Macroeconomic impact of Pannonia Ethanol in Hungary

Simulation results from a calibrated CGE model

Written for Pannonia Ethanol Zrt.

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„For Applicable Knowledge"
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Executive Summary

1. Pannonia Ethanol Zrt. produces bio-ethanol, most of which is sold abroad. The factory was constructed mainly in 2010-2011, but enlargement investments have been undertaken on a constant basis and are continuing today. The factory started production in 2012 and has increased production levels every year since, with 2016 certain to continue that trend and 2017 more than likely to continue that trend. The aim of this study is to measure and explain the overall impact of Pannonia Ethanol on the Hungarian economy.

2. The overall impact is the sum of direct and indirect impacts. Pannonia Ethanol's direct impacts come from its own employment, value added, export, and tax payments. Indirect impacts, by definition, are the sum of the other impacts that Pannonia Ethanol has on the rest of the economy. The indirect effect is estimated from a calibrated CGE model for Hungary for the 2010-2020 period, for which 2016-2020 is based on projections.

3. Pannonia Ethanol's suppliers earn income, generate valued added and create jobs as a result of their sales to Pannonia Ethanol. Therefore, the material inputs (maize, natural gas, electricity, chemicals, etc.) needed for producing ethanol increase demand within certain sectors of the economy. We assume that without the existence of Pannonia Ethanol, this additional demand would not exist. The indirect effect seeks to quantify the income (value added), employment, tax payments, etc. generated from the impact of this additional demand on Pannonia Ethanol's suppliers, and on the suppliers of the suppliers, etc. The indirect effects are the sum of all such impacts cascading through the input-output linkages in the economy.

	2010-2015			2016-2020		
	direct	indirect	total	direct	indirect	Total
GDP*	79	387	466	335	387	721
Employment**	78	1422	1500	147	1166	1313
Budget *	14	98	111	38	66	103
Export*	590	-156	434	1387	-361	1026
Import*	1	352	353	0	505	505
Trade Balance*	589	-508	81	1387	-865	521

*m€
**yearly average, persons

4. Pannonia Ethanol's total impact on GDP exceeds 1bn euros in the estimation period. The impact on employment is 1300-1500 workers, 90% outside Pannonia Ethanol. Tax revenues increase ~200m€, of which 75% are indirect. Pannonia Ethanol's ethanol and animal feed are sold abroad, which increases exports. However, other producers might sell more at home due to Pannonia Ethanol's impact on the economy, and therefore Pannonia Ethanol's total impact on exports is actually lower than its direct impact. This is because as domestic goods become relatively more expensive imports increase and exports decrease. Nonetheless the *total* impact on the trade balance is positive.

5. The total impact of Pannonia Ethanol's production on GDP is about 0.3€ for each liter of bio-ethanol produced. Of this, approximately 0.15€/liter is the value added of Pannonia Ethanol itself, whereas 0.15€ is a value added that is generated elsewhere in the economy.

6. As Hungary is a small, open economy, the extra demand that a new factory presents for domestic suppliers can always be very easily satisfied with foreign goods. The extra demand increases the prices of local goods, but as local goods are close substitutes for foreign goods, imports will increase and exports will decrease. Within the CGE model, adjustment mechanisms finally will not lead to high price responses but, as a result, most of the extra demand will benefit foreign suppliers rather than increase domestic production.

7. This general adjustment mechanism is illustrated in the current case study. The construction of the bioethanol factory itself presented a large demand for the construction industry, which, being a non-tradable industry, had a large impact on GDP and employment as well. However, when the production of bio-ethanol began, much of the demand went to agriculture, or, more specifically to maize farmers. Within the EU common market, domestic and foreign agricultural products, especially maize, are close substitutes for each other. Therefore, in the projection period the share of indirect impacts is lower than in the construction period. However, the overall impact on the Hungarian economy is a contribution to both growth and job creation.

8. The current study includes two alternative scenarios. One assumes continuing investments, which company management have communicated is more consistent with the actual plans of Pannonia Ethanol than are the Base Scenario assumptions. Pannonia Ethanol's production volumes have been growing at a 12.2% annual rate since 2012. The Base Scenario assumes that this rate of increase will continue in 2016, but that this rate of increase does not continue thereafter. Therefore, an Investment Scenario has been simulated by assuming that Pannonia Ethanol's investments will continue in the future at a rate similar to the past. The following table summarizes the results of the Investment Scenario on the main macroeconomic variables (m€) for the projection period (2016-2020) and shows the difference with the Base Scenario.

	Reinvested earnings			Difference		
	direct	indirect	total	direct	indirect	total
GDP*	424	611	1035	89	224	314
Employment**	147	2024	2171	0	858	858
Budget *	44	118	162	6	52	59
Export*	1795	-444	1352	408	-83	326
Import*	0	720	720	0	215	215
Trade Balance*	1795	-1164	631	408	-299	110

*m€

**yearly average, persons

Continued investments would add a total of 314m€ to the estimated overall GDP impact of Pannonia Ethanol, which is an almost 50% larger impact than if such investments stop. Employment would increase from 1300 persons to more than 2100 persons, and this increase would come entirely from indirect effects. Tax receipts would increase by about 10m€ a year. The decline of induced exports would be less, but nonetheless still rather significant. At the same time, imports would increase. The overall impact on the trade balance would remain positive; it might be 110m€ larger than in the Base Scenario.

9. The study's second alternative scenario involves the nature of Pannonia Ethanol's principal trading partner in the Hungarian economy, the maize farmer. The CGE model treats the maize farmer as being stimulated to make investments in increased production in response to an increase in overall demand for maize in the European Union, rather than being responsive to local demand. This is because the CGE model treats agriculture as a tradable sector, unlike construction, which is a non-tradable sector. Within the CGE model, a demand for maize in Hungary could be met fluidly with imports from any other part of Europe, whereas a demand to expand part of the factory would only be satisfied with a contract to a Hungarian construction company. Within the CGE model, the Hungarian maize farmer would not react any differently to an ethanol plant next to his field than to an ethanol plant constructed in Norway.

   However, the Hungarian agricultural community has objectively taken a strong interest in Pannonia Ethanol, and there is substantial anecdotal evidence that construction of the factory has been responded to by these farmers with an uptick in investments of their own to increase production. Accordingly, a Farmer Scenario has been simulated by assuming that the maize sector is non-tradable. The following table summarizes the results of the Farmer Scenario on the main macroeconomic variables (m€) for the estimation period (2010-2020) and shows the difference with the Base Scenario.

	Farm Investments			Difference		
	direct	indirect	total	direct	indirect	total
GDP*	424	2513	2937	89	2126	2216
Employment**	147	8476	8623	0	7310	7310
Budget *	44	238	283	6	172	180
Export*	1795	-499	1297	408	-138	271
Import*	0	639	639	0	134	134
Trade Balance*	1795	-1138	657	408	-273	136

*m€

**yearly average, persons

   If the maize sector was not a tradable sector, this would add a total of 2216m€ to the estimated overall GDP impact of Pannonia Ethanol, which is an almost four times larger impact. Employment would increase from 1300 persons to more than 8600 persons, and this increase would come entirely from indirect effects. Tax receipts would increase by about 30m€ a year.

