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The analysis of welfare effects in INTIMO

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This paper deals with the analysis of welfare effects for an EU member state brought by the Eastern enlargement of the EU. We will try to answer the traditional microeconomic question: "what amount of compensation would the consumers require in order to forego the change brought by the enlargement?" (...) The assessment of this point provided by our multisectoral model INTIMO is very detailed because it produces both the sectoral price indexes, the composition of personal consumption and the distribution of personal income. However, the quantitative analysis of the welfare issue with this tool raises some problems described in the following paragraphs. A solution is proposed and an estimation of welfare effects for some policy scenarios is presented.

The issue

When we approached the problem from a practical point of view, we found that the solution was not so straightforward as we thought. In fact, it was something that we had never studied before with our model.
In the basic literature of welfare economics, we found different ways to deal with this issue.[1] The answer to the question asked above ("what amount of compensation would the consumers require in order to forego the change brought by the enlargement?") implies the computation of **equivalent variation (EV)**. This measure uses the base year prices and asks what income change at these prices would be equivalent to the proposed change in terms of its impact on utility. Equivalently, it can be thought as the minimum amount of income the consumer would be willing to accept in order to forgo the move from situation 1 to situation 2. An alternative welfare measure is the **compensating variation (CV)**. It uses the new (simulated) prices as the base and asks what income change would be necessary to compensate the consumer for the price change (compensation take place after some change, so the compensating variation uses the after-change prices). Both of these numbers are reasonable measures of the welfare effect of a price change. Their magnitude will generally differ because it will depend on what the relevant prices are, but their sign will always be the same. Which measure is the most appropriate depends on what question we are trying to answer. If we are simply trying to get a reasonable measure of "willingness to pay", the equivalent variation is probably better for two reasons. First, the EV measures the income change at current prices, and it is much easier to judge the value of money at current prices than at some hypothetical prices. Second, if we are comparing more than one proposed policy scenario, the

[1] This section is based upon the analysis of welfare measures presented by Boadway and Bruce (1984).

compensating variation uses different base prices for each new scenario while the equivalent variations keeps the base prices fixed at the status quo. Thus the EV is more suitable for comparisons among a variety of scenarios (see Varian, 1992).

Difficulties may arise in the practical application of these measures.
First of all, the information required to obtain exact measures of welfare change, such as CV or EV, is very demanding . Hence it is often necessary to resort to empirical approximations in applied work.
Moreover, these are measures of the change in the well-being for *an individual household* between two situations where, for simplicity, the two situations refer to different bundles of commodities consumed. The adaptation of welfare change measures for a single household to welfare change measures for the economy as a whole requires both some approximations to make the measures empirically applicable, and some value judgments to enable one to go from single-household measures to many-household aggregates.

As for the first kind of problem, a common procedure to construct approximations to EV or CV is to compute quantity indices. Quantity indices are intended to indicate in one summary measure how much the quantities consumed have changed between the two situations. The two methods commonly used are the *Laspeyres quantity index* Q_L and the *Paasche quantity index* Q_P, defined as follows:

$$Q_L = \frac{\sum p_i^1 x_i^2}{\sum p_i^1 x_i^1}$$

$$Q_P = \frac{\sum p_i^2 x_i^2}{\sum p_i^2 x_i^1}$$

The Laspeyres quantity index is the weighted ratio of quantities consumed in the two periods, where the weights are the initial prices. The Paasche quantity index uses the new prices.
An alternative way of looking these indices is to write them in the following level form:

$$\sum p_i^1 x_i^2 - \sum p_i^1 x_i^1 = \sum p_i^1) x_i \approx EV$$

$$\sum p_i^2 x_i^2 - \sum p_i^2 x_i^1 = \sum p_i^2) x_i \approx CV$$

In the level form these indices are first order approximations of Equivalent Variation (EQ) and Compensating Variation (CV)[2]. If we think of the true quantity index at the prices p^1 as being EV in ratio form, the Laspeyres quantity index is an overestimate of the true index. Similarly, the true quantity index using the new prices can be thought of as CV in ratio form and the Paasche index is an underestimate of the true index.

