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Title:

**May the pro- poor impacts of trade liberalization
vanish because of imperfect information?**

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Key words: Agricultural trade liberalization, world CGE model, equity, imperfect information, price instability

Abstract :

In this paper, we try to evaluate the change in welfare gains and their distribution due to trade liberalization when imperfect information is considered . The results of two versions of a CGE model, using GTAP database and representing goods as well as capital flows, are compared. In the first one ,a standard world CGE approach is followed. In the second version we included risk aversion, imperfect information and production lag in the agricultural sector. After a brief description of the two versions, changes in welfare, represented by the income of two types of household (middle-low and middle-high) in three regions (Europe, United States, Rest of the World) after agricultural trade liberalization are presented. Theoretical and political consequences of the results are discussed.

Introduction

Following the multilateral trade liberalization negotiations, there are several studies evaluating the positive impacts on global welfare of trade liberalization, including the agricultural sector (Hertel and al. 1999, Hertel and Martin 2000, Anderson, 2001).

The development of generic general equilibrium model (Hertel and al. 1997) and the importance of expected side-effect between economic sectors has generated a large number of studies using this methodology. All of them are underlying the positive effect of trade liberalization due to efficiency gains. Recently there is a growing concern over developing countries impacts of trade liberalization. The consequences on equity within these countries of various schemes of liberalization are examined (Hertel and al. 2002). The new round of negotiations has been called the development round and there is large hope that trade liberalization will help fighting poverty. The negative impact of price instability on the poorest is well known : as consumers they often spend more than half their expenditures in food making them very sensitive to any increase in price. It was indeed the primary reason motivating trade restrictions by government isolating their market from high prices fluctuations and food price. Actually, stabilization is recommended to fight against poverty (Timmer 2000). As producers, risk limits investment preventing the poorest producers from using

more efficient technology. Recently some attempts have been done to include price instability and its impact on the poorest in the analysis (Hertel and al 2001). However price instability is always considered as to be only related to external shocks and climatic disturbances. In such a case, as demonstrated by Bale and Lutz (1978) and evaluated by Tyers and Anderson (1992), the removing of trade barriers will stabilize world price. Indeed, if instability originates from normally distributed exogenous shocks, the larger the market, the smaller the impact of shocks on price deviation. Following this line of reasoning, including price instability in the model will improve the pro-poor impacts of trade liberalization : price instability will decrease for the benefits of all and especially the poorest. (Hertel and al. 2001).

But it is now well established that at least a part of price instability on commodity markets is due to market itself. Such a situation arises when imperfect information hold (Keynes, 1921, Mandelbrot 1973 a and b Kindelberger, 1990, Chavas and Holt 1991,). The importance of price expectations in the price formation process explain that markets may sometimes forget normal functioning and be the theater of huge fluctuations, panics, krachs...Several authors, in the tradition of business cycle analysis have shown that endogenous prices fluctuations may be generate by models including liquidity constraint, risk and relatively rigid demand curves (Boussard, 1996, Day 1994, 1999, Nerlove 1979; 1994, Rosser 2000). In the meantime the recurrent currency crisis in the nineties remind us that market economy are subject to large fluctuations and that public regulations are needed (Stiglitz 1999). In this paper imperfect information and expectations are introduced in a standard CGE model including a rich and a poor household in each region. The analysis focus on the difference in the results due to the imperfect information assumption.

Modifying the basic CGE .

Let us define the sets I for factors, J for commodity, H for institution, t for time (with the above footnote (3) proviso concerning the planning horizon). Denote by: $F_j(.)$ a production function., U_{ht}

(.) the utility function of consumer h , and $G(\cdot)$ the investment function which transforms inputs into factors – mainly capital, but manpower as well.

Call y_{jt} the supply of commodity j ; z_{hjt} the final consumption of commodity j by consumer h ; x_{ij} the quantity of commodity or factor i used as input for commodity j ; v_{kjt} the demand of commodity j by consumer k for investment, e_{hi} the quantity of factor I belonging to institution k ; ϕ_{jt} the profit of industry j ; s_{ht} the savings by institution h , δ_{hi} a depreciation rate. Prices are denoted by p_{jt} for commodity, π_{it} for factors.