   The maize sector in Hungary is neither perfectly tradable or non-tradable and so the purpose of the Farmer Scenario is to provide a ceiling on Pannonia Ethanol's impacts, with the Base Scenario providing a floor. If agricultural experts were to conclude that Pannonia Ethanol has a strong stimulative effect on farm-level investments in Hungary, then this range would be important to know, and the existence of such a strong effect would mean that the Farmer Scenario could be more accurate in its estimate than the Base Scenario.

Introduction

Pannonia Ethanol produces bio-ethanol, most of which is sold abroad. The factory was constructed mainly in 2010-2011, but enlargement investments have been continuous since then. The factory started production in 2012 and has increased its ethanol production every year since. The full capacity was not reached even by the end of 2015, however in the upcoming years the factory is expected to reach full capacity.

The current paper introduces the results of a recent macroeconomic simulation analysis that aims at understanding how the factory influences the Hungarian economy. The main aim of this analysis is to estimate the impact on employment and GDP, including all the jobs and income created by other participants in the vertical supply-chain of production. This ambitious goal requires the application of a general equilibrium framework, in which inter-firm linkages can be taken into account. Therefore, a standard tool, a CGE model has been built and calibrated to the Hungarian economy and simulates how the factory influences incomes and jobs.

The present analysis employs a mixed approach to carry out an ex-post analysis of Pannonia Ethanol. An earlier ex-ante study by Hétfa Research Institute estimated the expected impacts of Pannonia Ethanol[1]. In that paper, Szabó-Morvai used a different method to calculate the ex-ante impact of the building up of two bioethanol factories (in Dunaföldvár and Mohács), of which only one factory was built and started production. Therefore, the results of the two impact analyses cannot be directly compared, although the conclusions are generally similar.

This analysis is restricted to the 2010-2020 period, of which 2010-2015 can be considered as the past, and so that part of the estimation to be of an actual impact on the Hungarian economy. However the 2016-2020 period is considered as a projection; numbers relating to this period are an ex-ante estimation, and as such dependent upon certain assumptions. One of these assumptions is the continuation of the investment activities of Pannonia Ethanol itself at historic levels. Therefore, we present two different scenarios considering either that there is no continuation of investment activities in the future, or there is. The results show that ongoing investments increase the positive impact to the Hungarian economy for both GDP and employment because there is a larger increase for the products of domestic suppliers.

It turns out from the analysis that economic impacts are highly influenced by the fungible nature of Pannonia Ethanol's inputs. The main input of bioethanol production is GMO-free maize, for which there is an open and free market across Europe. Moreover, the good itself is traded in liquid cross-border commodity markets, so domestic suppliers always have the option to sell it abroad. Therefore, the presence of Pannonia Ethanol plays a role in the economy that goes beyond the scope of any CGE model; it may stabilize the domestic demand for maize which in turns works as an insurance mechanism for domestic maize producers. It may also stimulate local investments in expanded maize production in expectation of sales not into the general Europe-wide market but specifically to Pannonia Ethanol. Unfortunately, these responses can not be modeled in a CGE framework, and so therefore we created a Farmer Scenario that assumes agriculture to be a closed, non-tradable sector. Definitely, in practice, agriculture and especially maize production

[1] Szabó-Morvai, Ágnes (2012): Estimating the Effects of Pannonia Ethanol on the Hungarian Economy, Hétfa Research Institute, Working Paper.

activities are not restricted to complete domestic marketing and sales. But it is important to understand the full extent to which domestic agriculture could be affected by the presence of Pannonia Ethanol. Our approach is an approximation, based on our knowledge about the labor intensity of production in the agriculture sector, through which we can understand how largely the sector itself might be influenced by the presence of Pannonia Ethanol.

This paper is structured as follows. The main body of the text focuses on the main modelling questions without going too much into the details of technical issues, which are addressed in Appendix 1. The next section introduces the modelling and estimation approach. The following section discusses the cost structure of Pannonia Ethanol and explains methodology. The final section summarizes the simulation results. In the appendices, we outline the applied CGE model in more detail and list the tables of the three different simulation scenarios that were run: the Base Scenario, the Investment Scenario and the Farmer Scenario.

Approach

The impact of Pannonia Ethanol on the Hungarian economy is estimated using a mixed approach. The overall impact is disaggregated into direct impacts and indirect impacts. Direct impacts come from Pannonia Ethanol's employees, value added, export, and tax payments. Indirect impacts, by definition, are the sum of all other impacts that Pannonia Ethanol has on the rest of the economy.

Namely, Pannonia Ethanol buys maize from farmers to produce ethanol. Also, other material inputs are needed for production, like energy, chemicals, logistic services and business services. We assume that without the existence of Pannonia Ethanol this demand would not exist either. The indirect effect includes the incremental income (value added), employment, tax payments, etc. of all those who supply material inputs to Pannonia Ethanol, and of suppliers to the suppliers, etc. The indirect effects are the sum of all such impacts cascading through the input-output linkages of the economy.

The indirect impacts are estimated from a numerical simulation. We applied a calibrated CGE model for the Hungarian economy for the period 2010-2020. Within this period, 2010-2015 has been calibrated to the observed macroeconomic facts (the known main macroeconomic aggregates). The 2016-2020 period is called the projection period, when both the production of Pannonia Ethanol and the overall performance of the Hungarian economy is assumed. The details of the CGE model and the assumptions made are summarized in Appendix 1.

However, we wish to add a short introduction of CGE models here. The acronym is for the Computable General Equilibrium models, which are based on general assumptions used for policy simulations. In a CGE model, households, firms, and governments are the domestic participants of the economy, whose behavior is described using standard solutions from microeconomics. We assume that households maximize their utility given their budget constraints, and wish to consume as much as is possible. The firms use labor, capital and material inputs for production. Governments buy products from firms, give income transfers to households and collect taxes. The transactions with the rest of the world are mainly pure exchanges of products, and we assume that domestic and foreign goods are not perfect substitutes to each other. The decisions of the participants (especially of households and firms), namely decisions on consumption, production, export and import are mainly driven by price differentials. The decision makers in the economy take prices as given; they do not take into account their own influence on the determination of prices (assumption of price takers). Whenever an event leads to a change in a price of a particular good, households and firms try to substitute that good with a cheaper one. This substitution effect is quite strong, much of the adjustment process is driven by price changes.

The indirect impacts of Pannonia Ethanol come from three different sources.

1. The factory itself was built in 2010–2011, and has seen increasing production from investments every year. The aggregate investment is 165m€, which has been paid from 2010 to 2015 gradually. Approximately half of this sum went to the construction industry; the other half went to buying equipment, machines, and production facilities. In the simulation we call this part of the demand shock the *'investment component'*.

