer. The distinction between farmers and non-farmers arises from the fact that farmers are the owners of the land. Indeed, in the countries we are looking at, there are, traditionally, very few landless farmers. It is due either to a traditional collective ownership of land or to a land reform of communist inspiration. Therefore, farmers are usually the owners of the land, and it is assumed that the number of farmers is fixed in the short-run, whatever is the agricultural policy. If the policy becomes more in favor of the agricultural sector, less farmers are going to work off-farm and / or more non-farmers are going to work in the agricultural sector. So, if the number of farmers is smaller than the number of persons employed in the farm sector, the difference represents the number of land-less agricultural workers. On the contrary, if the number of farmers is larger than the number of persons employed in the farm sector, the difference represents off-farm labor of farmers. In the model, there cannot be, at the same time, off-farm labor by farmers and landless agricultural workers.

The non-agricultural sector produces the non-agricultural good, which is consumed by the two agents. The agricultural sector produces two kinds of goods: A cash crop, sold on a market, and consumed by the two agents; and a food crop, consumed by the farmer only, on a inside-household basis, meaning that it is not marketed.

3.4.1 Presentation of the model

The model is solved following the social planner program[33]:

$$Max \int_0^\infty e^{-\rho t} \left(bU_A + (1-b) U_{NA} \right) dt \tag{3.21}$$

U_A represents the farmer's utility.

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[33]The subscripts t are omitted for simplification of the presentation.

$$U_A = \varepsilon \log C_C + \eta \log C_F + (1 - \eta - \varepsilon) \log C_2^A$$

for C_C : consumption of cash crop by the farmer,

C_F : consumption of food crop by the farmer,

C_2^A: consumption of non-agricultural good (2) by the farmer (A).

U_{NA} represents the non-farmer's utility.

$$U_{NA} = (\eta + \varepsilon) \log C_1^{NA} + (1 - \eta - \varepsilon) \log C_2^{NA}$$

for C_1^{NA}: consumption of agricultural products (1) by the non-farmer (NA);

C_2^{NA}: consumption of non-agricultural good (2) by the non-farmer (NA).

Both agents are assumed to dedicate the same share of their income to agricultural $(\eta + \varepsilon)$ and non-agricultural goods $(1 - \eta - \varepsilon)$. The only difference consists in the fact that farmers divide their consumption of agricultural goods between food (η) and cash crops (ε). For simplicity, leisure is not valued, since we are more interested in the evolution of the goods' consumption.

b represents the farmers' weight in the social utility function, while $(1 - b)$ represents the non-farmers' weight. It is assumed that $b = 0.5$, meaning that the social planner values on an equal rate the utility of the two representative agents. Indeed, the farmers are more numerous in the society, but they are also less represented on a political point of view. Therefore, the two categories get the same weight in the social planner program.

The social planner's utility maximization program is subject to market clearing conditions:

- For cash crop, the market clearing condition is:

$$C_C = Y_C - C_1^{NA} - NX_1 \tag{3.22}$$

for Y_C : production of agricultural product (cash crop)

NX_1 : net exports of agricultural products.

This constraint means that the agricultural production of cash crops is consumed by the two agents or is exported.

- For food crop, the market clearing condition is:

$$C_F = Y_F \tag{3.23}$$

for Y_F : production of agricultural product (food crop)

Since food crop is not marketed, the agricultural household production has to equal its own consumption.

- For non-agricultural good, the market clearing condition is:

$$\dot{K} = Y_2 - \delta K - C_2^A - C_2^{NA} - NX_2 \tag{3.24}$$

for Y_2: production of non-agricultural good

NX_2 : net exports of non-agricultural products.

K : amount of capital (only accumulable asset) in the economy

$\dot{K} = \frac{dK}{dt}$ = investment

δ : depreciation rate of capital

This constraint means that the non-agricultural production is consumed by the two agents, is exported, and is used for investment.

The model is also made up of:

- Production functions of non-agricultural goods (Y_2), cash crops (Y_C) and food crops (Y_F):

$$Y_2 = (ZL_2)^\theta (K_2)^{1-\theta} \tag{3.25}$$

for L_2 and K_2 the amounts of labor and capital used in non-agricultural production.

$$Y_C = (ZL_C)^\alpha (K_C)^\beta (ZT_C)^{1-\alpha-\beta} \tag{3.26}$$

for L_C, K_C and T_C the amounts of labor, capital and land used in cash crop agricultural production.

$$Y_F = (ZL_F)^\gamma (K_F)^\varphi (ZT_F)^{1-\gamma-\varphi} \tag{3.27}$$

for L_F, K_F and T_F the amounts of labor, capital and land used in food crop agricultural production.

Z represents the technical change embodied into new investments, therefore it is the same in all sectors. It is assumed that $\dot{Z} = \frac{dZ}{dt} = h$.

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As in the industrialized country's case presented in chapter 2, the technological change is assumed here to be Harrod-neutral (it is labor and land augmenting) in order to guaranty the existence of a steady state. Because of this technical change incorporated into investments, the accumulable input has to be precisely defined. Indeed, when speaking about capital, it should be though of accumulable input, in which skilled labor enters as well. So let us think about "capital" as all accumulable inputs, including general capital (able to be used in whatever sector) and skilled labor. And when speaking about "labor", let us think about unskilled labor and specific capital that can hardly be used in another sector than the one in which it is installed. This distinction is important in developing countries because capital is not always very mobile and skilled labor is very much valued.

The model also consists in:

- Government budget constraint:

$$(p - p_w)NX_1 + \tau Y_C + NT = 0 \tag{3.28}$$

The actual policy in the studied economies leads to a domestic price of agricultural product (p) being lower than the world price (p_w). It means that the government taxes net exports (or subsidizes net imports). The agricultural policy also consists in taxing the agricultural production of cash crops at the rate τ ($\tau < 0$). Finally, the government can give some net transfers NT to the agents ($NT > 0$).

- Trade balance:

$$pNX_1 + NX_2 = 0 \tag{3.29}$$

- Inputs normalization:

$$L_C + L_F + L_2 = \overline{L} = 1 \tag{3.30}$$

$$K_C + K_F + K_2 = K \tag{3.31}$$

$$T_F + T_C = \overline{T} \tag{3.32}$$

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The Hamiltonian corresponding to this program is:

$$H = e^{-\rho t}(1-b)\left[(\eta + \varepsilon)\log C_1^{NA} + (1-\eta - \varepsilon)\log C_2^{NA}\right] \tag{3.33}$$

$$+ e^{-\rho t}b\left[\eta \log (L_F)^{\gamma}(K_F)^{\varphi}(T_F)^{1-\gamma-\varphi} + (1-\eta-\varepsilon)\log C_2^A\right]$$

$$+ e^{-\rho t}b\varepsilon \log\left((L_C)^{\alpha}(K_C)^{\beta}(\overline{T} - T_F)^{1-\alpha-\beta} - C_1^{NA} - NX_1\right)$$

$$+ \Lambda\left(-\delta K + (\overline{L} - L_F - L_C)^{\theta}(K - K_F - K_C)^{1-\theta} - C_2^A - C_2^{NA} - NX_2\right)$$

for Λ : shadow price of capital accumulation.

No unemployment is assumed in the model. However, some hide unemployment is likely to exist in the pre-liberalized situation due to a lower labor productivity in the agricultural sector compared to the non-agricultural one. Off-farm work by farmer represents a solution to this hide unemployment.

3.4.2 Resolution of the model

The model is solved for 25 unknowns with 25 equations:

The unknowns are:

- the inputs levels: $L_C, L_F, L_2, K_C, K_F, K_2, K, T_C, T_F$;

- the production levels: Y_C, Y_F, Y_2;

- the inputs remunerations: r, ϖ, q;

- the shadow price of capital accumulation and of food crop: Λ, π;

- the consumption levels: $C_C, C_F, C_2^A, C_1^{NA}, C_2^{NA}$;

- the net exports: NX_1, NX_2;

- the net transfers: NT.

The equations are:

- the 3 production functions (equations 3.25, 3.26 and 3.27);

- the 3 input normalizations (equations 3.30, 3.31 and 3.32);

- the trade balance (equation 3.29);

- the government budget constraint (equation 3.28);

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- the 3 market clearing conditions (equations 3.22, 3.23 and 3.24);

- 6 inputs remunerations (3 for labor, 2 for land, 1 for capital: equations 3.51 to 3.56 presented below);

- 8 first order conditions of the Hamiltonian, which are presented next page (equations 3.42 to 3.44, and 3.46 to 3.50).