Then, reduced to skeleton, a standard recursive¹ CGE can be described with the following equations:

$$\begin{aligned}
 (1) \quad & F_j(\dots x_{ijt}\dots) = \sum_k z_{kjt} + \sum_{i \in I, j} x_{ijt} + \sum_h v_{hjt}, \quad j \in J \quad (\text{supply equates demand}) \\
 (2) \quad & \phi_{jt} = p_{jt} F_j(\dots x_{ijt}\dots) - \sum_{i \in I} p_{it} x_{ijt} - \sum_{i \in I} \pi_{it} x_{ijt}, \quad j \in J; \quad (\text{producer's utility}) \\
 (3) \quad & \sum_j x_{ijt} = \sum_k e_{hit} \quad \forall i \in I \quad (\text{factors availability}) \\
 (4) \quad & u_{kt} = U(\dots z_{hjt}\dots, s_{ht}), \quad h \in H; \quad (\text{consumer's utility}) \\
 (5) \quad & \sum_j p_{jt} z_{hjt} = \sum_{i \in I} s_k + e_{iht} \pi_{it} \quad h \in H \quad (\text{consumer's budget constraint}) \\
 (6) \quad & s_{ht} = \sum_h \sum_j p_{jt} v_{hjt} \quad h \in H \quad (\text{value for savings}) \\
 (7) \quad & e_{hit} = e_{hit-1}(1 - \delta_{hi}) + G(\dots v_{hjt}\dots) \quad h \in H, i \in I \quad (\text{recurrence equation})
 \end{aligned}$$

The model is closed by writing the first order equation for the producer's and consumer's optimality, that is the derivatives with respect to x_{ijt} of equation (2) subject to (3), and the derivatives with respect to z_{hjt} and s_{ht} of equation (4) subject to (5) It is to be noticed that, here, the only intertemporal equation is (9), which, applied to capital, is the basic dynamical equation.

How should such a model be modified to include imperfect information ?

First, a lag must be introduced between the production and the consumption decision. Equation (1) must be rewritten as:

¹ "Recursive" here means that plans $x_{t\Box}$ made at time t for time \Box depend on observed past values x_{t-1} . However, $x_{t\Box}$ may be eventually revised, in such a way that $x_{t+1,1}$ may be different from $x_{t,2}$. Thus, in this framework, a model may be both recursive and multiperiodic, although the planning horizon is only one in all applications below.

$$(1bis) \quad F_j (\dots x_{ijt-1}\dots) = \sum_k z_{kjt} + \sum_{i \in I, J} x_{jijt-1} + \sum_h v_{hjt}, \quad j \in J$$

Thus, the market equilibrium is between last year (given) production, and current consumption. But this mean that production decisions must not be taken on the basis of equilibrium prices. Rather, expected prices \hat{p}_{jt} must be used. Thus, equation (2) must be modified as:

$$(2bis) \quad \phi_{jt} = \hat{p}_{jt} F_j (\dots x_{ij}\dots) - \sum_{i \in J} p_{it} x_{ijt} - \sum_{i \in I} \pi_{it} x_{ijt} \quad j \in J;$$

In addition, an expectation function $E_m(\cdot)$ must be defined to determine \hat{p}_{jt} .

Here, as in Boussard (1996), $\hat{p}_{jt} = \tilde{p}$, that is, expectations are constant. But it is clear that different expectation schemes can (and should) be envisaged². Notice that actual equilibrium prices are used for inputs, so that expectations are important only for next year production. At the same time, since incomes are distributed immediately, incomes for year t depend heavily on expectations for year t+1, which implies that firms may suffer losses or gain profits. Thus, they bear risks, and this is the last and most important aspect of this model.

In fact, risk plays its role in two different ways: in the producer's utility function (2bis), and in the recurrence equation (7).

In the producer's utility function, after the above remarks, it is quite natural to introduce some sort of a risk premium. Although there is a variety of possibility for that, we opted for the simpler Markowitz utility function. Thus, instead of (2bis), we make use of (2ter):

$$(2ter) \quad \phi_{jt} = \hat{p}_{jt} F_j (\dots x_{ij}\dots) - \sum_{i \in J} p_{it} x_{ijt} - \sum_{i \in I} \pi_{it} x_{ijt} - 2A_{jt} \hat{\sigma}_{jt}^2 F_{jt}^2(\dots x_{ij}\dots)$$

where $\hat{\sigma}_{jt}^2$ is the expected variance of p_{jt} , and A_{jt} some risk aversion coefficient. Of course, this implies the necessity of defining an expectation function $E_v(\cdot)$ for the variance. With naïve expectations, E_m , it would be natural to take $\hat{\sigma}_{jt}^2 = (\hat{p}_{jt} - p_{jt})^2$. However, in the present state of the

