Evaluating the market and welfare impacts of agricultural policies in developed countries : comparison of partial and general equilibrium measures

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Evaluating the Market and Welfare Impacts of Agricultural Policies in Developed Countries: Comparison of Partial and General Equilibrium Measures

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Abstract :

We revisit the question of partial equilibrium (PE) versus general equilibrium (GE) modelling in applied policy analysis, specifically in the context of evaluating the effects of a complete phase-out of the common agricultural policy (CAP) of the European Union. We compare the results of three models: a standard three-sector GE model that allows for the usual *ad valorem* tax/subsidy distortions; a PE model obtained by restricting this GE model (the main state variables of the non-agricultural sector are exogenous); and a GE model that allows for one additional major distortion in the non-agricultural sector: the labour market does not clear (there is unemployment). We find that the market effects of a complete CAP phase-out that one obtains from all these models are very comparable (i.e., there are no major PE versus GE differences). On the other hand, the measures of welfare impacts may depend on the modelling choice. More precisely, the welfare effects are similar between the standard GE model and the corresponding PE model, but such measures differ considerably from those yielded by the GE model with the additional market distortion.

Keywords : Computable General Equilibrium, Partial Equilibrium, Agricultural Policies, Welfare

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0. Introduction

Agriculture continues to represent a major bone of contention in the negotiations of regional trade agreements, as well as in the ongoing multilateral trade negotiations conducted at the World Trade Organisation (WTO). It is widely acknowledged that the difficulties to make some progress in the agricultural dossiers significantly contribute to the failure of the 5th WTO Ministerial Conference held in Cancun in September 2003. Indeed, there remains disagreement and confusion as to the true extent of global farm subsidies.[1] Perhaps most important, there is still considerable debate over the impacts of these agricultural policies. Numerous quantitative analyses have been performed, of course. But the attributes of models used differ, and so do results thereof. The diversity of modelling approaches is understandable: there are many unresolved modelling challenges in this context, and no model can serve all purposes (Westhoff et al., 2004). Whereas the discrepancies between the results provided by alternative models purporting to address the same question may be acceptable (and even welcomed) by economists, policy makers and the public at large are often baffled by the seemingly inconclusiveness of applied policy analysis in this area. Shedding some light on the root of such discrepancies is therefore a potentially useful (albeit not new) pursuit, and that is what we undertake to do here. In particular, in this paper we concentrate on the comparison between Partial Equilibrium (PE) and General Equilibrium (GE) estimates of the impacts of agricultural policy in the European Union (EU).

It is common to distinguish between PE and GE models for the analysis of agricultural policies (e.g., Von Tongeren et al., 2001). Of course, a PE model is, at the end, just a restricted GE model. Ceteris paribus, therefore, a GE approach is bound to be more general, and the results from a GE model more appealing on theoretical grounds. But often there is a meaningful tradeoff between a GE and a PE approach. Generally speaking, PE models can provide a detailed analysis of some sectors, while ignoring the interactions with the other sectors of the economy. By contrast, GE models can take into account these interactions, often at the cost of relying on a more aggregated level of analysis. The fact that agriculture typically constitutes a small share of the economy in developed countries, however, may suggest a limited scope for capturing economy-wide effects in the analysis of agricultural policies. But, depending of the problem at hand, the choice between a PE versus GE approach may not be a trivial matter. The pros and cons of the two modelling approaches have been discussed elsewhere (see, for instance, Hertel, 2002). The conclusions are often predicated mainly on theoretical grounds and, somewhat surprisingly, there are relatively few comparative studies that provide empirical evidence. Moreover, such studies offer a mixed picture, some concluding that GE estimates are very different from PE estimates, whereas others do not find significant differences.

[1] See, for example, the recent exchanges on this issue between European Trade Commissioner Pascal Lamy, WTO Director General Supachai Panitchpakdi and Professor Tangerman (Agra Europe, 2004).

In what follows, we first review a number of studies that provide a PE and/or a GE analysis of agricultural policies, and we try to sort out the main reasons for diverging conclusions. In section two we then present our analytical framework, which nests the two modelling approaches and emphasizes their differences. Section three is devoted to the analysis of a radical policy experiment designed to "maximise" the economic impacts, and thus to make as difficult as possible the choice between the two modelling approaches. This experiment focuses on the common agricultural policy (CAP) of the EU, widely regarded as the epitome of a distorted sector. Some conclusions are offered in section four.