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[2] See Boadway and Bruce, 1984, p.213.

If $Q_p>1$ so $\Sigma p_i^2 x_i^2 > \Sigma p_i^2 x_i^1$, this indicates that the income available in the new situation is more than enough to be able to purchase the old set of goods at the new prices. In other words, x^1 was inside the budget constraint in situation 2. Since x^2 was purchased when x^1 could have been, this implies that x^2 is preferred to x^1. Moreover, x^2could not have been purchased when x^1 was, therefore $\Sigma p_i^1 x_i^2 > \Sigma p_i^1 x_i^1$, or $Q_L>1$.
So far we have considered the welfare change resulting from changes in the quantities of goods consumed by a household. Income has been taken as exogenously given. In practice, at least part of a household's is obtained from the sale of factors of production. Such factors may include the supply of labour, risk, and savings (or forgone consumption). Increases or decreases in the supply of these factors will influence the utility level of the household, and it may be useful to develop welfare change measures which account for them.

The welfare change measures developed so far were constructed on the assumption that we could aggregate all consumers into a single representative consumer for welfare measurement purposes. Treating a many-person economy as if it were a single-person economy implies first of all that aggregate demand functions have the same properties as individual demand functions. That is the aggregate demand function represents an aggregate preference ordering, or a set of social indifference curves. Aggregate welfare change measure has normative significance if we assume a Social Welfare Function to choose both the optimal quantity for each price either the optimal distribution of income. Alternatively, we regard the aggregate demand as representative of the sum of individual demands if we assume that individual preferences are identical and homothetic for all persons.[3]
Nonetheless, most practitioners of applied welfare economics proceed to measure welfare change by simply aggregating CVs (EVs) over individuals. The usual argument is that this measure should not be interpreted as measuring social welfare in the sense that if aggregate CV (EV) rises society must be better off but, rather, it should be interpreted as indicating whether or not there has been a potential Pareto improvement in social welfare (the gainers from the change could hypothetically compensate the losers from the change). However, the use of the unweighted sum of household compensating or equivalent variations as a necessary and sufficient indicator of potential Pareto improvement is full of difficulties. At best such measures can be used as a preliminary attempt ro rank social states.

By using individual data the welfare variations could be calculated for homogenous groups of individuals and aggregated with specific Social Welfare Functions (SWF). In particular, disaggregated data on household consumption should be used to estimate demand function for groups of households with similar characteristics. Then, CVs (EVs) could be computed and aggregated by using an additive SWF to sum the variations for homogenous groups of households attaching to the CVs distributional weights. In particular, weights reflect the proportion of each class of goods on total expenditure for households of different types.

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[3] A second measure could be estimated by using not only the variations of prices and quantities but also the substitution effects. Demand functions for different goods and Slutsky matrices of substitution effects should be estimated. This term should be added to the original formulas of the indices in the level form compute a second order approximation of EV and CV.

What have we done?

From what we have studied, it was clear that a "serious" analysis of welfare effects could only be done with individual data and estimation of demand function for homogenous groups of households. This is not something that was available in our model. With our data, we could compute a first order approximation of welfare variations by assuming all the restrictive hypotheses we have listed above (representative consumer, identical and homothetic preferences, and so on) or, at best, a second order approximation by using the estimated substitution effects for the demand system. We reckoned that the latter was not worth the effort required: in my opinion, the additional information obtained by this step was not very interesting. I personally would have liked to use individual data to make a definite step forward. Therefore, what we have done is simply the computation of Laspeyres and Paasche indices as measures of welfare changes in different scenarios. We think that the information contained in these indices, although very limited, has its own merits. In fact, we should remind that in INFORUM models, interrelations among real and nominal variables are a unique feature that is reflected also in the estimation of the household consumption. The simultaneity of model solution produces impacts on household consumption due to changes not only in prices, but also in disposable income, labour market, investments, international trade flows and so on. With the structure of the model in mind, we proceed to the analysis of our results.