2. Production of ethanol started in 2012 with continuously increasing capacity. It still has not reached its full level of capacity but assumed to reach it by 2016 (meaning that 2017 aggregate production will nevertheless be materially higher than for 2016). Production requires a large amount of material inputs, of which the most important is maize. The share of maize in the total costs of material inputs varies between 60-80%, which shows the importance of this input. In addition to maize, energy and chemicals are also needed for production. Logistic services and other business services are used to market ethanol and animal feed. This component is called in the simulation the *'production component'*.

3. Employees of Pannonia Ethanol live in Hungary. Therefore the non-saved part of their income increases demand for consumption goods. This income effect is taken into account as an approximation: we assume that the total sum of net wages increases the demand for consumption. This additional demand component is called in the simulation the *'income component'*.

The indirect effects of Pannonia Ethanol are the sum of the investment component, the production component and the income component. Their value is estimated using a CGE model. However as CGE models are highly nonlinear, we made four different simulations: one for each component, and a final simulation when all three components were present at the same time. Using these four simulations we can disaggregate the impact into relevant parts. Nonetheless, the total impact of Pannonia Ethanol on the Hungarian economy is just the sum of the direct and indirect impacts.

Bioethanol Production at Pannonia Ethanol

CGE models are powerful and useful tools when inter-sectoral linkages play a crucial role in adjustment mechanisms. The impact estimated by these types of models is always a difference between a business-as-usual scenario and a counterfactual scenario. The business-as-usual scenario is calculated assuming that there is no intervention, while the counterfactual scenario is calculated assuming that some parameters of the model have been changed. To understand how a single factory can influence a whole economy, we need to find a way how to interpret this idea in the modelling framework.

The key issue is the „representative firm" idea of CGE models. In these models, each sector is represented by a single firm which can be considered as an average of existing, real firms in a given industry. In general, there are different ways to introduce a new factory into a CGE model. Without going too much into the details, we outline here the possible approaches.

1. We can add the new firm to an existing branch of the economy by assuming that it behaves the same way as an average firm in the same branch. In this case, for example by shocking the productive capital of the industry, we can simulate the impact of a new producing plant. However, in this case we need to argue that the given firm is similar enough to the average firm in the industry; otherwise the results can't be explained well.

2. We can create a separate industry for the given firm. In this case it is possible to simulate the general equilibrium effect on output, employment and income if there is a change in the level of production of the given firm. However, in this case there is no way to simulate the counterfactual that is needed to understand how the economy would have evolved *without* the existence of the given firm.

3. Finally, if a firm is simple enough that it has only a few industrial relationships, then we can argue reasonably that input-output linkages are not too deep, and we can avoid fitting the given firm into the input-output structure of the economy and simply assume that its material input adds an extra demand to the economy. This is a reasonable approach if a firm's products are mainly sold abroad, since in that case we can avoid complications arising from a need to model domestic sales.

Each approach has its advantages and disadvantages. As for the first solution, it suits the CGE framework most naturally; however in this case we would need to be confident that the firm being researched is similar enough to the average industrial firm. The second approach is also very sound, but it does not allow an answer to the given research question. Therefore, it is crucial to see how similar or different the cost structure of Pannonia Ethanol is to other industrial averages.

The production of bio-ethanol requires maize, an input material that constitutes more than half of Pannonia Ethanol's material costs. Other main cost elements are energy (natural gas and electricity) and different kinds of chemicals. The marketing of bio-ethanol requires the usage of logistics and business services. The most important feature of this production technology is that *it is very much different* from the average manufacturing firm in Hungary, even from the average chemicals firm.

Bioethanol production, in the standard classification of activities (NACE rev. 2), belongs to the „20.14 Manufacture of other organic basic chemicals" category. The data on input-output linkages however is not available in such a deep disaggregation, but we know how the „20 – Manufacture of chemicals and chemical products" and „C – Manufacturing" industries' cost structure looks like. This information is summarized in the following table. There are material divergences in almost all entries. However, from our point of view, the most important issue is that an average firm in the „Chemicals" industry *does not use inputs from agriculture*, and even an average firm in the Manufacturing industry spends less than 5% of its material input costs on agricultural inputs. On the other hand, there is basically no other input for Pannonia Ethanol from the Manufacturing industry other then chemicals, whereas for an average Manufacturing firm more than two-thirds of its input is spent in this sector. Even an average firm in the Chemicals industry buys inputs to a large extent from the Manufacturing industry.

Table 1. Cost structures of average Manufacturing firm (NACE Rev. 2. „C"), an average Chemicals firm (Nace Rev. 2. „20"), and Pannonia Ethanol (%)

	Manufacturing	Chemicals	Organic basic chemicals	Pannonia Ethanol
	C	20	20.14	-
agriculture	**4.45**	**0**	n.a.	**60.47**
manufacturing	**69.73**	**48.17**	n.a.	**0**
chemistry	5.92	26.41	n.a.	8.10
energy	2.70	8.94	n.a.	12.98
water	0.60	0.76	n.a.	0
construction	0.13	0.10	n.a.	0
trade	4.08	5.79	n.a.	0
logistics	2.44	2.83	n.a.	5.83
services	9.54	6.57	n.a.	12.61
public services	0.42	0.43	n.a.	0
total inputs	100.00	100.00	n.a.	100.00
Additional statistics:				
export share	65.52	70.05	n.a.	90.80
labor share	48.11	52.15	n.a.	15.45

Source: Input-output table from the National Statistical Office of Hungary and Pannonia Ethanol Zrt.

The main conclusion from this comparison is that the first two approaches of the above list are not applicable for the current research. Therefore, we assume in the analysis that follows that the costs of Pannonia Ethanol represent additional demand to certain industries of the economy. Our simulation experiment will address how the overall employment, GDP and the sectoral distribution of these measures will change when extra demand appears.

The values of the assumed extra demand are summarized in Appendix 2. CGE model details and measurement issues are discussed in Appendix 1. Below, we show the results of the simulations. We generally express results in millions of euros (and numbers of persons, respectively), but in certain cases we also show the relative size of the impacts in order to get a better picture of what our simulations mean.