3.4.2.1 Normalization

Before solving the model, some normalizations are needed. These normalizations consist in dividing all the variables by the technical change Z, so that the model is solved for its steady state, when all the variables grow at the same rate.

$$k_C = \frac{K_C}{L_C Z}, \quad k_2 = \frac{K_2}{L_2 Z}, \quad k_F = \frac{K_F}{L_F Z} \quad k = \frac{K}{LZ} \tag{3.34}$$

$$y_C = \frac{Y_C}{L_C Z} = (k_C)^\beta \left(\frac{T_C}{L_C}\right)^{1-\alpha-\beta} \tag{3.35}$$

$$y_F = \frac{Y_F}{L_F Z} = (k_F)^\varphi \left(\frac{T_F}{L_F}\right)^{1-\gamma-\varphi} \tag{3.36}$$

$$y_2 = \frac{Y_2}{L_2 Z} = (k_2)^{1-\theta} \tag{3.37}$$

$$c_C = \frac{C_C}{LZ}, \quad c_F = \frac{C_F}{LZ}, \quad c_2^A = \frac{C_2^A}{LZ} \tag{3.38}$$

$$c_1^{NA} = \frac{C_1^{NA}}{LZ}, \quad c_2^{NA} = \frac{C_2^{NA}}{LZ} \tag{3.39}$$

$$\lambda = \Lambda ZL, \quad nt = \frac{NT}{LZ} \tag{3.40}$$

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$$nx_1 = \frac{NX_1}{LZ}, \quad nx_2 = \frac{NX_2}{LZ} \tag{3.41}$$

3.4.2.2 The first order conditions of the Hamiltonian

$\frac{\partial H}{\partial C_2^A} = 0 \Leftrightarrow$

$$c_2^A = \frac{b(1 - \eta - \varepsilon)}{\lambda} \tag{3.42}$$

$\frac{\partial H}{\partial C_2^{NA}} = 0 \Leftrightarrow$

$$c_2^{NA} = \frac{(1 - b)(1 - \eta - \varepsilon)}{\lambda} \tag{3.43}$$

$\frac{\partial H}{\partial C_1^{NA}} = 0 \Leftrightarrow$

$$c_1^{NA} = \frac{(1 - b)(\eta + \varepsilon)}{b\varepsilon} c_C \tag{3.44}$$

$\frac{\partial H}{\partial \Lambda} = \dot{K} \Leftrightarrow$

$$\frac{\dot{k}}{k} = -\delta + \frac{y_2}{k} L_2 - \frac{c_2^A}{k} - \frac{c_2^{NA}}{k} - \frac{nx_2}{k} \tag{3.45}$$

In steady state, $\frac{\dot{k}}{k} = 0$ and this condition is equivalent to the market clearing condition in the non-agricultural sector.

$-\frac{\partial H}{\partial K} = \dot{\Lambda} \Leftrightarrow$

$$\frac{\dot{\lambda}}{\lambda} = \rho + \delta + h - \frac{\partial y_2}{\partial k_2} \tag{3.46}$$

$\frac{\partial H}{\partial L_F} = 0$ gives:

$$c_F = b\eta \frac{\gamma (k_F)^\varphi \left(\frac{T_F}{L_F}\right)^{1-\gamma-\varphi}}{\lambda \theta (k_2)^{1-\theta}} \tag{3.47}$$

$\frac{\partial H}{\partial L_C} = 0$ gives:

$$c_C = b\varepsilon \frac{\alpha (k_C)^\beta \left(\frac{T_C}{L_C}\right)^{1-\alpha-\beta}}{\lambda \theta (k_2)^{1-\theta}} \tag{3.48}$$

$\frac{\partial H}{\partial K_F} = 0$ gives:

$$c_F = b\eta \frac{\varphi (k_F)^{\varphi-1} \left(\frac{T_F}{L_F}\right)^{1-\gamma-\varphi}}{\lambda (1-\theta)(k_2)^{-\theta}} \tag{3.49}$$

$\frac{\partial H}{\partial K_C} = 0$ gives:

$$c_C = b\varepsilon \frac{\beta (k_C)^{\beta-1} \left(\frac{T_C}{L_C}\right)^{1-\alpha-\beta}}{\lambda (1-\theta)(k_2)^{-\theta}} \tag{3.50}$$

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3.4.2.3 The first order conditions on the production side

$$\varpi = \pi\gamma\left(k_F\right)^{\varphi}\left(\frac{T_F}{L_F}\right)^{1-\gamma-\varphi} \tag{3.51}$$

$$\varpi = (1+\tau)\,p\alpha\left(k_C\right)^{\beta}\left(\frac{T_C}{L_C}\right)^{1-\alpha-\beta} \tag{3.52}$$

$$\varpi = \theta\left(k_2\right)^{1-\theta} \tag{3.53}$$

$$r = (1-\theta)\left(k_2\right)^{-\theta} \tag{3.54}$$

$$q = (1+\tau)p\left(1-\alpha-\beta\right)\left(k_C\right)^{\beta}\left(\frac{T_C}{L_C}\right)^{-\alpha-\beta} \tag{3.55}$$

$$q = \pi\left(1-\gamma-\varphi\right)\left(k_F\right)^{\varphi}\left(\frac{T_F}{L_F}\right)^{-\gamma-\varphi} \tag{3.56}$$

Capital and labor are mobile between the three production activities, hence their marginal productivity after agricultural instruments implementation need to be equal in their three uses. Land can be allocated between the two agricultural crops. Hence its remuneration needs to be the same in these two uses (for π: shadow price of food crops for farmers).

The step-by step route to solve this model is presented in appendix F. The last steps of the solution include numerical values of the parameters; otherwise, the analytical values of the variables become very heavy to handle. These values of the parameters are presented now.

3.4.3 Values of the parameters

In less developed countries, food is almost completely equivalent to agricultural products since they get almost no transformation or value added between producers and consumers. The stylized facts of several less developed economies show that the share of food in household expenditure is around 75 %. Referring to the values used in the household model, this share can be divided between 45 % for food crops and 30 % for cash crops in the agricultural household case. In the model presented here, utility function of poor and rich people is not distinguished. It is justified by the fact that we refer to very poor countries, where inequalities are not so salient as they can be in some intermediate

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countries like in Latin America for instance. Leisure is not taken into account in this model because it does not bring any useful pieces of information to our objective of income distribution focus. Therefore, the share of non-agricultural good in a household consumption is set to 25 %. This choice of utility parameters fits the choice made in the household model presented earlier.

As previously noted, technical change is assumed to be embodied into new investments, and therefore to be the same in all sectors. Its annual growth rate is set to 4 %, and represents an average between the last decade growth rates and the targeted growth rates for the forthcoming years (cf World Bank country reports) for the 4 countries taken as example of our representative economy (hence $h = 0.04$). The rate of preference for the present is set to 3 % for both agents ($\rho = 0.03$) and the capital depreciation rate to 10 % ($\delta = 0.1$), as is usually done in the literature.

Stylized facts, as well as econometric studies applied to less developed countries, show the following share of inputs remuneration:

	Labor		Capital		Land
	skilled	unskilled	general	specific	/
Agriculture	0.15	0.45	0.05	0.1	0.25
Other sectors	0.3	0.5	0.1	0.1	/

source: Ruttan and Hayami (1985, p.100 and 144) and Coxhead and Warr (1995, p.40-42)

Considering our definition of inputs (K represents all accumulable inputs, including skilled labor, and L takes into account specific capital as well as unskilled labor), we get:

	L	K	T
Agriculture	0.55	0.2	0.25
Other sectors	0.6	0.4	0

Indeed:

- the share of remuneration of L in the agricultural sector is represented by the share of unskilled labor and specific capital in the agricultural sector: $0.45 + 0.1 = 0.55$.

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- the share of remuneration of K in the agricultural sector is represented by the share of skilled labor and "general" capital in the agricultural sector: $0.15 + 0.05 = 0.2$.

- the share of remuneration of L in the non-agricultural sector is represented by the share of unskilled labor and specific capital in the non-agricultural sector: $0.5 + 0.1 = 0.6$.

- the share of remuneration of K in the non-agricultural sector is represented by the share of skilled labor and "general" capital in the non-agricultural sector: $0.3 + 0.1 = 0.4$.