1. PE versus GE estimates of farm policy: Review of empirical comparisons

At least since Harberger (1964) it is well known that a GE approach is theoretically preferable for the assessment of welfare effects when there are distortions in the economy under consideration.[2] In particular, the empirical determination of the extent by which distortions interact implicitly calls for GE modelling. Computable GE models were first used for the analysis of agricultural policy in the mid 1980s, motivated in part by the desire to model the potential impacts of the Uruguay Round multilateral negotiations. Several kinds of experiments were examined and GE estimates were, as far as possible, compared to PE counterparts (see, for instance, Sharma et al., 1996). Despite difficulties in performing strict comparisons between them, it has generally been observed that GE welfare gains turn out to be higher than their PE counterparts (Winters, 1987; Johnson, 1991).

In particular, Gylfason (1995) reviews fourteen studies measuring the cost of agricultural support in the EU in the 1980s. Nine of them were based on PE models and, on average, they estimate that the CAP imposes a cost on the EU economy which represents 0.7 percent of the GDP (with a minimum of 0.3 and a maximum of 1.3). By contrast, the five studies relying on GE models found an average cost equivalent to 2.2 percent of the GDP (with a minimum of 1.4 and a maximum of 3.3). Thus, on average, GE estimates are about three times as high as those obtained by PE estimates. According to Gylfason, this huge difference is mostly explained by the larger price elasticities of agricultural supply typically assumed in GE models. On the other hand, the existence of other distortions that may interact is seldom acknowledged. To see this more clearly, this author derives a synthetic formula which expresses static output gains from agricultural trade liberalisation as a function of only three elements: the level of agricultural protection, the agricultural productivity growth, and the price elasticity of industrial supply. The higher the price elasticity of industrial supply is, and the higher the price elasticity of agricultural supply is, the higher are the static output gains. For instance, with initial domestic farm prices 80 percent above world market prices, and given an average estimate of agricultural productivity growth, static output gains from complete agricultural liberalisation represent 0.7 percent of GDP when the price elasticity of industrial supply equals 0.05,

[2] For more recent formal demonstration, see Blackorby (1999).

and as much as 2.8 percent when this elasticity reaches 0.2. The rationale of Gylfason is that the GE approach takes into account the response of non-agricultural output to farm trade liberalization, and explicitly assumes a time horizon long enough for all farm inputs to have been gainfully reemployed outside agriculture. By contrast, PE estimates do not reflect the other side of the coin, namely the loss of producer surplus and the gain in consumer surplus in industry resulting from depressed industrial prices relative to agriculture.

At present there exist many quantitative modelling, using PE and GE approaches, that have been developed to assess the impacts of various proposals formulated in the context of the current round of multilateral trade negotiations. Instead of embarking on a comprehensive review of such different studies/results, we shall discuss in detail a recent study by Tokarick (2003) that offers estimates of the distortionary impacts of farm policies using both PE and GE models. More precisely, Tokarick uses an own-developed PE model with ten commodities whose structure is very similar to other PE models currently used to assess the impact of agricultural support (such as OECD, FAPRI, USDA, and UNCTAD models), as well as using the standard GTAP model calibrated with data for 1997 (Hertel, 1997), which is currently the most widely used GE model. Both models are used to assess the market and welfare impacts of a complete removal of agricultural policies of developed countries. Table 1 reports the welfare effects of this experiment for three developed countries. It appears that both frameworks yield positive welfare effects associated with this experiment. However, the figures vary substantially. According to the PE results, the USA and the EU are the main winners of agricultural liberalisation, whereas Japan has less incentive to pursue liberalisation. According to the GE results, however, the EU will gain the most from an agricultural liberalisation, followed by Japan, and with the USA receiving very limited benefits. If we now proceed to a per country comparison, the results appear even more differentiated. Like previous results mentioned earlier, welfare gains computed with the GE model are three times higher than those obtained with the PE model in the case of the EU. In the case of Japan, this ratio amounts to six, whereas for the USA it is only one half! From the discussion in Tokarick, admittedly mostly focused on developing countries, one may think that these important differences were primarily explained by the displacement of resources (labour and capital) from agriculture to other economic sectors (manufacturing and services) that is only taken into account in the GE model.