The estimated welfare effects of EU enlargement

We estimated the welfare effects through the quantity indices described above. The time horizon is up to 2010 with four alternatives:

- a ***baseline scenario***, without the enlargement and with the CEEC5 countries GNP rates of growth assumed to be following the average rate of growth of other countries in the system;
- a ***first scenario (Italy/CEEC5 countries vis-à-vis)*** considering the interaction between the Italian economy and the CEEC5 countries. In this scenario we assume that CEEC5 GNP is going to grow faster of about 2% with respect to the baseline. On the side of resources, we assume that imports will grow as faster as the GNP so that the resource structure does not change. Higher CEEC5 imports will turn out to be higher exports for the countries in the model system. *This scenario considers the effect of CEEC5 imports increase only over Italian exports.* In other words, given the increase in Italian exports due to the increase in CEEC5 demand, the Italian model is run alone;
- a ***second scenario (EU/CEEC5 countries via-à-vis)*** considering *the impact of the CEEC imports increase over the export structure of all the models in the system* through the BTM model and the countries models. We assume a growth rate of CEEC5 GNP as in the previous scenario. However, in this case, the effect of the exports increase generated by the accelerated growth of CEEC5 GNP will involve every model in the system and, in turn, each country will be affected by the modifications of every country resource structure. In this case, Italian exports will be determined by changes in demand of imports by *all* the countries in the system.
- a ***third scenario (Specializing CEEC5)*** where the growth rate of CEEC5 GNP will be 2% higher than in the baseline, as in scenarios 1 and 2, but the growth of their imports will

not be evenly distributed among sectors. Instead, *the overall growth rate will be obtained by a specialization of imports* in the following commodities: a) furniture, medical and surgical furniture, b) articles of apparel and clothing accessories, c) wood and articles from wood, d) mineral fuels, mineral oils and products of their distillation. In fact, these are the items where CEEC5 import flows have being concentrating in the last decade. In this scenario, INTIMO is run with the system of models as in the previous scenario.

So far, the simulation scenario do not include any change of prices due to the reduction of tariffs. Therefore, the economic effects are due to changes in the demand. In fact, an increase of the CEEC5 imports turns out to be an increase of Italian exports. Whatever will the sectoral output (or GNP) increases be, the magnitude of the impact on domestic prices is expected to be negligible because a) the CEEC5 prices do not change in any scenario and b) the increase in final demand will be expected to be modest and plausibly it will not sensibly affect the productivity which is - in this case - the main lever influencing the price formation.

The welfare effects resulting from changes in household consumption are presented in Tables 1 and 2. In these tables Laspeyres and Paasche indices are presented for all scenarios. We remind that these welfare measures are indices (1.0 at the base year) and only their level form is an approximation of EV and CV, respectively. We regard the eastern enlargement as welfare increasing if the differences between the simulation scenario and the baseline - the last three columns of the tables - are positive for each year. In fact, if these differences are positive it means that quantities consumed in the case of enlargement are larger then those consumed without this event. INTIMO provides data on prices and consumption for about forty categories of goods. Household consumption is estimated with PADS and a demographic projection model produces population projections for the demand system.[4] In these equations, household disposable income and a price term are the most important independent variables. Household disposable income is modelled in the accountant as the sum of Resources (such as compensation of employees, property income and transfer payments) minus Uses (such as taxes, social security contributions and transfers to others) of the Income Distribution Account for Households. For example, if exports increase then employment will rise and so wages. Therefore, personal consumption expenditure will be higher. On the other hand, a price increase will reduce consumption, but this effect is expected to be very low in these simulations, as explained above.