We then turn back to the values of parameters given to the cash and food crops production functions in the household model. We get:

	L	K	T
Cash crops	0.5	0.25	0.25
Food crops	0.7	0.05	0.25
Whole agricultural sector	0.55	0.2	0.25
Non-agricultural sectors	0.6	0.4	0

This integration of the two models keeps the coherence of the production functions since food crop production is more labor-intensive than the whole agricultural sector, while cash crop production is more capital-intensive.

Finally, the whole set of parameters of the model is:

α	β	γ	θ	φ	η	ε	h	δ	ρ
0.5	0.25	0.7	0.6	0.05	0.45	0.3	0.04	0.1	0.03

Scenarios are then run in the model. Three cases are studied:

A/ $p = 1, \tau = 0$

B/ $p = 1.3, \tau = -0.23$

C/ $p = 1.3, \tau = 0$

The changes from one case to another correspond to different scenarios of liberalization:

From A to C: First scenario, elimination of marketing boards;

From B to C: Second scenario, elimination of taxes on agricultural production.

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In any case, the global price received by the farmer ($p(1 + \tau)$) increases by 30 %, such that the two scenarios be comparable. Quantitative results of the model for these scenarios are now presented.

3.4.4 Results of the model

Results represent relative changes in the values of the endogenous variables when the agricultural policy changes. It has to be kept in mind that the directions of the changes are more important than their values, or, in other words, that qualitative results are more important than quantitative ones. Indeed, quantitative results change with the values of the parameters and with the initial conditions imposed to the model. However, the general direction of the changes does not change for a large range of parameters or initial conditions, as has been checked in a sensibility analysis.

We examine the changes in endogenous variables when different liberalization scenarios are implemented. We first look at the variables related to the production side of the economy, and then at the variables related to its consumption side. Complete results are presented in appendix G.

3.4.4.1 Changes in production variables

In both liberalization scenarios, agricultural production increases. More precisely, this increase is due to a dramatic increase in cash crop production: It increases by 140 % in the first scenario, and by 146 % in the second scenario. This rise in cash crop production is so large because the liberalization measure is itself large and because the agricultural sector is very important in the representative country studied, in terms of share of GDP and share of consumption. Cash crop production increase is logically explained by the end of farmers' taxation and by a higher price received by the farmer for each agricultural product sold. Cash crop production increases more in the second scenario because there is no negative demand effect due to higher consumer price, while this negative effect exists in the first scenario.

Regarding food crop production, it decreases by 5 % in the first scenario and by 20 % in the second one. This negative evolution is due to a transfer of agricultural resources towards cash crops, which benefit from liberalization. Since cash crop production increases more in the second scenario than in the first one, food crop production decreases more in the second scenario.

Non-agricultural production decreases in the two scenarios (between 45 and 50 %). This is logically explained by the fact that the anti-agricultural bias used to work as a pro-non-agricultural bias. Therefore, with agricultural liberalization, the non-agricultural sector loses its relative protection, and consequently declines.

With agricultural liberalization, there is a land transfer from food crop production towards cash crop production. The evolution of labor and capital employed in agriculture and non-agriculture follows similar trends as the evolution of their respective production levels: It increases in cash crops, more in the second than in the first scenario; it is constant in food crops, and it decreases in the non-agricultural sector (by exactly the same amount as the production level). Such an evolution reveals that less and less farmers work off-farm, since their labor force now finds employment in their own sector. However, it is difficult to say whether the agricultural labor force used in cash crops is used inside each agricultural household or if it is employed in the agricultural sector but only in some large farms.

It has to be noticed that this evolution represents only the response of the economy to domestic liberalization policy. At the world level, liberalization is expected to lead to stronger competition, and, hence, very likely, to a decrease of the number of persons employed in the agricultural sector. Therefore, domestic and international effects would act in different directions, and our model is too simple to tell which of these two effects would be the strongest. Moreover, the domestic evolution described in the previous paragraph is only the first step of the changes generated by agricultural liberalization. Indeed, since the reforms are expected to be positive for the farmers, and since they represent the main share of the population, the population is expected to get richer after the implementation of the reforms. Consequently, consumption of non-agricultural goods is expected to increase, since it is more income-elastic than consumption of agricultural goods. Therefore, labor and capital employed in

the non-agricultural sector are also expected to increase in a second step of the process of economic adjustment to the reforms. Unfortunately, the increase in the level of non-agricultural goods consumption may also lead to an increase in the amount of imports of these goods, if the domestic industry is not prepared to produce rapidly enough goods. However, all these side effects do not really affect our own conclusions which mainly regard the direct impact of inputs reallocation on income distribution.

Regarding the evolution of the rental rates of inputs when the agricultural sector is liberalized, it is noticeable that the rental rates of labor and capital (ϖ and r) do not change because they correspond to mobile inputs. In fact, marginal productivity of these inputs does not change in the non-agricultural sector when the agricultural sector is liberalized (or at least their marginal productivity is not directly affected by agricultural liberalization). Therefore, the remuneration of these inputs stays constant as well. Since they are mobile, it is the ratio of the inputs and / or the remuneration of land that have to change in the agricultural sector. Indeed, the rental rate of land increases by 185 % in the two scenarios.

Let us now turn to the evolution of consumption variables, that reveals more clearly the impact of liberalization on welfare.

3.4.4.2 Changes in consumption variables

Permanent consumption of the agents

Permanent consumption (PC) level is used as a proxy of the welfare level of the agents. It is deduced from the budget constraints of the agents, and hence depends very much on their definition:

For the farmer defined as the land-owner, who remains considered as farmer even if he works off-farm (and referred to as the "A" agent): Using the cash constraint (in steady state) and the food crop market clearing condition, as presented in the household model, it gives:

$$PC_A = \pi C_F + p C_C + C_2^A \tag{3.57}$$

$$PC_A = \pi Y_F + (1 + \tau) p Y_C + \varpi (L_A - L_C - L_F) + r (K_A - K_C - K_F) + NT_A - \delta K_A$$

for π: shadow price of the food crop product;

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for L_A : quantity of labor owned by the farmer (land-owner). This quantity is fixed initially. Since farmers are assumed to represent, in the initial situation, 80 % of labor force, we fix: $L_A = 0.8$ (because L has been normalized to 1).

$L_A - L_C - L_F$ represents off-farm labor of the farmer if it is positive or labor of landless agricultural workers hired in a farm if it is negative.

K_A represents the quantity of accumulable asset owned by the farmer. It is assumed that the asset ownership is distributed between the two representative agents on a fair basis, according to their weight in labor force. Hence, we have: $K_A = 0.8K$. The same assumption is made for the net transfers NT, therefore $NT_A = 0.8NT$.

For the non-farmer, defined as someone who does not own any land (referred to as the "NA" agent):

$$PC_{NA} = pC_1^{NA} + C_2^{NA} = \varpi L_{NA} + (r - \delta) K_{NA} + NT_{NA} \qquad (3.58)$$

for L_{NA} : quantity of labor owned by the non-farmer; $L_{NA} = 0.2$.

K_{NA} : quantity of accumulable asset owned by the non-farmer; $K_{NA} = 0.2K$

$NT_{NA} = 0.2NT$

Permanent consumption of non-farmers corresponds to the net remuneration of the owned inputs plus the net transfers.

However, these definitions of the agents according to their land ownership is not unique and it is interesting to study the evolution of the agents' welfare according to their work sector. Indeed, liberalization of the agricultural sector leads to the development of commercial agriculture and, consequently, to a likely disconnection between land ownership and labor in a farm. Instead of many small farmers owning their own land and partly producing for themselves, some large farms are likely to develop, owning large surfaces of land and employing many landless workers, previously producing for themselves or working off-farm in the non-agricultural sector. Therefore, the welfare of the whole rural population working in the farm sector has to be examined, with no distinction according to land ownership. Welfare of landless workers would then be included into the analysis, while the welfare

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of the land-owners working off-farm would be excluded. We get an expression of the permanent

consumption of the people working in the agricultural sector (referred to as the "1" agents):

$$PC_1 = (1 + \tau)pY_C + \pi Y_F + NT * L_1 - \delta(K_F + K_C) \tag{3.59}$$

Regarding the group working in the non-farm sector, their permanent consumption is represented

by:

$$PC_2 = \varpi L_2 + (r - \delta)K_2 + NT * L_2 \tag{3.60}$$

The whole society permanent consumption does not depend on these distinctions, and is

represented by:

$$PC = (1 + \tau)pY_C + \pi Y_F + NT + \varpi L_2 + rK_2 - \delta K \tag{3.61}$$

When agricultural liberalization measures are implemented in the model, the permanent

consumption of the farmers group (defined as the persons owning the land, working in or off-farm:

PC_A) increases by 30.5 % in the first scenario, and by 32.7 % in the second scenario. At the same time,

the permanent consumption of the non-farmers group (PC_{NA}) decreases by 41 % in the first scenario

and by 39 % in the second one. Since the number of persons in each group is regarded as constant, the

per capita permanent consumption levels follow the same patterns as the whole group levels. The whole

society permanent consumption increases in both scenarios, by 20 % in the first one, and by 22.3 % in

the second one.