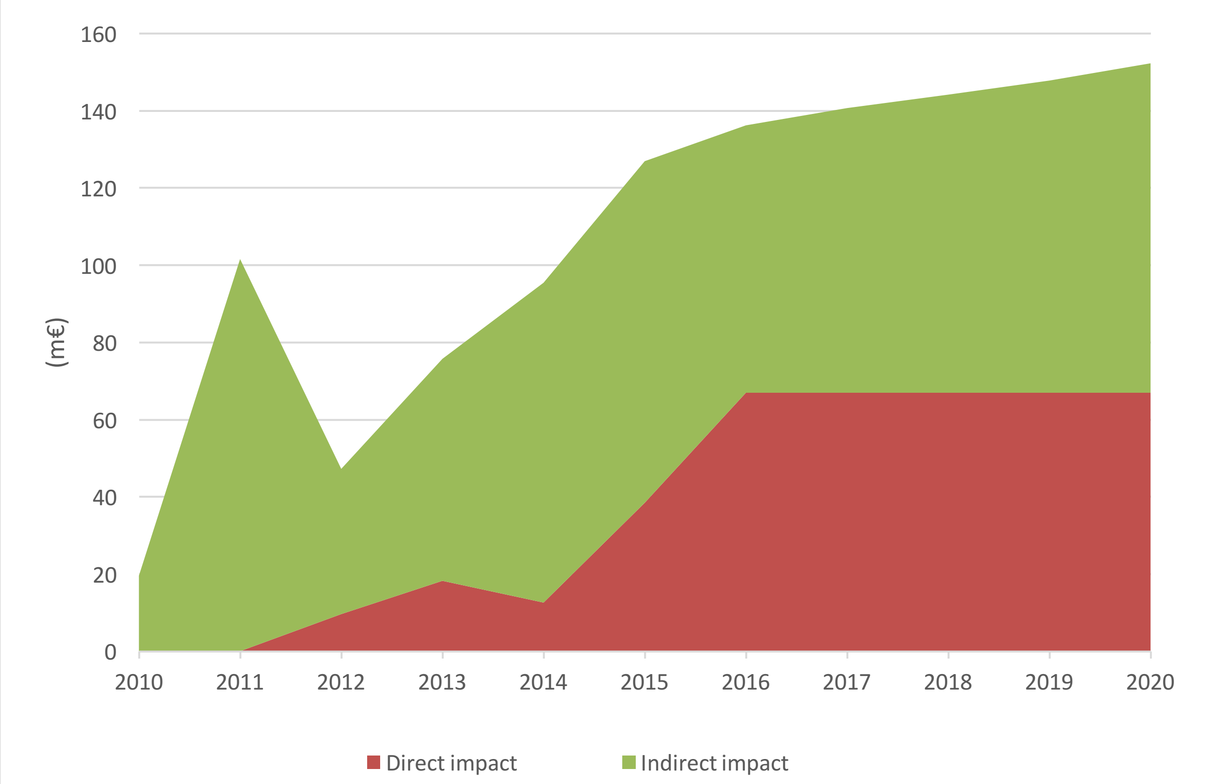
Base Scenario: Macroeconomic Impacts

The Base Scenario shows that the presence of Pannonia Ethanol in Hungary has led to an increase in overall employment, income and production. Both on the national level and on the sectoral level, the indirect and direct impacts are positive and contributed to a relevant measure of observed growth in the Hungarian economy between 2010-2015. For the projection period, the expected impact may even exceed the impacts already evident.

The overall impact of Pannonia Ethanol on Hungarian GDP between 2010-2020 sums up to over 1.2bn€, of which approximately two-thirds arises from indirect impacts of the factory. Detailed results can be seen in Figure 1 here and Table 6 in Appendix 2. These indirect impacts come from the value added of suppliers through the input-output linkages of the Hungarian economy, and the suppliers of the suppliers, etc. The yearly impact varies depending on the extra demand Pannonia Ethanol creates. As production started only in 2012, there is no direct impact before that year. The direct impact from 2012 onwards follows the ramping up of the production as it has gradually reached its current level. It is assumed that production will reach its full capacity in 2016 and it does not change in the rest of the projection period.

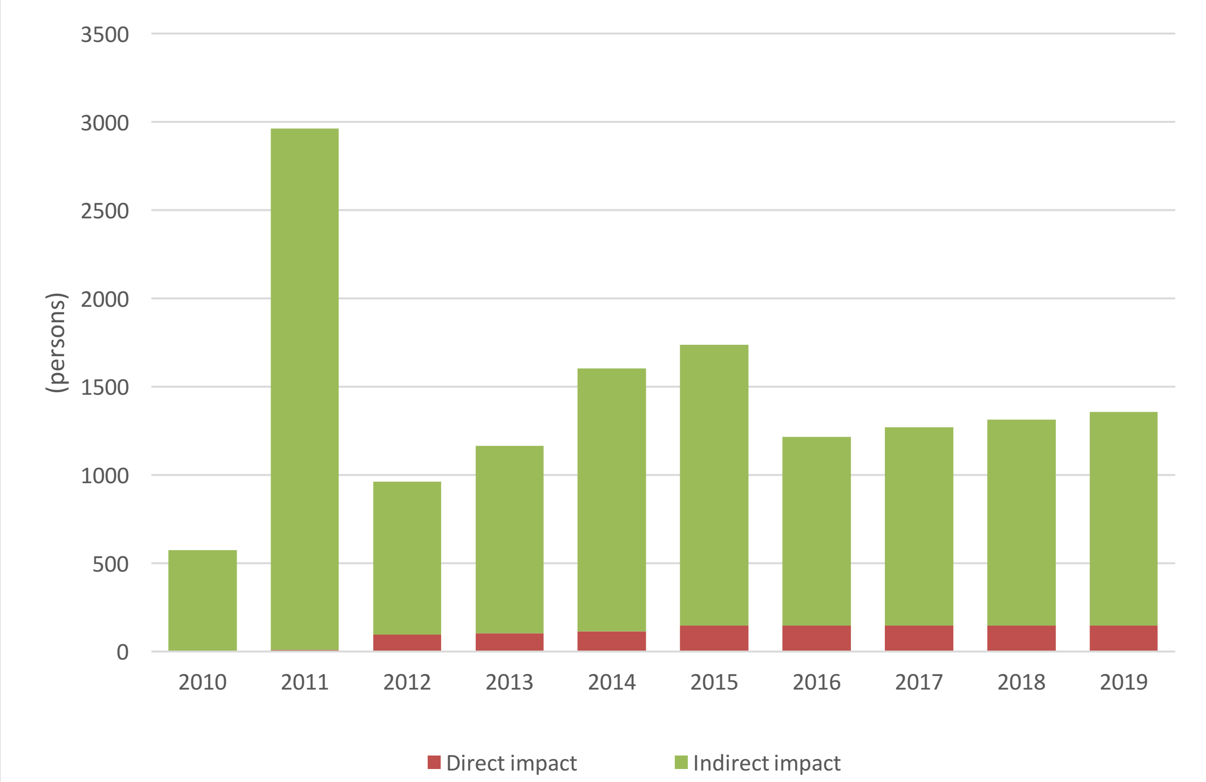
The yearly indirect impact of Pannonia Ethanol varies between 20m€ to 100m€, depending on the structure of the extra demand. The years of construction show a larger indirect impact as these demand components address non-tradable sectors. Therefore we observe smaller crowding-out effects in those years. For the projection period, the direct impact of Pannonia Ethanol is constant, 67m€ a year; however indirect impacts show continued small growth. It may be surprising that indirect impacts increase even if the shock itself does not change in absolute terms (see Table 12 in Appendix 2). This result can be explained by the basic growth path of the Hungarian economy that is programmed into the CGE model. It has been assumed that overall national investment demand increases in this period, which leads to a small increase in the capital stock of the economy. This results in slow growth. The simulation aims at calculating how the path of the GDP changes if there is additional demand from Pannonia Ethanol, and even if this additional demand is the same in monetary terms, it creates a larger impact in a slowly increasing economy by enlarging the multiplicative processes of the input-output linkages.