Results suggest that eastern enlargement is welfare increasing for the Italian economy. Laspeyres and Paasche quantity indices for the base simulation, compared with similar indices for the simulation scenarios with the EU enlargement are always lower. The main reason of the welfare improvement is that personal consumption increases for almost all items. In all enlargement scenarios the aggregate household consumption rate of growth is higher than in the baseline. Welfare increases through the scenarios: the most welfare improving scenario is the one with specialization in CEEC5 imports (see column (3)of both tables), but also the second scenario shows differences with the baseline that are approximately twice as large as the differences between the first scenario and the baseline (compare the figures in columns (2) and (1)). The reason is that the

[4] At present, inside DPM we have not assumed any impact in net immigration due to EU enlargement.

increase in foreign demand for the Italian economy is larger in scenarios 2 and 3. In both these scenarios *(EU/CEEC5 countries via-à-vis* and *Specializing CEEC5*), Italian exports increase not only because of CEEC5 imports but also for the demand of other EU members: integration implies an expansionary effect for all Europe and Italy is directly and indirectly affected through international trade flows. Moreover, when CEEC5 imports growth is simulated in some specialized commodity groups, the effect on Italian exports is higher because some of these are leading Italian exporting sectors (textiles, wood, apparels). For the macroeconomic results of all scenarios, see Table 3 at the end of this paper.

Figures 1 and 2 show the growth rates of our quantity indices in all scenarios. The growth rates present the same pattern: they are in the range from 1.4 to 1.9 percentage points, with a peak around the year 2003, then a slow down to the lowest value after 2006, and an upturn at the end of the period. This pattern is explained mainly by the behaviour of investments (see Table 3). In most cases, the lines do not cross and the ranking is the same as that we have seen in the Tables: the slowest growth of welfare indices is in the baseline, the fastest in the third scenario.

References:

Varian H. (1992), Microeconomic Analysis, Third Edition.
Boadway R.W., Bruce N. (1984), Welfare Economics, Blackwell.

Table 1 - Laspeyres indices for all scenarios (2000-2010) and differences from the baseline scenario

	Laspeyres Indices for the baseline and the simulation scenarios				Differences from the baseline scenario (%) (*)		
	QL(0)	QL(1)	QL(2)	QL(3)	(1)	(2)	(3)
2000	1.000	1.000	1.000	1.000			
2001	1.016	1.017	1.017	1.017	0.10	0.10	0.10
2002	1.033	1.034	1.035	1.036	0.10	0.19	0.29
2003	1.050	1.053	1.055	1.056	0.29	0.48	0.57
2004	1.066	1.070	1.073	1.074	0.38	0.66	0.75
2005	1.082	1.087	1.091	1.093	0.46	0.83	1.02
2006	1.098	1.104	1.109	1.112	0.55	1.00	1.28
2007	1.113	1.120	1.126	1.130	0.63	1.17	1.53
2008	1.131	1.138	1.146	1.150	0.62	1.33	1.68
2009	1.150	1.158	1.167	1.172	0.70	1.48	1.91
2010	1.169	1.177	1.187	1.193	0.68	1.54	2.05

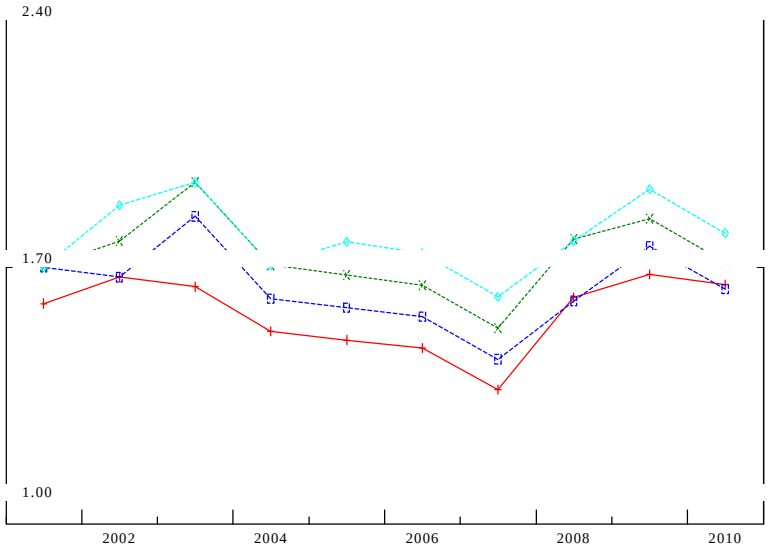
Note: (0) Baseline Scenario
(1) Italy/CEEC5 vis-à-vis Scenario
(2) EU/CEEC5 vis-à-vis Scenario
(3) Specializing CEEC5 Scenario
(*) $100*(QL_t(\text{scenario})-QL_t(0))/QL_t(0)$