In contraposition to these studies stressing significant differences between PE and GE estimates, others find the opposite. Hertel (1992), for example, finds that the market effects of CAP removal on agricultural markets are very similar, regardless of whether one uses a PE or GE model. For instance, his experiment yields a decrease of EU agricultural production of 10.9 percent with the GE model, and of 11.9 percent with the PE model. Contrary to previous authors, Hertel starts from a highly aggregated GE model (the SALTER model with three commodities and nine regions), and generates the PE specification by assuming: (i) non food output levels and prices are exogenous, (ii) income is exogenous, and (iii) non land primary factor rental rates are exogenous. Differences between the two approaches are kept to a minimum (in particular, same database, sectoral and regional disaggregation, price specifications, and market structures). The fact that results are similar between GE and PE specifications reveals that exogenously specified variables in PE are indeed marginally affected by the experiment (for instance, there is only a slight increases of EU manufacturing and services outputs, 1.5 and 0.5 percent respectively). Hertel then argues that, in this case, the PE model performs very well and the major benefit of a GE analysis is its ability to draw the link between agricultural and non agricultural interests in farm policy, and by extension to find new advocates of policy reform. At this stage, it is worth mentioning that Hertel performs another experiment and contemplates full removal of all policies, excluding the CAP.[3] Here differences between PE and GE estimates of production impacts are more pronounced (they reach 8 percent), mainly because the shock is greater and competition for fixed factor endowments becomes more severe. The main message of this second experiment is to reveal the inadequacy of PE models for handling simultaneous shocks to both agriculture and non agriculture.[4]

Peterson et al. (1994) also provide empirical comparisons between PE and GE estimates of agricultural liberalisation. In this paper, the starting modelling framework is a variant of the well-known PE model SWOPSIM, with three regions and twenty-three agriculturally related commodities. Peterson et al. add one non-agricultural commodity to the model and close it with an income equation to get the GE version. These two models are used to examine the impacts of complete agricultural liberalisation in the USA and the EU. World price impacts are very similar, with the main difference reaching only 0.5%. Percentage changes in agricultural factor returns are also comparable. These authors then conclude that, if one is only interested in the farm sector effects of farm policies, it is sufficient to treat the nonfood sector as exogenous. On the other hand, complete coverage of the agricultural sector is very important to account for otherwise significant leakages.

Finally, Nielsen (1999) investigates the effects of the EU enlargement to the East with GTAP as the core of the modelling framework. Six different closures are imposed on this GE model, leading to five PE versions as well as the standard GTAP version. The first version assumes the existence of ten agricultural commodity markets that are completely independent (cross price elasticities are put to zero). The second version takes into account cross price elasticities between these markets. Version three generalises the previous one by introducing the land market, whereas version four introduces all primary factor markets. Version five adds five food markets and, finally, the GE model includes other commodity markets and makes endogenous regional incomes. It appears that the first two PE versions give estimates far different from the four others. For instance, following integration, EU15 wheat

[3] This includes the removal of farm policies in non EU regions.

[4] Swaminathan et al. (1997) find similar implications in an analysis of the EU enlargement to the East.

production declines by 10.2 and 13.2 percent according to the first two PE versions, compared to 4.4, 3.5, 5.1 and 4.2 percent in the four subsequent versions. These results suggest that GE modelling reveals only minor new effects compared to a PE model that includes a land market clearing mechanism, mainly because these added effects pull in opposite directions.