Figure 1. GDP Impact (Base Scenario)



The employment effect shows a very different picture, as the indirect effect is much larger than the direct effect (see Figure 2 here and Table 7 of Appendix 2). This result comes from the fact that Pannonia Ethanol's technology is less labor intensive than that of the average Hungarian firm. Even if we compare it to any industrial average, much less labor is employed by Pannonia Ethanol to achieve the same value added. Therefore, Pannonia Ethanol's additional demand has a large impact on local employment.

Figure 2. Employment Impact (Base Scenario)



In many cases it is easier to understand the size of an impact if we express it in relative terms. Table 2 shows relative measures for the shock and the impact as well. The extra demand this factory gave to the Hungarian economy from 2010 onwards reached 0.18% of GDP and is expected to increase further to 0.2% by 2020. As we will see below, a large part of this extra demand is satisfied from increased imports and a decrease in exports, so local production increases are muted.

However, the relative size of the impact varies across years. In 2010 and 2011, the extra demand increased production and value added at the same amount as the shock itself; we can say there was no crowding out effect in these years. As the construction and enlargement of the factory was only finished in 2015, from 2010-2015 a substantial amount of the factory's extra demand was absorbed by non-tradable sectors, at least half of the extra demand increased local production and employment. In contrast, for the projection period we expect that a bit less than half of the extra local demand will be satisfied from increased local production; on average the 0.2% increase in demand, that PE states, will increase value added by 0.08% and employment by 0.03%.

Table 2. Size of the Impact (Base Scenario, %)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Demand shock to GDP	.023	.119	.118	.169	.172	.184	.214	.210	.207	.204	.201
Impact on Output	.023	.120	.049	.072	.094	.101	.082	.084	.085	.087	.089
Impact on GDP	.022	.118	.045	.067	.091	.096	.076	.079	.080	.082	.085
Impact on Employment	.015	.080	.025	.031	.042	.045	.030	.031	.032	.033	.034

Table 3 quantifies the size of the crowding-out effect for the simulation years.[2] Row 1 shows the additional amount of demand that the factory creates in the Hungarian economy. Rows 2-7 show the results from simulation of the economic changes due to this extra demand. As investment demand is assumed to be exogenous, there is no simulated impact on overall investment. The increase in income leads to an increase in consumption. However, exports decline and imports increase; therefore, the overall indirect impact on GDP is less than the total extra demand that Pannonia Ethanol creates. But still, the extra demand leads to job creation and increases value added of the economy.

Table 3: Crowding-Out Effect (m€)

	2010	2012	2014	2016	2018	2020	Total
1. Extra demand of Pannonia Ethanol	19.7	98.7	155.7	195.0	199.5	202.5	1685.1
Impact on							
2. consumption	6.6	13.6	32.2	30.5	36.5	43.5	327.6
3. investment*	0	0	0	0	0	0	0
4. government expenditure*	2.5	5.5	14.8	12.9	14.4	16.6	134.5
5. export	3.4	-37.0	-42.9	-78.6	-71.4	-66.8	-516.9
6. import	12.6	43.1	77.0	90.4	101.6	110.4	856.6
7. trade balance	-9.3	-80.2	-120.0	-169.0	-173.0	-177.2	-1373.5
Total indirect impact on GDP (1.+2.+3.+4.+7.)	19.5	37.5	82.7	69.3	77.3	85.3	773.8

The reason for the strong crowding-out effect comes from the price adjustment mechanisms that are present in the model. Pannonia Ethanol increases overall demand within the economy. The overall size of this shock is about 0.2% yearly. The increase in the demand for domestic goods makes them relatively more expensive compared to foreign counterparts, and therefore producers will decrease their own sales abroad and increase their sales at home. Import reacts in just the opposite direction; consumption of foreign goods will increase as their relative price decreases. The magnitude of these substitution effects is governed by substitution elasticity parameters.[3]

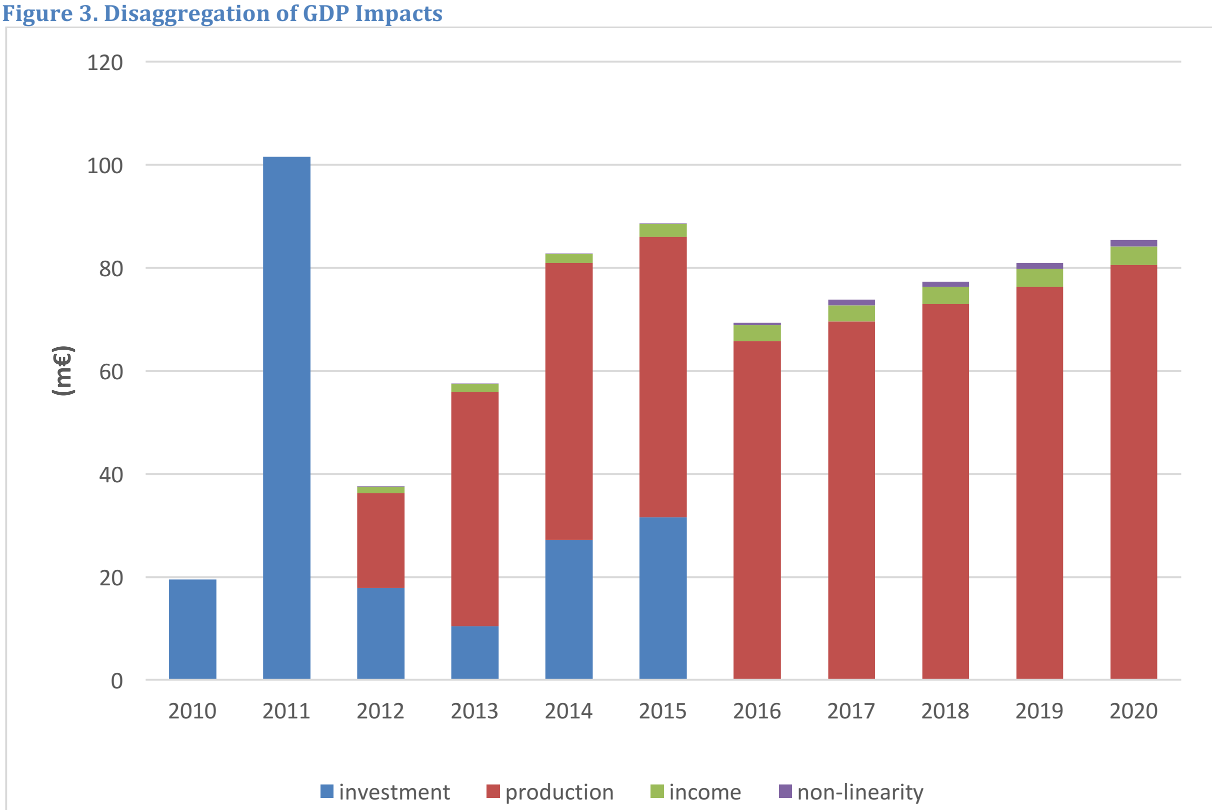
[2] For only even years, Table 13 in Appendix 2 shows the simulation results for every year.