Table 1 - Paasche indices for all scenarios (2000-2010) and differences from the baseline scenario

	Paasche Indices for the baseline and the simulation scenarios				Differences from the baseline scenario (%) (*)		
	QL(0)	QL(1)	QL(2)	QL(3)	(1)	(2)	(3)
2000	1.000	1.000	1.000	1.000			
	1.016	1.016	1.017	1.017	0.00	0.10	0.10
	1.032	1.034	1.035	1.036	0.19	0.29	0.39
	1.050	1.053	1.055	1.056	0.29	0.48	0.57
	1.065	1.069	1.072	1.073	0.38	0.66	0.75
	1.081	1.085	1.089	1.091	0.37	0.74	0.93
	1.096	1.102	1.107	1.110	0.55	1.00	1.28
	1.111	1.117	1.124	1.127	0.54	1.17	1.44
	1.128	1.135	1.143	1.148	0.62	1.33	1.77
	1.147	1.155	1.163	1.169	0.70	1.39	1.92
	1.165	1.174	1.183	1.189	0.77	1.55	2.06

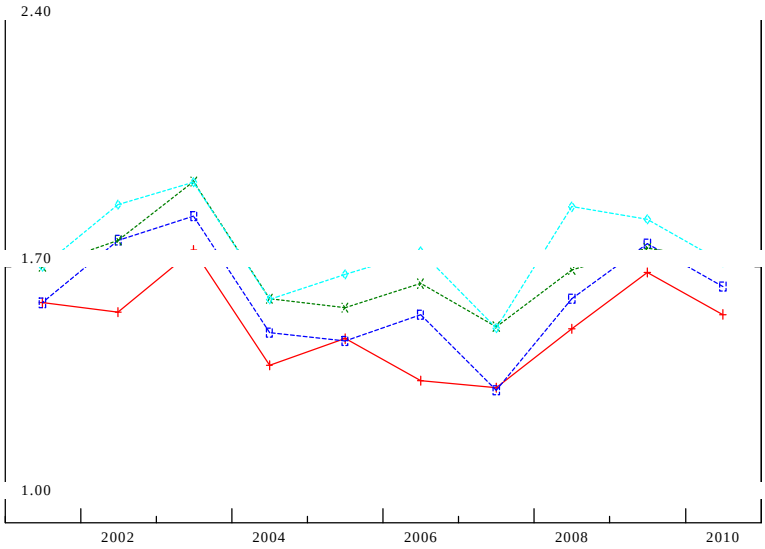
Note: (0) Baseline Scenario
(1) Italy/CEEC5 vis-à-vis Scenario
(2) EU/CEEC5 vis-à-vis Scenario
(3) Specializing CEEC5 Scenario
(*) $100*(QP_t(\text{scenario})-QP_t(0))/QP_t(0)$

Figure 1 - Laspeyres Indices (EV) Annual Growth Rates (%) for the Baseline and the Simulation Scenarios



Legenda:
plus line: Baseline Scenario
square line: Italy/CEEC5 vis-à-vis Scenario
cross line: EU/CEEC5 vis-à-vis Scenario
diamond line: Specializing CEEC5 Scenario

F I A R B S S **igure 2 - Paasche ndices (CV) nnual Growth ates (%) for the aseline and the imulation cenarios**



Legenda:
plus line: Baseline Scenario
square line: Italy/CEEC5 vis-à-vis Scenario
cross line: EU/CEEC5 vis-à-vis Scenario
diamond line: Specializing CEEC5 Scenario

Table 3

Line 1: Baseline
Line 2: Italy and CEEC5 vis-a'-vis - difference from base
Line 3: Italy-EU and CEEC5 vis-a'-vis - difference from base
Line 4: Specialising CEEC5 - difference from base

Alternatives are shown in deviations from base values.