This review of empirical comparisons between PE and GE estimates of agricultural policies in developed countries thus provides a rather mixed picture. Additional efforts may be warranted to make results from these quantitative economic tools more perceptible. In that respect, a quick review of the literature assessing farm policies in developing countries is a worthwhile detour.[5] Agriculture in developing countries represents a larger share of the economy and is generally perceived as taxed relative to the industrial sectors. Recently, Bautista et al. (2001) proceed to a comparison between PE and GE evaluations of the policy bias against agriculture with a "stylised" version of a Tanzania-like economy. This economy is clearly dominated by agriculture, where the share of agriculture in total gross production amounts to 42 percent (and 56 percent in value-added at market prices). They find that PE measures miss much of the action operating through indirect product and factor market linkages, while overstating the strength of the linkages between the changes in the exchange rate and price of traded goods on the agricultural terms of trade. This study then supports the use of GE models. However, close inspection of the results reveals that differences between the two approaches mainly come from different assumptions concerning the degree of tradability of all commodities, but in no case from "large" second-best effects because the starting point of the policy simulations is a distortion-free base solution. More precisely, PE models typically assume perfect substitutability between domestic and traded goods, while GE models adopt imperfect substitutability between domestically produced and imported goods, as well as between domestic products for exports and for internal use (the so-called Armington specification, with finite elasticity of substitution and/or transformation). Thus, like previous studies on developed countries and finding significant differences between PE and GE estimates, this study reveals that, to a large extent, what really matters is the specification of price elasticities.

It is tempting to dismiss the PE versus GE modelling question as simply one of choosing appropriate parameters and/or exogeneity assumptions. But two points warrant further consideration. First, the studies that find significant differences between PE/GE estimates exclusively focus on welfare effects, while the other studies concentrate mostly on market effects. So are the results really conflicting? To address this first issue, market and welfare effects must be simultaneously evaluated and, to our knowledge, this has not been tackled. Joint evaluation of market and welfare effects in the context of an explicit agricultural trade liberalization framework constitutes the first objective of our empirical analysis. Second, Harberger tells us that welfare measured in one market is inappropriate if distortions exist in the other markets. The aforementioned studies either fail to take into account these

[5] A recent survey of this literature is done by Schiff and Valdés (2002).

other distortions or seem to suggest that distortions marginally interact. Then the second question that remains to be pursued is: are the other relevant distortions correctly captured in any one particular GE analysis? There are no simple answers to this latter question, of course, because there exist many other distortions (e.g., public goods, tax and income policies, scale economies, capital market imperfections) that may be relevant. The domestic distortions that probably receive most attention are labour market regulations. For instance, Goulder and Williams (2003) argue that the traditional measure of the excess burden of commodity taxes, which ignores labour market regulations, underestimates the true one (in some cases by a factor of 10 or more). It is thus highly desirable to correctly specify this labour market in GE models. This aspect has been ignored in previous comparisons of PE/GE estimates and clearly deserves more attention. Analysis of this problem, therefore, is the second point we want to examine with our empirical analysis, to which we turn now.

2. Empirical framework

We use the GTAP model and its associated database version 4 as the core of our empirical framework.[6] Three different versions are developed in order to address our two main concerns. The first one, hereafter labelled the standard GE specification, is a slightly modified version of the standard GTAP model, as described in Harrison et al. (1997), where our modifications are meant to introduce more realistic price/income elasticities. The second one, hereafter labelled the PE version, treats non-agricultural components as exogenous. Finally, the third one, hereafter labelled the distorted GE version, introduces one labour market regulation. We first detail the main characteristics of the standard GE version before mentioning only differences between it and the two others.

Our first version is thus a relatively simple multi-region, multi-sector computable GE model which is static and perfectly competitive. The aggregation retains only three mono-product sectors, namely crop activity, animal activity and other activities (hereafter labelled services for simplicity); two regions, the EU and the Rest of the World (RoW); and, three primary factors of production (labour, capital and land).[7] Bilateral trade between the two regions is modelled with an "Armington" specification (Armington, 1969). Due to the crude commodity aggregation, we assume that substitution elasticities on the import side equal 2 (half of usual values) but maintain perfect tradability on the export side. Each region has a single representative consumer who allocates his income across commodities so as to maximise his welfare. In order to capture the characteristics of food demand in

[6] This database version captures economic flows in 1995.