The second scenario is preferred to the first one by both agents, and hence by the whole society.

Indeed, in the first scenario, the farmers benefit from the liberalization measures as producers, but they

suffer from them as consumers. On the contrary, in the second scenario, they get the same benefit as

producers, and there is no negative effect for the consumers. For the non-farmers, they suffer more from

the liberalization measures in the first scenario than in the second: In the first scenario, the price they

have to pay for the agricultural good increases, while it remains constant in the second scenario. The

effect on the whole society is the sum of the effects on the two agents. Since farmers are much more

numerous than non-farmers, the evolution of their permanent consumption gives the trend of evolution of the global permanent consumption.

The evolution of the per capita permanent consumption of the group of persons working in the agricultural sector (PC_1, including landless workers and excluding off-farm work of land-owners) is negative. It decreases by 21.3 % in the first scenario, and by 19.6 % in the second. It reveals the fact that the number of persons employed in the agricultural sector increases much more than the income of the sector. On the contrary, the per capita permanent consumption of the persons working in the non-farm sector (PC_2) decreases less than the one of the non-farmers' group (PC_{NA}): It decreases by 27.4 % of its initial level in the first scenario, and by 26 % in the second scenario. This is due to the decreasing number of persons working in the non-farm sector. From the fact that the welfare per land-owner (PC_A) increases while the welfare per agricultural worker (PC_1 per capita) decreases, we can deduce that the landless agricultural workers become more numerous, or that the global income of their group becomes smaller. The ranking of the scenarios suggests that eliminating marketing boards is particularly harmful for landless agricultural workers (cf $PC_1(L_1)/L_1$ in appendix G), while eliminating the tax on agricultural production is particularly positive for land-owners (cf $PC_A(L_A)$ in appendix G). Therefore, on the whole society point of view, it is preferred to eliminate agricultural production tax rather than marketing boards. Indeed, the second scenario leads to higher increase in permanent consumption. Hence, if an agricultural policy instrument had to be chosen previously, it would have been better to implement marketing boards rather than production tax. Indeed, since the removal of marketing boards leads to a smaller increase of permanent consumption, it means that its implementation was not as bad as the production tax was. Moreover, if the government wants to liberalize the agricultural sector progressively, it might be a solution to progressively replace production tax by marketing boards, although they should not guaranty prices as low as they were usually in the reality, or as they are in the model.

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Other consumption variables

The evolution of the relative levels of consumption of each type of good by each agent does not necessarily follow the evolution of the permanent consumption levels. Indeed, relative consumption of food crops by agricultural households decreases by 23 % in both scenarios, since its relative price increases. This makes the farm household much more dependant on international price fluctuations. Relative consumption levels of agricultural cash crops and non-agricultural goods change in the same way for the two agents: Relative consumption of agricultural cash crops decreases by 23 % in the first scenario (when its price increases), and it remains constant in the second (when its price remains constant as well). Consumption of non-agricultural goods increases by 53 % in the first scenario, and by 33 % in the second: There is a transfer of consumption from agricultural goods (food and cash crops) towards non-agricultural goods.

Agricultural sector liberalization leads to an increase in agricultural products exports. Indeed, they follow a trend corresponding to the difference between domestic production and consumption levels: Since production increases while consumption decreases, exports of agricultural products increase (or imports decrease) in both liberalization scenarios. Agricultural liberalization is hence positive for the agricultural trade balance. In the two scenarios, exports increase by the same amount; indeed, consumption of agricultural products decreases more in the first scenario than in the second one, but production increases less.

As for non-agricultural products imports, they increase in both scenarios. Indeed, the domestic consumption of this product increases, while its domestic production decreases. Imports increase more in the first scenario than in the second because domestic consumption increases more while domestic production decreases more.

Regarding net transfers from the government to the agents, they decrease in both scenarios. The removal of the agricultural sector taxation represents a decrease in the sources of income for the government. Net transfers logically decrease more in the second scenario than in the first one. Indeed,

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when marketing boards are removed (first scenario), the government can no longer tax agricultural exports. In the second scenario, it is a tax applied to the whole agricultural production that is removed. Since this tax is larger than a tax on the exports only, its removal leads to more dramatic consequences on government's budget. However, the decrease in the amount of net transfers distributed to the agents is not necessarily as bad as it seems to be. In fact, it is not sure that the government's income was previously used in an equitable and efficient way. Cases of corruption are very frequent in developing countries, and public money is often used for private interests. Therefore, the decrease in the amount of taxes levied by government does not necessarily mean that the agents are going to receive less transfers.

3.4.5   Conclusion of the general equilibrium model

The scenarios studied lead to some dramatic changes in the values of the endogenous variables. However, it has to be kept in mind that these scenarios are themselves extreme, and unlikely to be implemented in one step as they are described here. Therefore, the results of our simulations are useful to give hints on the relative consequences of different policies. According to the main objectives chosen, the results show that different policies might be implemented.

The welfare of the agents can be estimated by their permanent consumption level. Since the countries we are looking at are very rural and based on the agricultural sector, the global welfare of the society increases with the agricultural sector liberalization. Nevertheless, this is a global conclusion and agricultural liberalization might be harmful for the poorest part of the population. Indeed, all cash crop buyers suffer from agricultural liberalization policy and, paradoxically, they are not all urban, but also landless agricultural workers. These landless workers become more numerous while the commercial agricultural sector expands. They can be former agricultural food crop producers who did not own enough of the inputs necessary to adapt to the new environment (skilled labor, capital, land) and to transform their former production into cash crop production. They can also be former off-farm workers

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who can no longer find any job in the non-agricultural sector and become off-household workers in the farm sector.

Moreover, regarding many productive variables of the economy, liberalization results are not so obviously positive as they are when looking at the global welfare of the society. Agricultural liberalization logically enhances agricultural variables, such as production, employment and remuneration of the agricultural specific input (land). On the contrary, it logically hurts production and employment in the non-agricultural sector, since agricultural taxation used to work as subsidies to the non-agricultural sector. Agricultural liberalization, by enhancing consumption of non-agricultural products, may lead to trade balance problems if the domestic industry is not prepared to respond to this increase in domestic demand, and, consequently, it may increase debt problems.

Because of this balanced assessment of agricultural liberalization consequences, political choices have to be clearly identified before choosing an instrument of liberalization. In the context of the model, it means that the two studied agricultural instruments have to be carefully compared. Results of the model show that the second scenario (elimination of the production tax) should be preferred if the government prefers to increase more cash crops production, to decrease less non-agricultural production and to increase less imports of non-agricultural goods. It should also be preferred if the welfare of the people working in the agricultural sector (independently of any land ownership consideration) is regarded as an important variable. On the contrary, the first scenario should be preferred if the goal is to reduce less food crop production. Therefore, depending on the variables regarded as more important by the government, one or the other means of taxation (and of liberalization) of the agricultural sector should be chosen. Indeed, marketing boards should be preferred if the government wants to decrease the amount of non-agricultural imports and to increase non-agricultural production (when marketing boards are removed, in the first scenario, these variables change dramatically, suggesting that the agricultural policy instrument was particularly effective). It can also be noticed that marketing boards are less harmful than production tax for cash crop production, since, when they are removed, the cash crop production increases less than in the second scenario. On the contrary, a tax on agricultural production

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should be preferred if the government wants to increase more food crop production. Therefore, depending on the whole economic and social context of the country, one or another policy should have been implemented. Moreover, when liberalizing, one policy could partially replace the other one. Indeed, instead of implementing one-step liberalization measures like the ones presented in the model, a government can choose partial measures. For instance, according to its priorities, it can decide to temporarily and partially replace marketing boards by a production tax, or vice versa.

All these conclusions have to be moderated by examining the limits of the model. The main one regards the capital market. It has been assumed in the model that households can rent or hire some capital as if a perfect capital market existed. However, the existence of such a market is not granted in developing countries. And even if such a market existed, it could be hardly accessible to all households: The more rural a household, the more difficult to reach a capital market or a bank. This assumption of the existence of a perfect capital market therefore appears as a limit of the models presented in this chapter. Nevertheless, this assumption can be justified by two means.