[3] It is important to note that the results are sensitive to the *magnitude* of the elasticity parameters, but relatively stable for small changes in these values.

Base Scenario: Disaggregation of the Indirect Effect

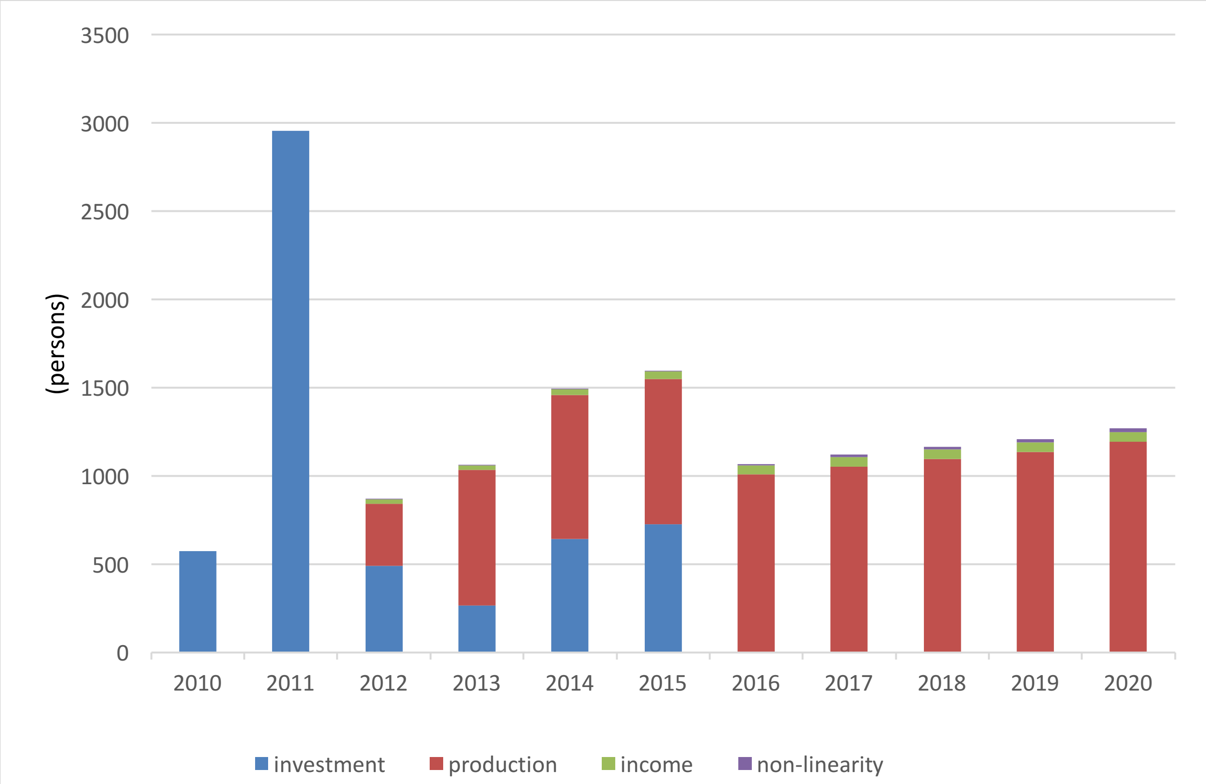
The indirect impacts on GDP and employment can be disaggregated into production, investment and income, as explained above. The investment component has the largest impact on both GDP and employment, both in absolute value and also relative to the size of the shock. This result can be explained by the fact that half of the investment component goes to the construction sector, which is a non-tradable industry. Therefore the extra demand can only be met by a corresponding increase in local production.

Figure 3. Disaggregation of GDP Impacts



The production component has a relatively smaller impact on both GDP and employment than the investment component. This is mainly related to the openness of the agricultural sector. Within the EU common market, domestic and foreign agricultural products are largely fungible. Therefore, increased local demand can stabilize demand for locally produced maize but does not really contribute to the overall demand that local producers face.

Figure 4. Disaggregation of Employment Impact



Base Scenario: Sectoral Distribution of the Indirect Impacts

It seems from the aforementioned simulation results that impacts highly depend on which sector or industry is affected. Output (local production), value added (income) and employment are disparately impacted. Table 9, Table 10 and Table 11 in Appendix 2 summarize the simulation results for different segments of the economy.

In 2010-2011, when the initial investment was made, a small sectoral restructuring occurred: increased labor demand in the construction sector adversely impacted the labor intensive agricultural sector. As both construction and agriculture are labor intensive, an asymmetric shock to only one of these industries leads to a movement of workers from one industry to another. However, this crowding-out effect is weak, and in this case we may reasonably assume that it is the result of the nonlinearity of the model. So, the period of investment generally increased the production, value added and employment parameters of the manufacturing sector.

From 2012, when production started at Pannonia Ethanol, the impact is more evenly distributed across sectors. Agriculture and manufacturing increased production with 11-23m€ and 50m€-100m€, while value added increased similarly at about 5-25m€ yearly. For services, we also found a material increase in production and value added as well.

The employment effect is the largest in the manufacturing industry in the years of the largest construction payments . This result comes from the fact that construction is one of the most labor intensive industries. Apart from the investment component, the employment effect is similar in total manufacturing (~300 persons) and agriculture (~300 persons). These numbers include all general equilibrium effects, and not only the changes in employment of the suppliers of Pannonia Ethanol, but also all changes in employment in a given sector due to input-output linkages.

In order to better understand how these adjustment mechanisms work, we prepared a separate impact table on the agricultural sector. Table 4 shows the change in demand for agricultural products due to Pannonia Ethanol- the extent to which Pannonia Ethanol's maize purchases change the overall production of *the whole agricultural sector*, as well as export and import. The last row of the table shows the change in production as a percentage of the change in sectoral demand. Due to the openness of EU agricultural markets and the fungible nature of most agricultural products, we calculate that *5% of the extra demand is met through increased local production in the agricultural sector*.[4]

[4] It is important to emphasize that this increase in agricultural production can happen anywhere in the vertical supply chain, as the general equilibrium approach (and the aggregate model of the whole industry) makes it impossible to identify exactly which agricultural products will be produced in greater quantities.