² We tried also to make use of naïve, "Ezekiel" expectations. Results are surprising: in this case, the model becomes unstable, and cease to converge after a few periods, generally a few a dozen of "years". It is surprising, because naïve expectations, even subject to criticism, are more plausible than perfect indifference to recent past price levels. Also, in the case of the Boussard's theoretical one commodity model, other expectation schemes worked as well. Many hypothesis may explain this result. One is that never in history any economic policy has been pursued without change for more than ten years. Another is that the naïve expectation scheme is itself too naïve, and should be replaced by adaptive or more complicate functions of past prices.

model, we took $\hat{\sigma}_{jt}^2$ constant. Again, much more complicated expectation schemes can be envisaged. The order of magnitude of A_{jt} is important. It is an absolute risk aversion coefficient, the magnitude of which should therefore be commensurable with $1/w$, where w is the wealth of the decision-maker. Of course, the data used in our model in this respect have been the subject of rough guesses. Finally, the last term of equation (2ter), $2A_{jt} \hat{\sigma}_{jt}^2 F_{jt}^2(\dots x_{ij}\dots)$, is an expected profit. It should be distributed one way or another. We decided to distribute it just as the income from capital.

But (2ter) is not the only equation for which risk matters. As far as growth and accumulation is concerned, equation (7) and the function $G(\dots v_{hjt}\dots)$ is of the utmost importance. In the first CGE, function G was straightforward: changes in total labor force were driven by demography, while capital was easily shifted from one sector to another, so that it was “naturally” invested in the most productive places. Yet, such assumptions imply that a nuclear power plant can be used to harvest grain, or that a bus driver can be employed immediately as a teacher in mathematics. It not very realistic. Thus, many model have been set up with sector specific labor force and capital. The difficulty, in that case, is that, obviously, nor capital nor labor are stick with any sector for ever. Some flexibility must be added.

In the present model, no special care has been taken of labor: it is freely shiftable within groups of sectors (agriculture, manufactures, etc..). In addition, the total labor force is driven by simple demographic considerations. By contrast, an original submodel has been developed for capital. The old capital is fixed by sector, just decaying at constant rate. But the “new” capital owned by each institution is allocated between sectors according to a Markowitz(1970) mean/variance portfolio choice model.

Let,

k_{jt} : capital of branch j , time t

S_t : total saving period t

$\hat{\pi}_{jt}$: expected profitability of capital in branch j

$\hat{V}(\pi_{jt})$: expected variance of π_{jt}

A_k : risk aversion parameter

P_{kjt} : price of the capital good for branch j

\hat{P}_{kjt} : expected value of P_{kjt}

I_{jt} : capital good bought for branch j, time t

Then, I_{jt} is chosen by investors through the maximisation of :

$$(8) \sum_j \hat{\pi}_{jt} P_{kjt} I_{jt} - A_k \hat{V}(\pi_{jt}) I_{jt}^2$$

subject to :

$$(9) \sum_j P_{kjt} I_{jt} \leq S_t$$

with a naïve expectation scheme :

$$(10) \hat{\pi}_{jt} = \pi_{jt}$$

$$(11) \hat{P}_{kjt} = P_{kjt-1}$$

$$(12) \hat{V}(\pi_{jt}) = (\hat{\pi}_{jt-1} - \hat{\pi}_{jt-2})^2$$

In addition, since $\hat{P}_{kjt} \neq P_{kjt}$, some saving may last or created on time t. It is then credited to or subtracted from saving year t+1.

Then, of course, the capital available for each branch j is updated in the recursive loop over time:

$$(13) k_{j,t+1} = k_{jt}(1-*) + I_{jt}$$

Although, for these results, rate of exchange variability has not been taken into account, such a model could very well extended to cope with this important source of volatility.

A world of perfect foresight versus uncertainty :models presentation

The Gtap data base (version 4) has been used to represent the world through three³ regions (Europe, United States, Rest of the world), five production factors⁴ and ten sectors, including five for agricultural production and one for agri-business⁵.

Two types of households are considered , splitting the population around the income median, and defining middle-low income and middle-high income group , in order to be able to include equity considerations when analyzing the results.

Agricultural policy is represented by producers support estimates (PSE), as calculated by OECD. Armington assumption of imperfect substitutes of products from different countries hold. Parameters as well as transport costs are taken from the GTAP data base.