The first one regards the nature of the social relationships in the countries studied. Indeed, even if there is no official capital market working efficiently and easily reachable by many people, some unofficial capital markets are likely to exist, inside the enlarged family, or the village. A household can hence borrow or lend money inside its social group. Reputation constraints compel borrowers to reimburse within the agreed period. In this kinds of transactions, some shortages could happen, but, at least, market for capital is not completely non-existent.

The second justification of the assumption of perfect capital market is methodological: A model which would take into account an imperfect capital market would be much more complicated than the models presented in this chapter. However, considering that our main goal is to give agricultural policy recommendations, it is not certain that a more sophisticated model would give a better answer to our questions. The trade-off between the elaboration of a more realistic and complicated model and the improved answers it could give us is not clear. Therefore, our simple model gives a first range of answers to some important questions we were interested in.

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3.5 Conclusion

The last two decades have seen the development of off-farm labor among rural population in many developing countries. It is partly explained by the agricultural sector being highly taxed; such a policy restraints the normal development of the agricultural sector, and hence generates an excess rural labor force. Working off-farm is a way of using this labor force, in uses probably more productive than in the agricultural sector. At the same time, it may enhance agricultural productivity since less labor is left in it. Moreover, if off-farm work permits to bring money to the farm household, it might enhance investments favorable to productivity as well. However, off-farm labor can also be seen as the first step of rural migrations towards cities, which governments usually want to prevent.

A lighter tax burden on the agricultural sector might be a way of reducing rural-urban migrations, or, primarily, off-farm work. Indeed, agricultural liberalization consisting in taxing less the agricultural sector would enhance its commercial part. Consequently, there would be an increase in the share of the inputs used in this sector. The farmers, previously partly employed off the farm sector, would become more and more "true" farmers, in the sense that more and more of their work time would become employed in the farm sector. However, it is difficult to tell whether this labor would be used in the own farm of the worker, or in another one, usually larger. What can be concluded is that there would be less off-farm sector work, but it might also represent agricultural work outside the farm household, in larger commercial farms. This is represented by the rise in the number of landless agricultural workers, whose welfare suffers from liberalization. Hence, agricultural liberalization would reduce the risk of too large migrations from countryside towards cities, but it might be harmful for rural dwellers with low inputs endowments.

Depending on the main goal of the government, different routes of liberalization could be adopted, with the use of different instruments stressed. However, agricultural liberalization policy should be undertaken carefully, since, in the kind of countries studied, the agricultural population represents the large majority of total population. Therefore, income distribution depends very strongly on agricultural

policy. The models developed in this chapter have shown that agricultural liberalization is positive for the whole society, and seems positive for the overall income distribution, since farmers (land-owners) benefit from the relaxation of the agricultural tax burden, while non-farmers suffer from it. Since non-farmers are often better-off than farmers, overall income distribution may improve. However, the main losers of agricultural liberalization are all the net buyers of commercial agricultural products, who are often the poorest share of the population, either urban or rural. Therefore, some redistributive schemes should be implemented in order to compensate the losers of the reforms. However, redistributive policies are difficult to implement in developing countries. Hence, agricultural liberalization is likely to hurt the most vulnerable part of the society: Poor urban-dwellers, food crop producers, land-less agricultural workers, whose number increases.

Agricultural liberalization also leads to some productive negative effects. They regard the negative reaction of the non-agricultural sector, which is worrying for the future of the economy. It is explained by the fact that the anti-agricultural bias used to work as a pro-non-agricultural bias. Therefore, with agricultural liberalization, the non-agricultural sector loses its protection. A one-step liberalization policy should therefore be avoided. Or, if it is implemented, the non-agricultural sector should be temporarily subsidized, which is in complete opposition to the theories sustaining the liberalization of the agricultural sector. Therefore, agricultural liberalization should not be undertaken by itself, but should be included into a larger reorganization of the economy, not necessary going only towards a more liberal route.

One of the measures favoring an easier transition to a liberalized agriculture would consist in accompanying the insertion of the economy into the world market economy. Indeed, the development of cash crops makes the country more vulnerable to international price fluctuations that might emerge from liberalization. In order to cope with these fluctuations, the political, social and economic structures of the country have to be ready for its larger insertion into the world economy. It means, inter alia, developing the infrastructures, and mainly the rural ones, such as credit and input delivery system for instance. It will not necessarily be improved with higher agricultural prices, and it need significant and

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autonomous institutional and organizational changes. Indeed, price and market reforms will turn out to be adequate for boosting agricultural productivity only if infrastructures are reformed as well, since output depends a great deal on what happens to rural infrastructure. Another accompanying measure would consist in developing the financial and land markets. All the spirit of these accompanying measures could be summarized as follows: "In terms of sequencing of reforms, there is some general agreement that one should [...] initiate measures to promote a competitive private sector long before dismantling the public sector. [...] In order to prevent the conversion of a public monopoly into a private monopoly, it is important to strengthen the public regulatory framework before attempts at privatization" (Bardhan, 2001, p.159).

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APPENDIX C   Resolution of the household model

The ratio of 3.15 and 3.16 gives:

$$L_F = \frac{r\gamma}{\varpi\varphi}K_F \qquad\qquad C.62$$

The ratio of 3.18 and 3.19 gives:

$$L_C = \frac{r\alpha}{\varpi\beta}K_C \qquad\qquad C.63$$

C.63 in 3.18 gives:

$$K_C = T_C\left[\left(\frac{\varpi}{\alpha}\right)^{\alpha}\left(\frac{r}{\beta}\right)^{1-\alpha}\frac{1}{\lambda p(1+\tau)}\right]^{\frac{1}{\beta+\alpha-1}} \qquad\qquad C.64$$

C.62 in 3.15 gives:

$$K_F = T_F\left[\frac{\lambda}{\pi}\left(\frac{\varpi}{\gamma}\right)^{\gamma}\left(\frac{r}{\varphi}\right)^{1-\gamma}\right]^{\frac{1}{\gamma-1+\varphi}} \qquad\qquad C.65$$

From 3.3, 3.5, C.64 and C.65:

$$K = \overline{T}\left[\frac{\lambda}{\pi}\left(\frac{\varpi}{\gamma}\right)^{\gamma}\left(\frac{r}{\varphi}\right)^{1-\gamma}\right]^{\frac{1}{\gamma-1+\varphi}} + K_O + \qquad\qquad C.66$$

$$T_C\left[\left(\left(\frac{\varpi}{\alpha}\right)^{\alpha}\left(\frac{r}{\beta}\right)^{1-\alpha}\frac{1}{\lambda p(1+\tau)}\right)^{\frac{1}{\beta+\alpha-1}} - \left(\frac{\lambda}{\pi}\left(\frac{\varpi}{\gamma}\right)^{\gamma}\left(\frac{r}{\varphi}\right)^{1-\gamma}\right)^{\frac{1}{\gamma-1+\varphi}}\right]$$

Family labor is allocated between cash and food crops such that it has the same marginal productivity in both activities. Therefore we have (from 3.15 and 3.18):

$$\varpi = (1+\tau)p\frac{\partial Y_C}{\partial L_C} = \frac{\pi}{\lambda}\frac{\partial Y_F}{\partial L_F} \qquad\qquad C.67$$

Using C.62 and C.63 in the two parts of C.67, it gives:

$$L_C = \left[\left(\frac{\varpi}{\alpha}\right)^{1-\beta}\left(\frac{r}{\beta}\right)^{\beta}\frac{1}{p(1+\tau)}\right]^{\frac{1}{\alpha+\beta-1}}T_C \qquad\qquad C.68$$

$$L_F = \left[\left(\frac{\varpi}{\gamma}\right)^{1-\varphi}\left(\frac{r}{\varphi}\right)^{\varphi}\frac{\lambda}{\pi}\right]^{\frac{1}{\gamma+\varphi-1}}T_F \qquad\qquad C.69$$

Using C.64, C.65, C.68 and C.69 in 3.20:

$$\pi = \varpi^{\left(\frac{\alpha(1-\gamma-\varphi)}{\alpha+\beta-1}+\gamma\right)}r^{\left(\frac{\beta(1-\gamma-\varphi)}{\beta+\alpha-1}+\varphi\right)}\lambda^{\left(\frac{(\alpha-1)(1-\gamma-\varphi)}{\beta+\alpha-1}+\gamma+\varphi\right)}(\gamma)^{-\gamma}(\varphi)^{-\varphi} \qquad C.70$$

$$\left(\frac{1}{p(1+\tau)}\right)^{\frac{1-\gamma-\varphi}{\alpha+\beta-1}}\left(\frac{1-\alpha-\beta}{1-\gamma-\varphi}\right)^{1-\gamma-\varphi}\left(\frac{1}{\alpha}\right)^{\frac{\alpha(1-\gamma-\varphi)}{\alpha+\beta-1}}\left(\frac{1}{\beta}\right)^{\frac{\beta(1-\gamma-\varphi)}{\alpha+\beta-1}}$$