[7] Our crop activity is the aggregate of the following original sectors : paddy rice, wheat, grains, vegetables, oilseeds, sugar cane and beet, plant-base fibers, other crops, vegetable oils, sugar and processed rice. The animal activity includes : bovine cattle, other animal products, raw milk, wool, bovine cattle meat, other meat products and dairy products. The services sector aggregates all other sectors of the GTAP version 4 database. Skilled labour and natural resources are aggregated with capital.

developed countries (inelastic price and income responsiveness), we adopt a latent separability specification (Gohin, 2003). Elasticity of substitution is assumed to be 0.5 for the pair crop/animal and 0.1 for the two other pairs. Income elasticities are set to 0.2 for the crop commodity, and to 0.3 for the animal commodity. The income elasticity for services (1.05) is derived from the budget constraint (Engel condition). All final demand elasticities are reported in table 2. As for the production side, the technologies of profit-maximising producers exhibit constant returns to scale. With a medium term horizon in mind, we assume that capital is fixed in each sector, whereas both labour and land are perfectly mobile between activities and are in fixed supply. Substitution between intermediate inputs and primary factors is assumed to be zero (still due to the crude commodity aggregation) while the substitution between primary factors is governed by a constant elasticity of substitution (CES) function. The value of the substitution elasticity is calibrated at 0.2 in the crop and animal sectors, so that price elasticities of supply are around 0.7 in the base. For the services sector, the substitution elasticity is 0.5 which leads to a price elasticity of supply of 0.35. The distortions included in this standard GE version are production taxes (on intermediate inputs and volume of production), consumption taxes, and trade taxes (export and import). All these distortions are represented as *ad valorem* price wedges. Finally, we choose the EU consumer price of services as our numeraire so as to minimise the inevitable difference between the compensating and equivalent variation measures of welfare (Hausman, 1981), and to facilitate the comparison with the PE results.

To obtain our PE version, we follow Hertel (1992) by first adopting the standard GE model and assuming that (i) the prices of services, (ii) the productions of services, (iii) regional incomes, and (iv) wages are now exogenous variables. Accordingly, the equations defining these variables are dropped. At this stage, two remarks are in order. First, we maintain the land market equilibrium equation because this procedure has progressively become the norm in PE models focused on agriculture, and also because Nielsen already stresses the substantial bearing of this relation. Second, we also maintain the complete final demand system because we only have one good in the rest of the economy, and regional incomes are kept fixed.[8]

Finally, our last version still starts from the standard GE model and removes its labour market closure for the EU. We now assume that there is some rigidity in the wage formation and recognize the existence of severe unemployment rates in the EU countries (averaging 9 percent in the 1990s). Practically, we introduce the constraint that EU nominal wage not be allowed to fall from its benchmark value, and that labour supply is perfectly elastic. It follows that any changes in labour demand are automatically matched by changes in labour supply. Thus, our rather simple modelling of the effects of unemployment follows, for instance, Harrison et al. (1993) and Mercenier (1995).

[8] Thus we are not concerned by the downward bias of welfare measures from partial demand systems (Haneman and Morey, 1992).

3. Simulation results

We simulate a complete removal of the CAP in order to maximise the resulting economic impacts and also because this allows us to circumvent the question of how particular instruments operate at the margin (especially given our commodity aggregation). Practically, we remove export subsidies, production subsidies and import tariffs on the two agricultural commodities, but maintain all taxes on services as well as consumption taxes on all products. Before interpreting simulations results, it is worth underlining some features of the base (Table 3). Crop and animal sectors represent very small shares of the EU economy, with respectively 1.5 and 3.0 percent in total gross production and 1.7 and 1.9 percent in total value-added. As is well known, these two sectors benefit from significant support compared to the services sector that faces production and export taxes. It also appears that the animal sector is highly insulated from world market prices, as reflected by the high export subsidy and import tariff rates, while relatively the crop sector benefits most from direct subsidies and to a lesser extent from price support instruments.[9]