Whenever a factor is labeled “commodity specific”, as for capital, it means that the amount of capital available is fixed on a yearly basis , in the recursive loop over time, according to past equipment existing in the sector and new one determined by investment, based on expected return and risk by sector.

The production module represents physical flows of products, production and consumption behavior. It has been largely taken from Burniaux and Van der Mensbrugge (1991). Production is described by embedded CES production functions. At the first level, aggregate added value and aggregate variable inputs are considered. There are disaggregated at the second level, using again two CES, one for the five production factor and another for inputs. Parameters are taken from the GTAP data base⁶. Demand is a linear expenditure system, estimated by using GTAP income

³ An other version of the same model split the world into 12 regions using the same data base, allowing for a more detailed analysis of gains and losses across the world. The authors are currently working on updated versions of the model using GTAP version 5 and a new sectoral and spatial desaggregation

⁴ Land, Natural resources, Highly and low qualified workers , Capital. Land is used only by agricultural sectors, it has a perfect mobility among these sectors and flexible prices. Natural resources is used only by forestry and energy-resources sectors and show the same characteristics. Workers mobility is free inside 4 aggregated sectors (agriculture, manufacture, services,energy), wages are flexible. Capital is sector specific, flexible prices

⁵ Rice,Other Grains (wheat,others cereal grains),Other crops(Vegetables-fruits-nuts, oil seeds, sugar cane, sugar beet, plant-based fibers, others crops) , Livestock (Bovine cattle-sheep-goats-horses, other animal products, raw milk, wool, silk worm cocoons, fishing), Forestry, Agri-business (9 GTAP sectors),Wood products,Other industries (15 GTAP sectors),Services (4 GTAP sectors),Energy, resources (7 GTAP sectors)

⁶ Detailed equations of the model can be found in Boussard et al. (2002)

elasticities as well as consumption level and prices. Exchange rate are exogenous. Investment is determined by savings and foreign capital flows, calculated to balance the external trade. Government budget is balanced through public consumption adjustment. Both version are dynamic, using temporary equilibria. Because of uncertainty on agricultural prices, the expected profitability of agricultural activity, which determines resources allocation to the various agricultural activity, may differ from the real ones, which will be calculated one year later. Therefore, at least one production factor has return to be distributed with the same lag, to allow the adjustment between expected and real results. Capital returns are calculated ex-post, in order to allow this adjustment.

Results : welfare gains for the poor vanished with imperfect information.

Preliminary results are presented in figures 1 to 4, representing GDP variations due to trade liberalization along the simulation period (45 years) in the two versions of the model.

In figure 1 usual results of welfare gains associated to world trade liberalization in a world of perfect information are presented. The welfare gains increase with time according to the depreciation and investment rates as well as to labor migration across sectors, allowing productions factors to be allocated in a more efficient way. As expected, the liberalization of agricultural trade is highly beneficial to most participants. It is particularly beneficial to the rest of the world confirming the positive impact, at least at the aggregated level, of trade liberalization on poverty alleviation. As underlined by Anderson (2002)“Fortuitously, that too is in the economic interests of rural poor countries” This result is confirmed by income analysis (figure 3) : the poor from the Rest of the World are the winner of the game. The only (slight) loser is EC .

In figure 2 and 4 the same results are given obtained from the model modified to include short term supply rigidity of agricultural supply, risk averse behavior and imperfect information. The results are much more unstable, at the aggregate level (GDP) as at the household incomes level. Periods of

gains and losses succeeded years after years⁷. Overall, aggregate results on the whole simulation period are negative for all players. The poor from the Rest of the World are the principal loser. Prices generated by the version including imperfect information are indeed highly fluctuating because of unfulfilled expectations and short term rigidity of the agricultural supply. Then part of the efficiency gains disappear because of misleading behaviour coming from wrong expectations. These results are still preliminary⁸. Would they be confirmed by further research they may change economist prescriptions on trade liberalization when uncertainty holds.

Then price instability becomes one major issue: will price instability on agricultural markets be removed by trade liberalization or not? If price instability is coming from exogenous, normally distributed shocks, it will be largely enlightened by globalization and may then be neglected. It is this line of reasoning which has been followed by global trade analyst up to now. By contrast, if it is generated by market functioning itself, due to imperfect information, risk averse behavior and liquidity constraint, the price instability will remain after trade liberalization and may seriously affect trade liberalization gains as shown in this paper.