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From 3.3, 3.4, C.68 and C.69:

$$L_O = \bar{L} - E - \left(\left(\frac{\varpi}{\gamma}\right)^{1-\varphi}\left(\frac{r}{\varphi}\right)^{\varphi}\frac{\lambda}{\pi}\right)^{\frac{1}{\gamma+\varphi-1}}\bar{T} - \tag{C.71}$$

$$T_C\left[\left(\left(\frac{\varpi}{\alpha}\right)^{1-\beta}\left(\frac{r}{\beta}\right)^{\beta}\frac{1}{p(1+\tau)}\right)^{\frac{-1}{\alpha+\beta-1}} - \left(\left(\frac{\varpi}{\gamma}\right)^{1-\varphi}\left(\frac{r}{\varphi}\right)^{\varphi}\frac{\lambda}{\pi}\right)^{\frac{1}{\gamma+\varphi-1}}\right]$$

From 3.9, C.64 and C.68:

$$Y_C = T_C\left(\frac{\varpi}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta-1}}\left(\frac{r}{\lambda\beta}\right)^{\frac{\beta}{\alpha+\beta-1}}\left(\frac{1}{p(1+\tau)}\right)^{\frac{\alpha+\beta}{\alpha+\beta-1}} \tag{C.72}$$

From 3.2, 3.11, 3.12, and C.72:

$$\frac{1-\eta}{\lambda} + \delta K = \varpi L_O + r K_O + NT + \tag{C.73}$$

$$T_C\left(\frac{1}{p(1+\tau)}\right)^{\frac{1}{\alpha+\beta-1}}\left(\frac{\varpi}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta-1}}\left(\frac{r}{\beta}\right)^{\frac{\beta}{\alpha+\beta-1}}\left(\left(\frac{1}{\lambda}\right)^{\frac{\beta}{\alpha+\beta-1}} - \alpha - \beta\left(\frac{1}{\lambda}\right)^{\frac{1}{\beta+\alpha-1}}\right)$$

From 3.6, 3.10, 3.14, C.65 and C.69:

$$T_F = \pi^{\frac{1}{\gamma+\varphi-1}}\eta\left(\frac{\gamma}{\varpi}\right)^{\frac{\gamma}{\gamma+\varphi-1}}\left(\frac{1}{\lambda}\right)^{\frac{\gamma+\varphi}{\gamma+\varphi-1}}\left(\frac{\varphi}{r}\right)^{\frac{\varphi}{\gamma-1+\varphi}} \tag{C.74}$$

From 3.3 and C.74:

$$T_C = \bar{T} - \pi^{\frac{1}{\gamma+\varphi-1}}\eta\left(\frac{\gamma}{\varpi}\right)^{\frac{\gamma}{\gamma+\varphi-1}}\left(\frac{1}{\lambda}\right)^{\frac{\gamma+\varphi}{\gamma+\varphi-1}}\left(\frac{\varphi}{r}\right)^{\frac{\varphi}{\gamma-1+\varphi}} \tag{C.75}$$

From C.71 and C.75:

$$L_O = \bar{L} - E - \bar{T}\left[\left(\frac{\varpi}{\alpha}\right)^{1-\beta}\left(\frac{r}{\beta}\right)^{\beta}\frac{1}{p(1+\tau)}\right]^{\frac{-1}{\alpha+\beta-1}} + \pi^{\frac{1}{\gamma+\varphi-1}}\eta\left(\frac{\gamma}{\varpi}\right)^{\frac{\gamma}{\gamma+\varphi-1}}\left(\frac{1}{\lambda}\right)^{\frac{\gamma+\varphi}{\gamma+\varphi-1}}\left(\frac{\varphi}{r}\right)^{\frac{\varphi}{\gamma-1+\varphi}} \tag{C.76}$$

$$*\left[\left(\left(\frac{\varpi}{\alpha}\right)^{1-\beta}\left(\frac{r}{\beta}\right)^{\beta}\frac{1}{p(1+\tau)}\right)^{\frac{-1}{\alpha+\beta-1}} - \left(\left(\frac{\varpi}{\gamma}\right)^{1-\varphi}\left(\frac{r}{\varphi}\right)^{\varphi}\frac{\lambda}{\pi}\right)^{\frac{1}{\gamma+\varphi-1}}\right]$$

APPENDIX D   Values of the household model variables

With the values of the parameters presented in section 3-3-3-2, we get values for the variables of the model: Equations 3.13, C.73, C.75 and C.76 give an expression of K as a function of K_O and the exogenous parameters. If we equalize this expression with equation C.66 (using C.75), we get values for K and K_O (system of two equations with two unknowns). It is then straightforward to get the values of all the other endogenous variables.

Hence we have:

$$K_O = 15.577 + 3.0923\overline{T}\frac{(p(1+\tau))^4}{\varpi^2} - 14.286\left(NT + \varpi\overline{L}\right) \qquad \text{D.77}$$

and:

$$K = 3.633\left(p(1+\tau)\right)^4 \frac{\overline{T}}{\varpi^2} + 14.077 - 14.286\left(NT + \varpi\overline{L}\right) \qquad \text{D.78}$$

From C.70:

$$\pi = .5474p(1+\tau)\varpi^{-2} \qquad \text{D.79}$$

From 3.17:

$$\lambda = .58824 \qquad \text{D.80}$$

From 3.11 and D.80:

$$C_C = \frac{.425}{p} \qquad \text{D.81}$$

From 3.12 and D.80:

$$C_2 = .595 \qquad \text{D.82}$$

From 3.13 and D.80:

$$E = \frac{.255}{\varpi} \qquad \text{D.83}$$

From 3.14 and D.79:

$$C_F = \frac{.73073}{\varpi^{-2}p(1+\tau)} \qquad \text{D.84}$$

From C.74, D.79 and D.80:

$$T_F = \frac{3.1443\varpi^2}{(p(1+\tau))^4} \qquad \text{D.85}$$

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From C.75, D.79 and D.80:

$$T_C = \overline{T} - \frac{3.1443\varpi^2}{(p(1+\tau))^4} \qquad \text{D.86}$$

From C.68 and D.86:

$$L_C = \frac{.18383\,(p(1+\tau))^4}{\varpi^3}\overline{T} - \frac{.57802}{\varpi} \qquad \text{D.87}$$

From C.69, D.79, D.80 and D.85:

$$L_F = \frac{.47598}{\varpi} \qquad \text{D.88}$$

From C.64, D.80 and D.86:

$$K_C = \frac{6.4736 \times 10^{-2}\,(p(1+\tau))^4}{\varpi^2}\overline{T} - .20355 \qquad \text{D.89}$$

From C.72, D.80 and D.86:

$$Y_C = \frac{.21626\,(p(1+\tau))^3}{\varpi^2}\overline{T} - \frac{.67999}{p(1+\tau)} \qquad \text{D.90}$$

From C.71, D.79, D.80, D.83 and D.86:

$$L_O = \overline{L} - \frac{.153}{\varpi} - .18383\overline{T}\frac{(p(1+\tau))^4}{\varpi^3} \qquad \text{D.91}$$

From C.65, D.79, D.80 and D.85:

$$K_F = .2 \qquad \text{D.92}$$

Partial derivatives with respect to agricultural policy instruments are computed from these expressions of the variables, assuming that $\overline{T} = \overline{L} = \varpi = 1$.