Table 4 reports the market effects of our policy experiment, and table 5 reports the welfare effects under the three modelling specifications. For completeness and transparency, we provide the impacts on all main EU variables. Let's first consider the impacts under the standard GE specification (second column of both tables). As expected, the removal of the CAP leads to a significant decline of EU agricultural production which is more pronounced for the animal sector (14.9 percent) than for the crop sector (8.1 percent). Hence, we again find that price support instruments have more coupling impacts on production than direct subsidies. European producer and consumer prices of the animal commodity decrease by nearly 8 percent, leading to a rather limited increase of its final demand (1.0 percent) due to the price inelasticity. On the other hand, crop price decreases are very limited and crop consumption stagnates. The production declines are compensated by larger imports and smaller exports which are considerable for the animal commodity (respectively 208.2 and 90.8 percent variations). These trade effects lead to substantial world price increases, explaining the traditional external pressure for CAP reform. Regarding production technologies, land allocation shifts towards crop production (4.7 percent) to the detriment of the animal sector (6.0 percent), while land return decreases considerably (58.4 percent). Agricultural production decreases are mainly attributable to the "extensification" process with respect to land. But these decreases come with a large reduction of farm labour (17.4 percent in total). By assumption, capital is fixed in each sector and capital returns in the agricultural sectors substantially decrease. Thus this experiment hurts European farmers, which is consistent with their continuing resistance to CAP reforms. By contrast, services production increases (0.3 percent), mainly thanks to the flow of labour to this sector (0.9 percent) and the wage decline (0.1

[9] This mainly results from the 1992 CAP reform which places great emphasis on the arable crop sector and preserves the milk policy.

percent). This supplementary production translates into more domestic consumption and exports and less imports. This experiment then benefits the European services sector (a slight increase of the dual prices of capital) but percentage figures here are low due to the small share of the agricultural sectors. In terms of welfare, farm value added decreases by 93.5 billions dollars. On the other hand, the services sector value added increases by 28.7 billions dollars. Net taxes increase by 51 billions, mainly following the removal of agricultural output/export subsidies and import tariffs. Disposable income decreases by 13.4 billions dollars. But total welfare, computed as the Equivalent Variation (EV) measure, increases by 8.9 billions dollars following the food price decreases.

All these impacts are not especially surprising. In particular, we obtain very limited impacts on the services sector, wages and disposable income, so that one may wonder if it really matters to include them. In fact, once we compare these first results with those derived from the PE specification (third columns), we observe that food market impacts are very similar. The differences are almost within 1 percent range. Agricultural productions decrease slightly more, because price decreases are more pronounced. For the same reason, final consumptions marginally increase, so that trade effects are magnified. Typical welfare measures in PE models are the producers/consumers/taxpayers surplus. Producer surplus is computed as the returns to capital and land only. We ignore labour returns because wages are fixed and labour is perfectly mobile across activities. Using this definition, it appears that European farmers lose 67 billions dollars, compared to 65.8 billions dollars with the standard GE specification. The overestimation of European farmers' benefits from the CAP that one expects (Chambers, 1995) is here actually very limited. Taxpayer surplus only includes food subsidies and tariffs. The taxpayer gain amounts to 50.2 billions dollars, slightly less than with the standard GE version because increasing taxes on services production and consumption are not taken into account. Finally, consumer surplus computed with EV increases by 29.7 billions dollars.[10] This measure is not comparable to the previous EV estimate because it does not include variations in the disposable income. On the other hand, it is common practice to simply sum producers, taxpayers and consumers surplus to get a measure of total welfare. The latter amounts to 12.8 billions dollars, which is quite comparable to the EV welfare estimate we obtain with the standard GE version. Indeed we find, contrary to previous studies, that our PE model leads to higher welfare gains than our standard GE model, mainly because we don't assume that the removal of the CAP comes with some reductions of other distortionary taxes. Our welfare results also contrast with those reported by Gylfason because our estimates never exceed 0.2 percent of initial GDP.

Is this picture challenged when one takes into account the existence of European unemployment and wage rigidity? Comparison of the distorted/standard GE results again reveals marginal changes in terms of market effects. The main difference is the reduction of labour use by 0.8 percent. Assuming a 9 percent unemployment rate in the initial solution, that would mean an increase

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[10] This includes welfare of intermediates users.

of unemployment of 8.1 percent to the level of 9.7 percent. Practically, this represents the fact that European farmers do not easily find jobs in the rest of the economy. This effect translates into a decrease of disposable income of 40.8 billions dollars and a welfare loss of 19.1 billions dollars. Quite clearly, the differences in terms of welfare effect are much more severe here. As underlined before, many empirical studies already reveal the substantial bearing of the labour market modelling. For instance, Harrison et al. (1993) find that the welfare impact of a CAP elimination scenario in 1974 ranges from a decrease of 0.2 percent of initial GDP to an increase of 0.5 percent, depending on the introduction/absence of unemployment and that this dramatic difference is an incarnation of the familiar Theory of the Second Best.