RATES OF GROWTH

PRODUCT ACCOUNT

	01-02	02-03	03-04	04-05	05-06	05-06	06-07	07-08	08-09	09-10
RESOURCES										
Gross National Product	3.121	2.432	1.679	1.877	1.667	1.667	1.434	1.897	1.845	1.786
	0.198	0.181	0.191	0.163	0.131	0.131	0.132	0.134	0.148	0.146
	0.389	0.339	0.370	0.394	0.352	0.352	0.385	0.357	0.381	0.365
	0.448	0.393	0.434	0.485	0.472	0.472	0.512	0.494	0.507	0.422
Imports	6.294	6.289	4.685	4.951	4.177	4.177	3.662	4.643	4.517	4.483
	0.282	0.255	0.292	0.221	0.146	0.146	0.145	0.139	0.165	0.172
	0.538	0.460	0.518	0.502	0.402	0.402	0.451	0.416	0.406	0.407
	0.628	0.557	0.628	0.631	0.566	0.566	0.644	0.623	0.605	0.496
USES										
Consumption	1.737	1.809	1.628	1.628	1.640	1.640	1.552	1.714	1.761	1.741
	0.081	0.082	0.081	0.069	0.050	0.050	0.046	0.044	0.052	0.055
	0.149	0.136	0.139	0.149	0.134	0.134	0.137	0.118	0.123	0.109
	0.174	0.166	0.166	0.180	0.185	0.185	0.197	0.181	0.178	0.139
Household consumption	1.610	1.701	1.470	1.469	1.483	1.483	1.368	1.576	1.635	1.609
	0.104	0.105	0.103	0.089	0.064	0.064	0.059	0.058	0.068	0.072
	0.190	0.173	0.178	0.191	0.173	0.173	0.178	0.152	0.160	0.141
	0.221	0.212	0.213	0.232	0.238	0.238	0.255	0.233	0.230	0.181
Government expenditure	2.200	2.200	2.200	2.200	2.200	2.200	2.200	2.200	2.200	2.200
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Private collective consumption	2.200	2.200	2.200	2.200	2.200	2.200	2.200	2.200	2.200	2.200
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fixed capital formation	7.903	9.080	4.063	4.755	2.873	2.873	1.259	3.925	3.024	2.541
	0.372	0.251	0.318	0.131	-0.081	-0.081	-0.048	-0.081	-0.041	0.040
	0.695	0.518	0.573	0.354	-0.001	-0.001	0.053	0.070	-0.081	0.116
	0.783	0.614	0.666	0.458	0.078	0.078	0.170	0.177	0.021	0.111
Changes in inventories	7.522	6.045	4.371	4.794	3.793	3.793	3.182	4.177	4.161	4.205
	0.501	0.444	0.463	0.372	0.301	0.301	0.296	0.288	0.311	0.287
	0.964	0.785	0.851	0.880	0.773	0.773	0.843	0.727	0.772	0.690
	1.052	0.875	0.953	1.015	0.972	0.972	1.067	0.971	0.971	0.665
Exports	5.932	2.805	2.831	3.195	3.211	3.211	3.425	3.468	3.748	3.944
	0.406	0.401	0.416	0.419	0.443	0.443	0.420	0.439	0.447	0.371
	0.837	0.745	0.830	0.992	1.047	1.047	1.108	1.010	1.119	0.939

0.981 0.860 0.989 1.229 1.368 1.368 1.423 1.361 1.445 1.102