APPENDIX E   Values of the partial derivatives in the

household model (for $\overline{T} = \overline{L} = \varpi = 1$)

i	di / dp(1+τ)
PC	$1.4553\ (p(1+\tau))^3$
C_c	$-0.425 / p^2$
C_F	$-0.7307 / (p(1+\tau))^2$
C_2	0
K	$14.532\ (p(1+\tau))^3$
K_O	$12.369\ (p(1+\tau))^3$
K_c	$0.2589\ (p(1+\tau))^3$
K_F	0
L_O	$-0.7353\ (p(1+\tau))^3$
L_c	$0.7353\ (p(1+\tau))^3$
L_F	0
T_c	$12.577 / (p(1+\tau))^5$
T_F	$-12.577 / (p(1+\tau))^5$
Y_c	$0.6488\ (p(1+\tau))^2 + 0.68 / (p(1+\tau))^2$
Y_F	$-0.7307 / (p(1+\tau))^2$
π	0.5474

APPENDIX F Resolution of the general equilibrium model

From 3.37 and 3.46 in steady state:

$$k_2 = \left(\frac{1-\theta}{\rho+\delta+h}\right)^{\frac{1}{\delta}}$$

F.93

From 3.47, 3.49 and F.93:

$$k_F = \frac{\theta\varphi}{(1-\theta)\gamma}\left(\frac{1-\theta}{\rho+\delta+h}\right)^{\frac{1}{\delta}}$$

F.94

From 3.48, 3.50 and F.93:

$$k_C = \frac{\theta\beta}{(1-\theta)\alpha}\left(\frac{1-\theta}{\rho+\delta+h}\right)^{\frac{1}{\delta}}$$

F.95

From 3.52, 3.53, F.93 and F.94:

$$\frac{T_C}{L_C} = \left(\frac{\theta}{\alpha}\right)^{\frac{1-\beta}{1-\alpha-\beta}}\left(\frac{1}{(1+\tau)p}\right)^{\frac{1}{1-\alpha-\beta}}\left(\frac{1-\theta}{\rho+\delta+h}\right)^{\frac{1-\theta-\beta}{\theta(1-\alpha-\beta)}}\left(\frac{1-\theta}{\beta}\right)^{\frac{\beta}{1-\alpha-\beta}}$$

F.96

From 3.51, 3.53, F.93 and F.94:

$$\frac{T_F}{L_F} = \left(\frac{1}{\pi}\right)^{\frac{1}{1-\gamma-\varphi}}\left(\frac{\theta}{\gamma}\right)^{\frac{1-\varphi}{1-\gamma-\varphi}}\left(\frac{1-\theta}{\rho+\delta+h}\right)^{\frac{1-\theta-\varphi}{\theta(1-\gamma-\varphi)}}\left(\frac{1-\theta}{\varphi}\right)^{\frac{\varphi}{1-\gamma-\varphi}}$$

F.97

From 3.55, 3.56, F.94, F.95, F.96 and F.97:

$$\pi = \left(\frac{1-\theta}{\rho+\delta+h}\right)^{\frac{\gamma(1-\theta-\beta)+\alpha(\theta-1+\varphi)+\theta(\beta-\varphi)}{\theta(1-\alpha-\beta)}}((1+\tau)p)^{\frac{1-\gamma-\varphi}{1-\alpha-\beta}}\left(\frac{1-\alpha-\beta}{1-\gamma-\varphi}\right)^{1-\gamma-\varphi}\left(\frac{\alpha}{\theta}\right)^{\frac{\alpha(1-\gamma-\varphi)}{1-\alpha-\beta}}$$

F.98

$$\left(\frac{\beta}{1-\theta}\right)^{\frac{\beta(1-\gamma-\varphi)}{1-\alpha-\beta}}\left(\frac{\theta}{\gamma}\right)^{\gamma}\left(\frac{1-\theta}{\varphi}\right)^{\varphi}$$

From F.97 and F.98:

$$\frac{T_F}{L_F} = \frac{(1-\gamma-\varphi)(1-\theta)\theta}{(1-\alpha-\beta)(\rho+\delta+h)\gamma}\left(\frac{1}{(1+\tau)p}\right)^{\frac{1}{1-\alpha-\beta}}\left(\frac{\theta}{\alpha}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{1-\theta}{\beta}\right)^{\frac{\beta}{1-\alpha-\beta}}$$

F.99

From 3.32, F.96 and F.99:

$$L_C = \frac{T}{\left(\frac{\theta}{\alpha}\right)^{\frac{1-\beta}{1-\alpha-\beta}}\left(\frac{1}{(1+\tau)p}\right)^{\frac{1}{1-\alpha-\beta}}\left(\frac{1-\theta}{\rho+\delta+h}\right)^{\frac{1-\theta-\beta}{\theta(1-\alpha-\beta)}}\left(\frac{1-\theta}{\beta}\right)^{\frac{\beta}{1-\alpha-\beta}}}$$

$$-\frac{(1-\gamma-\varphi)\alpha}{(1-\alpha-\beta)\gamma}\left(\frac{1-\theta}{\rho+\delta+h}\right)^{1-\frac{1-\theta-\beta}{\theta(1-\alpha-\beta)}}L_F$$

F.100

We now replace the parameters by their numerical values, otherwise the expression of the variables becomes very heavy.

F.100 becomes:

$$L_C = .153\,72T\left((1+\tau)\,p\right)^{4.0} - .714\,29L_F \qquad\qquad \text{F.101}$$

From 3.30, 3.31, F.93, F.94 and F.95:

$$L_C = 4.0 - .960\,97k - 3.571\,4L_F \qquad\qquad \text{F.102}$$

From F.101 and F.102:

$$L_F = 1.4 - .336\,34k - 5.380\,3 \times 10^{-2}T\left((1+\tau)\,p\right)^{4.0} \qquad\qquad \text{F.103}$$

From F.102 and F.103:

$$L_C = .192\,15T\left((1+\tau)\,p\right)^{4.0} - 1.0 + .240\,24k \qquad\qquad \text{F.104}$$

From 3.30, F.103 and F.104:

$$L_2 = L - .4 + .0961k - .138\,35T\left((1+\tau)\,p\right)^{4.0} \qquad\qquad \text{F.105}$$

From F.99 and F.103:

$$T_F = 6.505\,4\left(\frac{1}{(1+\tau)\,p}\right)^{4.0} - 1.562\,9\left(\frac{1}{(1+\tau)\,p}\right)^{4.0}k - .25T \qquad\qquad \text{F.106}$$

From F.96 and F.104:

$$T_C = 1.25T - 6.505\,4\left(\frac{1}{(1+\tau)\,p}\right)^{4.0} + 1.562\,9\left(\frac{1}{(1+\tau)\,p}\right)^{4.0}k \qquad\qquad \text{F.107}$$

From 3.23, 3.36, 3.47 and F.103:

$$k = 4.162\,4 - .882\,37\frac{b}{\lambda} - .159\,97T\left(1+\tau\right)^4 p^4 \qquad\qquad \text{F.108}$$

From 3.22, 3.35, 3.44, 3.48 and F.104:

$$k = 1.960\,9\frac{.75 - .45b}{\lambda} + 1.960\,9nx_1\left(1+\tau\right)p - .799\,84T\left((1+\tau)\,p\right)^4 + 4.162\,5 \qquad\qquad \text{F.109}$$

From 3.24, 3.29, 3.37, 3.42, 3.43 and F.105:

$$k = 10.109 - 25.273L + 3.496\,4T\left((1+\tau)\,p\right)^{4.0} + \frac{3.571\,4}{\lambda} - 14.286pnx_1 \qquad\qquad \text{F.110}$$

From F.108 and F.109:

$$nx_1 = .326\,31T\left((1+\tau)\,p\right)^3 - \frac{.750\,01 - 1.784\,9 \times 10^{-5}b}{\lambda\,(1+\tau)\,p} \qquad\qquad \text{F.111}$$

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From F.109 and F.110:

$$nx_1 = \frac{\frac{2.1007+.88241b}{\lambda} + 4.2962T\left((1+\tau)p\right)^4 - 19.327}{p(16.247 + 1.9609\tau)} \qquad \text{F.112}$$

From F.111 and F.112:

$$\lambda = \frac{\frac{2.1007+.88241b}{16.247+1.9609\tau} + \frac{.75001-1.7849\times10^{-5}b}{1+\tau}}{p\left(.32631T\left((1+\tau)p\right)^3 - \frac{4.2962T((1+\tau)p)^4-19.327}{p(16.247+1.9609\tau)}\right)} \qquad \text{F.113}$$

From F.111 and F.113:

$$nx_1 = .32631T\left((1+\tau)p\right)^3 - \qquad \text{F.114}$$
$$\frac{.75001 - 1.7849\times10^{-5}b\left(.32631T\left((1+\tau)p\right)^3 - \frac{4.2962T((1+\tau)p)^4-19.327}{p(16.247+1.9609\tau)}\right)}{\left(\frac{2.1007+.88241b}{16.247+1.9609\tau} + \frac{.75001-1.7849\times10^{-5}b}{1+\tau}\right)(1+\tau)}$$

From F.108 and F.113:

$$k = 4.1624 - .15997T\left((1+\tau)p\right)^4 \qquad \text{F.115}$$
$$-.88237b\frac{p\left(.32631T\left((1+\tau)p\right)^3 - \frac{4.2962T((1+\tau)p)^4-19.327}{p(16.247+1.9609\tau)}\right)}{\frac{2.1007+.88241b}{16.247+1.9609\tau} + \frac{.75001-1.7849\times10^{-5}b}{1+\tau}}$$

With this expression of k, we get all the endogenous variables.