Concluding comments

In this paper we have revisited the question of PE versus GE modelling in the context of evaluating the effects of agricultural policies. Our motivation for this analysis is rooted in two observations: (a) the continuing challenges that agriculture poses for domestic policy reform in developed countries and the enduring critical role that agriculture plays in the ongoing WTO efforts at international trade liberalization; and (b) the fact that PE and GE analyses often provide widely differing conclusions on the economic effects of interest. The latter observation, which is not new to practitioners in this area, was documented with a selective literature review. We then presented the results of a simulation exercise that offers a few interesting insights into the question of choosing and/or interpreting PE and GE analyses of agricultural reform in developed economies.

The specific question we address in our simulation exercise concerns the estimation of the economic effects of a complete phase-out of the CAP, probably the most significant farm policy reform that can be contemplated. In this context, we compare and contrast the effects predicted by three models: a GE model built on the standard GTAP framework, and allowing for standard tax/subsidy distortions (in the form of *ad valorem* price wedges); a PE model obtained by restricting this GE model (the main state variables of the non-agricultural sector are exogenous); and a GE model that allows for one additional major distortion in the non-agricultural sector: the labour market does not clear (there is unemployment). The main results are as follows. First, the market effects of a complete CAP phase-out that one obtains from all these models are very comparable (i.e., there are no major PE versus GE differences). On the other hand, the measures of welfare impacts may depend on the modelling choice. More precisely, the welfare effects are similar between the standard GE model and the corresponding PE model, but such measure differ considerably from those yielded by the GE model that accounts for the additional labour market distortion.

We are somewhat reluctant to draw too general a conclusion from our exercise as it clearly addresses an empirical issue. But it seems that, when analyzing the agricultural sector of developed economies (where agriculture constitutes a small fraction of economic activities), and when no other major distortions exist in the rest of the economy, GE and PE models yields comparable implications. The predicted market effects are in fact very similar, and indeed the magnitudes of welfare effects are also similar. This latter observation may provide some comfort to users of existing mainstream PE models for the agricultural sector (e.g., FAPRI and AgLink). But it also suggests that these models' reluctance to engage in welfare evaluations cannot be justified on the grounds that this is the province of GE models. Finally, the real advantage of GE models in our context appears to be the ability to model explicitly other known distortions in non-agricultural sectors. In other words, the attribute "general" in GE models should not be interpreted narrowly in terms of how many sectors are explicitly represented in the model but, as students of GE analysis know well, should reflect a correct structural representation of the economy.

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Table 1. Welfare effects of agricultural liberalisation in developed countries : Partial versus General Equilibrium estimates (in millions US dollars)

	USA	EU	Japan
Partial equilibrium results			
Producer surplus	-36,725	-31,786	-131
Consumer surplus	37,556	20,308	14,374
Taxpayer surplus	10,472	22,194	-10,823
Total welfare*	11,303	10,716	3,420
General equilibrium results			
Equivalent variation	6,182	31,788	22,333

Source : Tokarick

* : Sum of producer surplus, consumer surplus and taxpayer surplus

Table 2. Final demand elasticities

Marshallian demand

	Crop	Animal	Services	Income
Crop	-0.121	0.014	-0.093	0.200
Animal	0.004	-0.117	-0.187	0.300
Services	-0.019	-0.044	-0.989	1.052

Hicksian demand

	Crop	Animal	Services
Crop	-0.116	0.023	0.093
Animal	0.010	-0.103	0.093
Services	0.002	0.005	-0.007

Source : Own computation

Table 3. Some features of the EU economy in the initial situation (in billions US dollars or %)