Then, the arguments presented here are in the line of thought of Timmer(2000): some social benefit may be associated to price uncertainty reduction, for specific commodities in specific context.

Conclusion

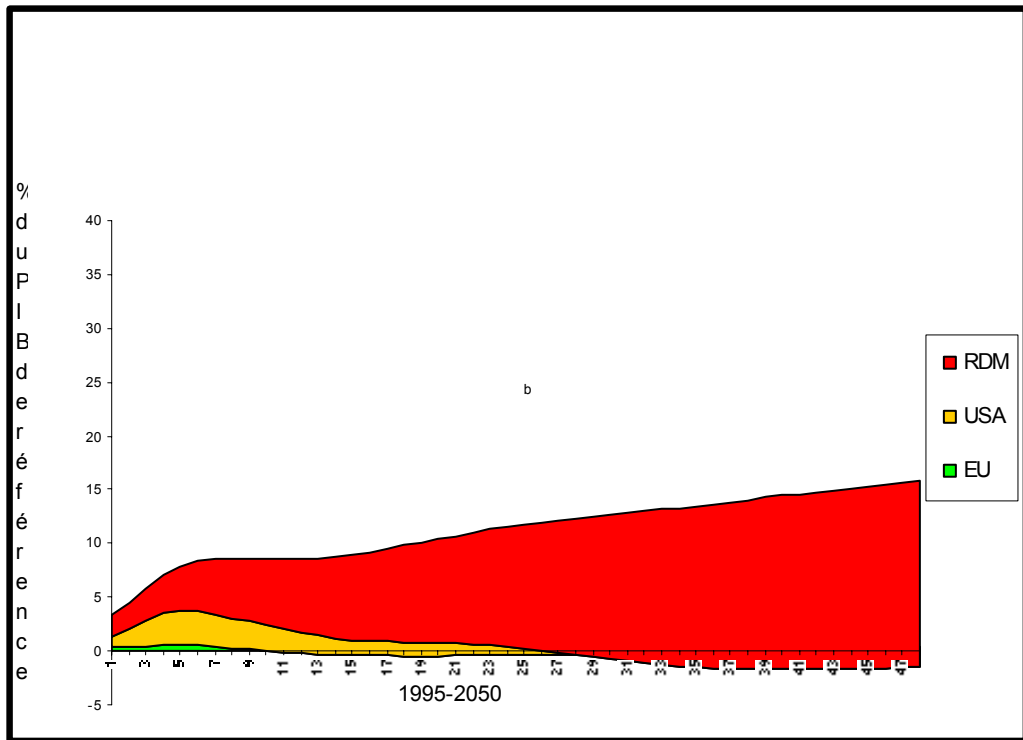
In this paper, two different versions of a world CGE model, one with classical perfect foresight, the other with imperfect information, are used to evaluate the impact of trade liberalization on growth and poverty. For each version, the results of a “free-trade” simulation are compared with the base-run. The main finding is that the global gains associated with trade liberalization are removed by the imperfect information assumptions as included in this model. As underlined by Stiglitz (1998), imperfect information appeared as a constraint preventing the economy to reach the optimal. Recent

⁷ It is because this instability of results that the simulation is performed on 50 years, to get a general picture of the impact of trade liberalization on the long term. This kind of simulation model help exploring possible futures, it is not design for forecasting purpose.