When $nx_1 = 0$, equation F.114 gives a relationship between T and p that will allow us to fix T for b, p and τ given by the policy. More precisely, p and T are chosen such that the model reproduces the stylized facts of the economy, such as the proportion of each production in GDP, and the proportion of labor in each sector. The chosen value of T will remain the same throughout the experiments, while the value of the policy variables p and τ will change. We fix T from a situation where $p = 1, \tau = -0.3$, $nx_1 = 0$. It gives T=7.7593 (for b set to 0.5).

APPENDIX G   Change in endogenous variables in the general

equilibrium model

% change	1st scenario	2nd scenario
Y_C	140	146
Y_F	- 5	- 20
Y_2	- 50	- 45
K_C	211	219
K_F	0	0
K_2	- 50	- 45
L_C	211	219
L_F	0	0
L_2	- 50	- 45
T_C	9	12
T_F	- 46	- 53
q	185	185
pi	30	30
X_1	180	180
M_2	261	182
NT	- 100	- 120
C_F	- 23	- 23
C_C	- 23	0
C^A_2	53	33
C^{NA}_1	- 23	0
C^{NA}_2	53	33
$PC_A(L_A)$	30.5	32.7
$PC_{NA}(L_{NA})$	-41	-39
$PC_1(L_1)/L_1$	-21.3	-19.6
$PC_2(L_2)/L_2$	-27.4	-26
PC	20	22.3

Conclusion

This thesis has presented the recent evolution of agricultural sectors and agricultural policies in some developed and developing countries. The models developed were applied to the European Union and to a very poor representative developing country, where the share of agriculture in the economy is very large. In both kinds of countries, some common salient features can be distinguished: Regarding the evolution of the agricultural sector, it consists in the development of off-farm labor by farmers, meaning that current farmers often have other activities than farming, which does no longer represent a full time job. These activities consist in other sectors' activities or in farm activities but in farms larger than the ones they own (mainly in developing countries). Regarding agricultural policies' evolution, it consists in an evolution towards less public intervention: In developed countries, it means that agricultural support has to be diminished, while in developing countries agricultural taxation has to be reduced.

The evolution of the farm sector leads to a necessary reconsideration of the definition of a farmer, since, previously, he was usually defined as someone spending all his work time in the agricultural sector. This change in the definition of the agents gives a new perspective on the existing results on the welfare consequences of agricultural liberalization. It also leads to new results about the agricultural instruments most adapted to different economic, political and social objectives. Indeed, in this new perspective, agricultural instruments have to change not only in order to allow more liberalized policies, but also in order to take into account the changes in the structure of the farm sector.

The model developed to represent the European Union agricultural policy shows that farmers's welfare decreases dramatically when agricultural support measures are eliminated. However, considering the very small share of farmers in the society, social welfare increases, and it is hence possible to compensate the farmers for their losses. It has been shown that direct payments are the best instrument to target specific farmers. For instance, direct payments can be used to remunerate some

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environmental activities of the farmers which are not remunerated through the market. Symmetrically, in the developing country studied, farmers benefit from the decrease in the agricultural sector taxation. Since they represent the main part of the population, global welfare increases, and, again, it is possible to compensate non-farmers for their losses (although compensation schemes are very difficult to implement in developing countries). However, in the two kinds of countries, the global positive results of agricultural liberalization hide negative results for some categories of the population. For instance, in developing countries, agricultural liberalization is likely to hurt the most vulnerable part of the society, since food buyers suffer from agricultural liberalization through food price rise. And, paradoxically, food buyers are not all urban dwellers, but they are also food crop producers and landless agricultural workers. Landless agricultural workers become even more numerous with agricultural liberalization. Indeed, farmers with low inputs endowments have difficulties to adapt to the liberalized environment that enhances commercial farming, where higher productivity is necessary. These farmers therefore have to abandon their own independent farm activities and to sell their labor in larger farms. However, in developing countries, agricultural liberalization would reduce the risk of too large migrations from the countryside towards the cities, since it enhances the commercial part of the agricultural sector.

From these main findings of the thesis, some policy recommendations can be attempted. First of all, the evolution of the farm sector makes necessary to change the way to think about and to define a farmer, since he works less and less exclusively in a farm. In the European Union, the way of looking at the farmers should be more linked to land ownership, which would better represent the stylized facts of the sector. In developing countries, on the contrary, liberalization measures increase the number of landless agricultural workers, and hence makes necessary to look carefully at their welfare, even in countries where landless agricultural workers were traditionally few.

Changes in the agricultural sector also makes necessary to change the instruments of the agricultural policy. It is actually what is done in the European Union, with the reforms of the Common Agricultural Policy. However, the way to compensate the farmers for the losses they suffer during

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agricultural liberalization may be different from the one implemented in the CAP reforms framework. The duration of this compensation should be limited, excepted if the compensation is seen as a way of remunerating some services not accounted for by the market, such as environmental external effects. In this case, instead of deficiency payments (subsidies to production) often implemented in Europe, direct payments given to farmers completing an environmental role or according to social concerns should be preferred.

In developing countries, agricultural liberalization policy should be undertaken carefully, since the agricultural population represents the very large majority of the total population. Therefore, income distribution depends very strongly on agricultural policy. Moreover, since redistributive policies are difficult to implement in developing countries, any negative consequence of a liberalization policy on a share of the population would be difficult to compensate for. For these reasons, liberalizing the agricultural sector through the elimination of the production tax rather than the elimination of the marketing boards permits to go on subsidizing some poor consumers hardly reached by any other policy. However, liberalization should be progressive, in order to allow the domestic economy to adapt smoothly to its insertion into world markets from which it was previously isolated.

The conclusions reached in this dissertation obviously depend on the structure of the models developed to represent the agricultural situation. The models developed in this dissertation display several limits, and can be improved by many ways. Each way would represent a possible extension of the analysis. For instance, the models could be improved by representing imperfect markets and by taking uncertainty, risk and missing markets into consideration. Indeed, a stochastic environment would give the opportunity to study price volatility in addition to price level considerations. However, deterministic models have seemed sufficient to give the first hints on the studied situation. Making the models more realistic and sophisticated would not necessarily serve significantly the first purpose of the dissertation, which was to assess the distributive impact of agricultural liberalization measures when new features of

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the sector are taken into account[34]. Moreover, by being very general, the models of this dissertation can

be extended to a large range of countries and situations. Another direction in which the dissertation could

be extended would be in studying the two kinds of countries (developed and developing) simultaneously,

in a two-country model, in order to study the interactions between them when their agricultural policies

change. Finally, the model could be enriched by taking into account some environmental externalities of

the agricultural sector, which would have an impact on the utility of the agents.

All these extensions would give more richness to the conclusions reached. However, this

dissertation only aimed at pointing out the importance of the changing definition of the farmers in

agricultural policies assessment, and the first elements of response to this issue were presented here.

The following steps of the analysis are left for future research.

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[34]Indeed, although uncertainty considerations are very important in agriculture (because of the specific features of supply and demand), stochastic models are not the panacea. For instance, Pannell and alii (2000) review all the limits of risk analyses in the farm sector: They argue that, "for the types of decision problems most commonly modelled by agricultural economists, the extra value of representing risk aversion is commonly very little" (p.69). They add that it "is not that risk aversion does not affect the farmer's optimal plan, but that the impact of the changes on farmer welfare is small" (p.72). They continue by arguing that "the importance of representing risk aversion depends very much on the objectives of the study. Risk aversion will be relatively more important in studies with an objective of predicting behavioural responses to a change, rather than of assessing welfare impacts or making recommendations to farmers" (p.74). Finally, they remark that "risk and uncertainty may still be considered in any analysis by the use of sensitivity analysis to investigate discrete scenarios of interest" (p.75).

(Reference: Pannell D.J., B. Malcolm and R.S. Kingwell, 2000, "Are we risking too much ? Perspectives on risk in farm modelling", *Agricultural Economics*, vol.23, p.69-78).