	Crop	Animal	Services	Total
Production	240.5	491.7	15,544.2	16,276.4
Share	1.5%	3.0%	95.5%	100%
Value Added	126.9	141.8	7,367.8	7,636.5
Share	1.7%	1.9%	96.4%	100%
Output subsidy	25.0	23.2	-358.9	-310.7
Output subsidy rate	10.4%	4.7%	-2.3%	
Export subsidy	2.6	9.8	-3.8	8.6
Export subsidy rate	15.8%	42.9%	-0.4%	
Import tariff	5.2	5.3	23.1	33.5
Import tariff rate	12.9%	52.1%	2.7%	

Source : GTAP version 4 database

Table 4: Market impacts of CAP removal (Differences in % with respect to the base)

	Standard GE	PE	Distorted GE
EU productions			
Crop	-8.1	-8.7	-8.4
Animal	-14.9	-15.2	-15.2
Services	+0.3	-	+0.02
EU Producer prices			
Crop	-1.1	-1.2	-0.9
Animal	-7.7	-7.7	-7.6
Services	+0.03	-	-0.02
EU final consumption			
Crop	+0.0	+0.1	-0.1
Animal	+1.0	+1.1	+0.8
Services	+0.1	+0.4	-0.4
EU final prices			
Crop	-1.5	-1.6	-1.3
Animal	-8.9	-8.9	-8.8
Services	0	-	0
EU import			
Crop	+11.0	+12.6	+11.3
Animal	+208.2	+215.5	+209.2
Services	-2.8	-	+0.8
EU import prices			
Crop	-2.6	-3.0	-2.6
Animal	-15.1	-15.3	-15.0
Services	+0.2	-	+0.2
EU export			
Crop	-39.4	-41.3	-40.0
Animal	-90.8	-91.2	-90.7
Services	+3.3	-	+3.1
RoW import prices			
Crop	+9.1	+8.6	+9.2
Animal	+18.3	+17.7	+18.4
Services	+0.4	-	+0.3
EU land market			
Price	-58.4	-59.6	-59.0
Demand by crop sector	+4.7	+4.5	+4.6
Demand by animal sector	-6.0	-5.8	-5.9
EU labor market			
Price	-0.1	-	0
Demand by crop sector	-12.0	-12.8	-12.5
Demand by animal sector	-21.0	-21.4	-21.3
Demand by services	+0.9		+0.03
EU capital market			
Dual price in crop sector	-47.8	-49.7	-48.6
Dual price in animal sector	-69.5	-70.0	-69.8
Dual price in services	+0.7	-	+0.1

Source : Own computations

Table 5: Welfare impacts of CAP removal (Differences in billions US dollars with respect to the base)

	Standard GE	PE	Distorted GE
Land values	-12.9	-13.2	-13.0
Crop	-7.0	-7.2	-7.1
Animal	-5.9	-6.0	-5.9
Labor values	-31.7	-27.3	-26.1
Crop	-10.2	-10.1	-9.8
Animal	-17.5	-17.2	-17.1
Services	-4.0	-	0.8
Capital values	-20.1	-53.8	-50.8
Crop	-17.0	-17.7	-17.3
Animal	-35.9	-36.2	-36.1
Services	+32.8	-	2.5
Value added	-64.7	-94.4	-90.0
Crop	-34.2	-35.0	-34.2
Animal	-59.3	-59.4	-59.2
Services	28.7	-	3.4
"Producer surplus" (cap+land)			
Crop	-24.0	-24.8	-24.4
Animal	-41.8	-42.2	-42.0
Services	+32.8	-	+2.5
Output subsidies	-49.4	-48.2	-48.2
Crop	-25.0	-25.0	-25.0
Animal	-23.2	-23.2	-23.2
Services	-1.2	-	+0.1
Export subsidies	-12.6	-12.4	-12.5
Crop	-2.6	-2.6	-2.6
Animal	-9.8	-9.8	-9.8
Services	-0.1	-	-0.1
Import tariffs	-11.0	-10.5	-11.0
Crop	-5.2	-5.2	-5.2
Animal	-5.3	-5.3	-5.3
Services	-0.5	-	-0.6
Taxpayer "surplus"			
Values of preceding taxes/subsidies	+51.0	+50.2	+49.7
"Consumer surplus"			
Disposable income	-13.4	-	-40.8
EV	+8.9	+29.7	-19.1
"Total Welfare"	+8.9	+12.8	-19.1

Source : Own computations