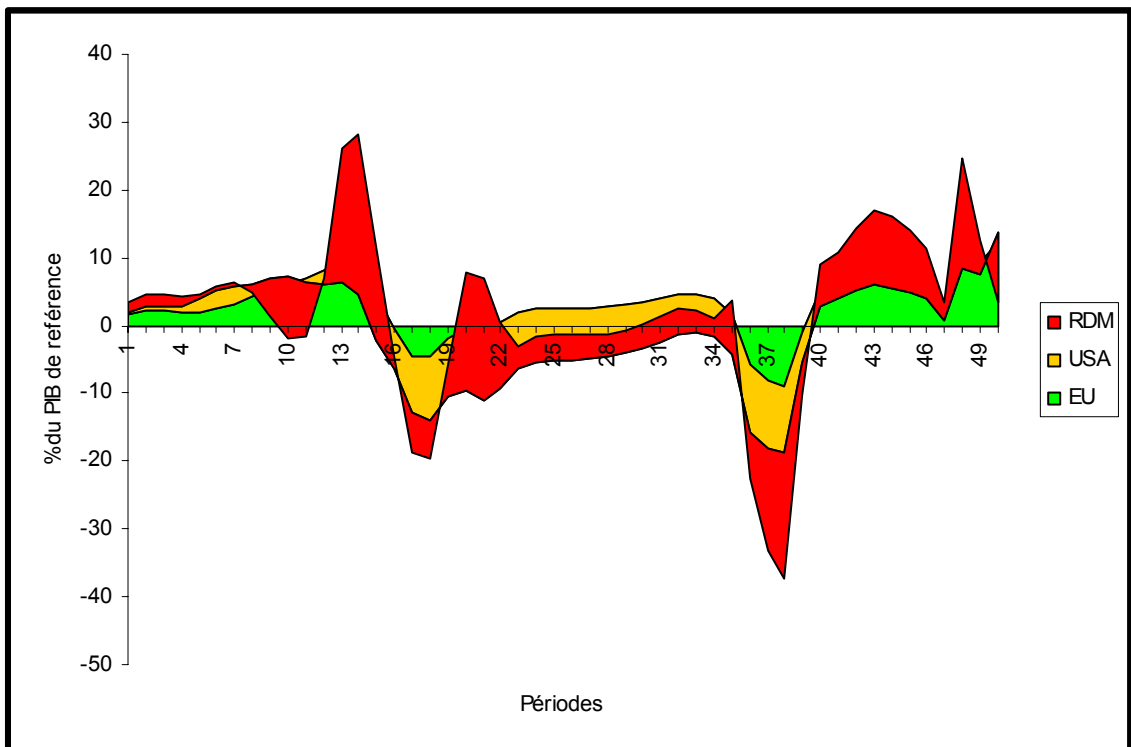
⁸ Especially, the sensitivity of the results to changes in key parameters value has not been yet performed.

crises have forced both academic economists and policymakers to question some of their most basic assumptions about the appropriate design of capital liberalization (Bagwati, 1998; Stiglitz,2000). As underlined by Duncan (1997, page 442), “Research, is needed on the question of the social value of reducing price uncertainty (...)”.Some of them should include risks and its impacts on producers behavior.

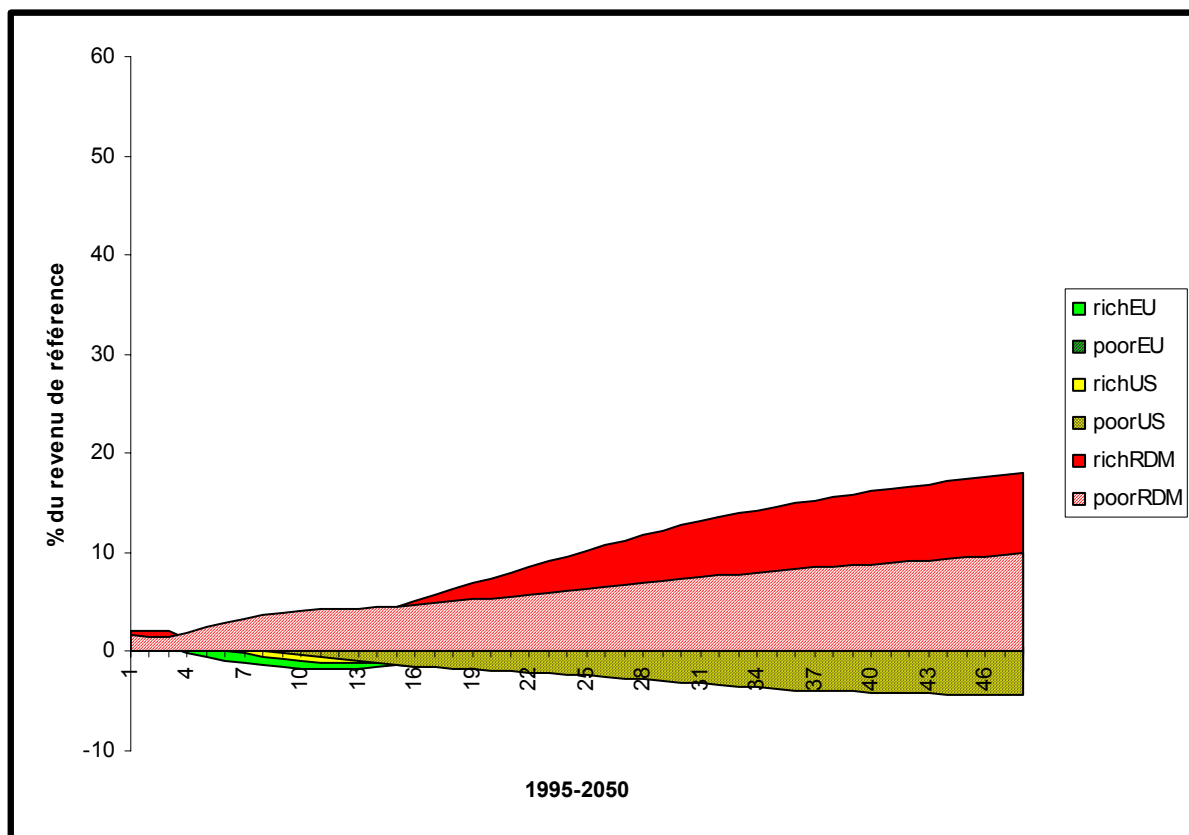
**Figure 1 : Change in GDP after trade liberalization
in the perfect information model
% of base-run**