Table 4. Crowding-out effect in agricultural production

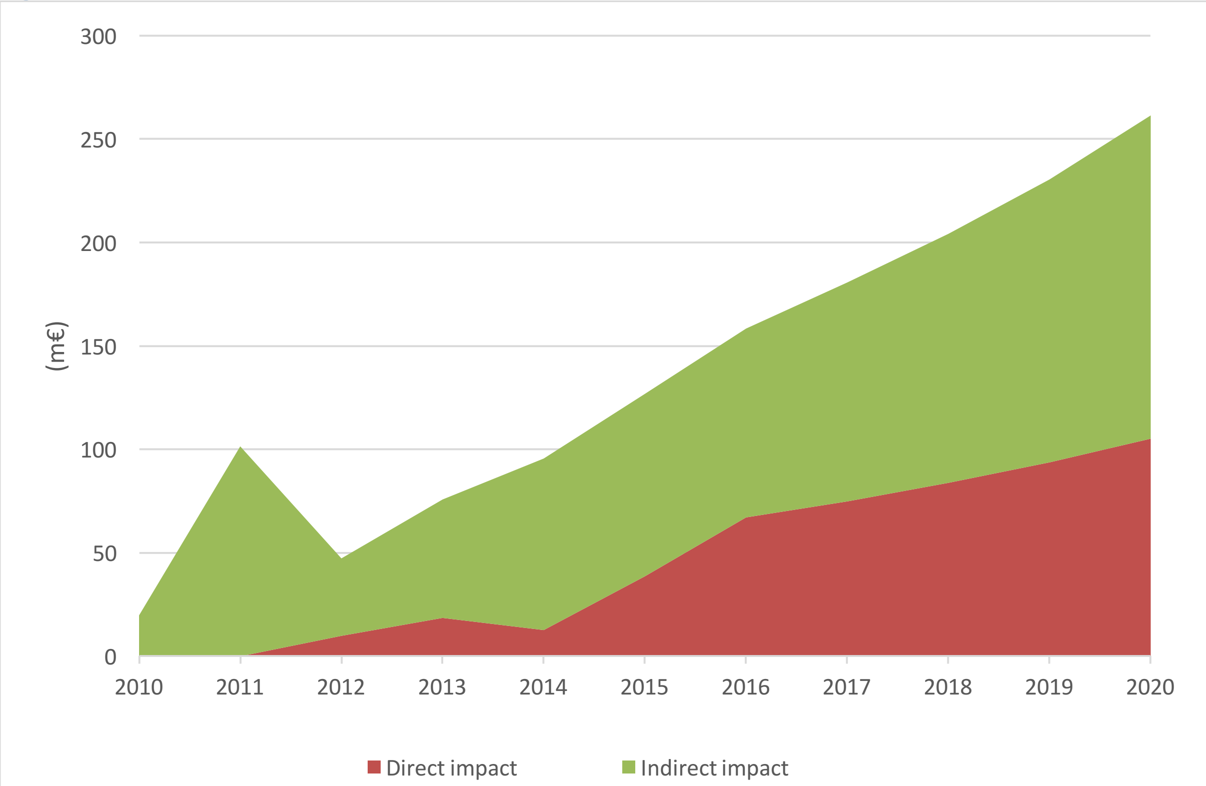
Agriculture	2012	2013	2014	2015	2016	2017	2018	2019	2020
New demand	57.90	80.52	69.49	77.93	123.51	123.51	123.51	123.51	123.51
Change in production	2.81	3.58	3.10	3.65	6.31	6.55	6.76	6.88	7.00
Change in export	-33.77	-46.31	-37.86	-42.05	-65.60	-62.87	-60.41	-58.65	-56.84
Change in import	21.02	30.42	28.68	32.40	51.78	54.61	57.18	59.05	61.01
Impact on domestic production (%)	4.85	4.44	4.46	4.68	5.11	5.30	5.47	5.57	5.67

Investment Scenario

Because Pannonia Ethanol expanded constantly after opening in 2012, actual sales volumes and revenues increased every year as well. It is projected that maximum capacity will be reached in 2016. Therefore, in the Base Scenario we assume that Pannonia Ethanol will work at full capacity in the years between 2016 and 2020. Nonetheless continuous reinvestment into the factory is also a reasonable scenario. We examine below what would happen if Pannonia Ethanol continued to invest at historical levels, which would lead to additional demand in the construction and machinery sectors. Also, as a result of this investment, the productive capacity of Pannonia Ethanol would increase further, which would create additional demand for suppliers. This section summarizes the result of this Investment Scenario.

Production increased at a 12.2% annual rate between 2012 and 2015. For that trend to continue in the projection period (that is between 2016 and 2020), an average yearly 14m€ investment would be needed. The simulation shows that the potential impact on GDP and employment would be much larger in this case than in the Base Scenario. The detailed results are presented in Appendix 2, whereas the main results can be summarized as follows.

Figure 5. GDP impact in the continuous investment scenario



A further increase in Pannonia Ethanol's production levels in the projection period leads to an enlargement of both the direct and indirect GDP impacts. The difference between the Base Scenario and the Investment Scenario is 314m€ in total, from which 90m€ is direct impact. The remaining 224m€ represents extra indirect impacts on GDP arising from both investment activities and extra production. The overall impact on GDP is 25% larger than in the Base Scenario. Figure 5, Figure 6 and Figure 7 graph this continuous investment scenario.

The larger GDP impact is partly due to investment activities, which are responsible for about 120m€ in extra generated income by suppliers to Pannonia Ethanol. The remaining 104m€ is the result of production activities, which income is distributed among farmers, suppliers of chemicals and sellers of other inputs needed by Pannonia Ethanol.

The employment effect shows a dramatic change in comparison with the Base Scenario. Extra demand from Pannonia Ethanol's continuous investments increases employment at the levels of suppliers of Pannonia Ethanol and at the level of suppliers of those suppliers, etc, The impact is twice as profound as in the Base Scenario. The large impact is partly driven by the investment component, which increases domestic production to a large extent due to the impact on a non-tradable sector.

Figure 6. Disaggregation of Indirect GDP Impacts (Investment Scenario)