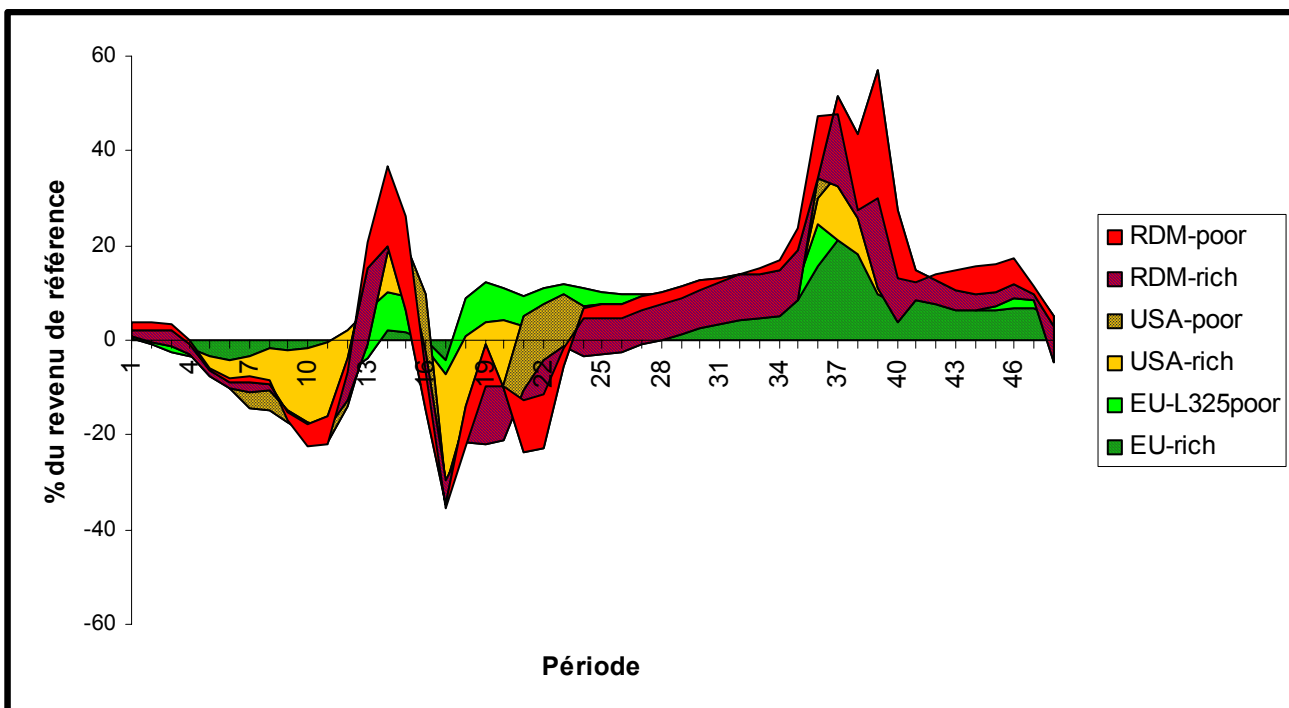
**Figure 2 : Change in real income after trade liberalization
in the imperfect information model
% of base-run**



**Figure 3 : Change in household income after trade liberalization
in the perfect information model
% of base-run**



**Figure 4 : Change in household income after trade liberalization
in the imperfect information model
% of base-run**



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