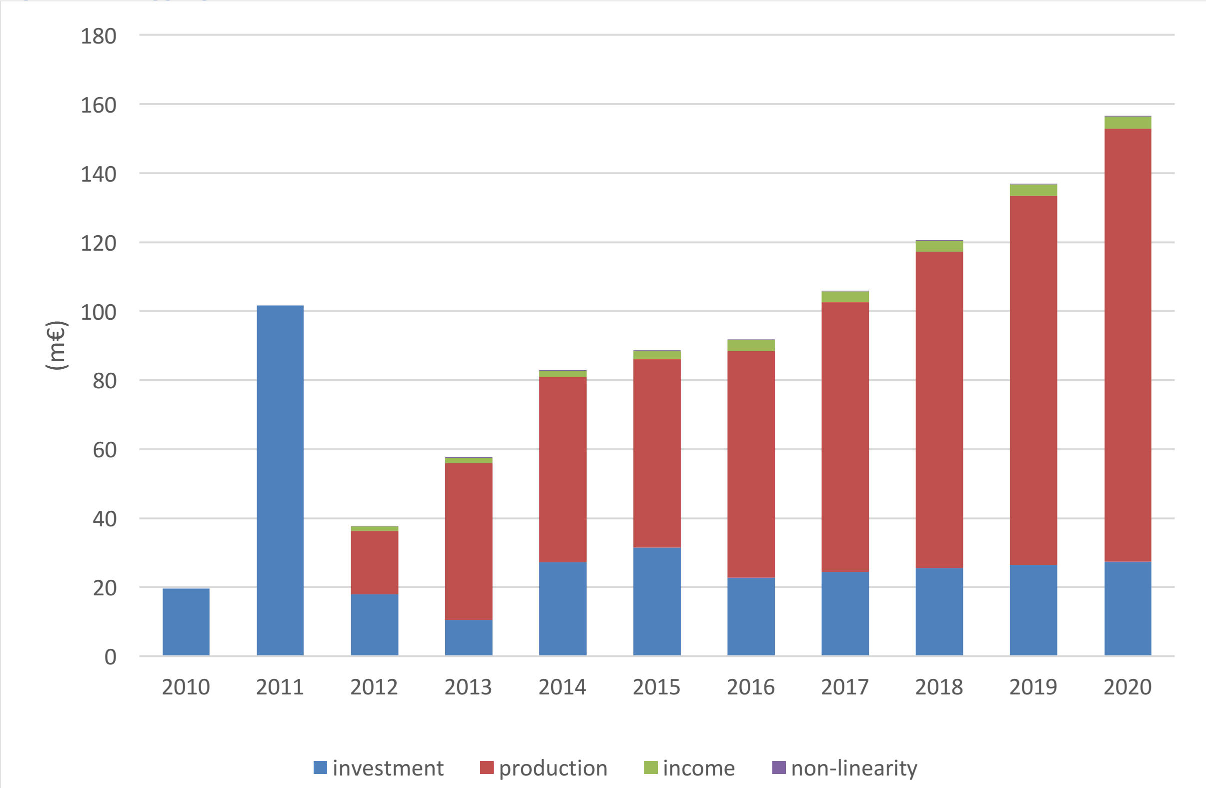
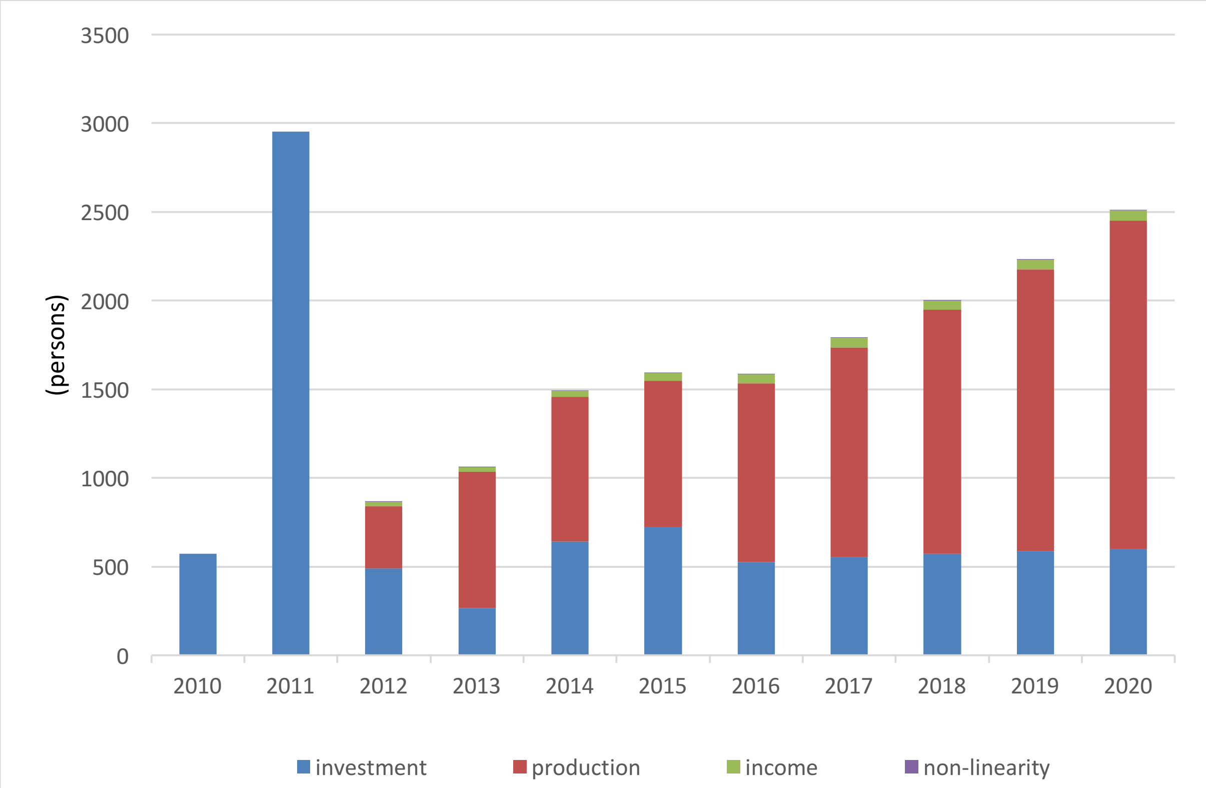


Figure 7. Disaggregation of the Indirect Employment Impact (Investment Scenario)



Farmer Scenario

The Base Scenario includes a relatively large crowding-out effect. Therefore, the simulated impacts on GDP and employment are generally lower than the original extra demand. This large crowding-out effect is generally related to the openness of certain sectors. As the main input of bioethanol production is maize, we made a hypothetical scenario concerning the agricultural sector. In this hypothetical scenario we ask how different the impact numbers would look if the extra agricultural demand was completely satisfied from domestic sources.

However, such an experiment is not without methodological challenges. Closing an industry that is open originally means that the business-as-usual path of the economy, to which we compare the counterfactual path will be different as well. A new business-as-usual path has been calibrated assuming that agriculture is closed (export and import of agriculture has been set to zero and trade balance had been added to the household consumption). This new base path has a lower GDP than in the original simulation; therefore, the extra demand from Pannonia Ethanol has not been added in absolute terms but rather as a percentage of the simulated GDP. This way the relative size of the shocks in the different scenarios are comparable.

Table 5 compares the impact on domestic agricultural supply in all three scenarios. We see that in the Base Scenario and the Investment Scenario, domestic supply expansion covers about 5%, of additional demand, regardless of whether there is reinvestment or not. This basically means that by enlarging the productive capacity of Pannonia Ethanol the impact on the domestic agriculture production will be larger as well, at least in absolute terms. But at the same time in both scenarios we see that approximately 95% of the increased extra demand is satisfied from foreign sources (either by importing more or by exporting less).

The simulation results show a very different picture in the Farmer Scenario. Assuming that agriculture is closed, the extra demand of Pannonia Ethanol for maize will lead to a large increase in domestic production: approximately 70% of the extra demand will be met by a parallel increase in domestic production. At the same time, the growth of the economy will lead to an expansion of other industries as well, which increases the demand for agriculture products further. As farmers reach the boundaries of the available primary factors of production (labor and capital, respectively), they will not be able to satisfy this extra demand fully. Therefore, the household consumption of agriculture products will decline to a large extent. However, in comparison with the other two scenarios, the main difference is in the response of farmers, who produce more.

Table 5. Farmer Productivity in Different Scenarios

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Base Scenario									
New demand	57.90	80.52	69.49	77.93	123.51	123.51	123.51	123.51	123.51
Change in production	2.81	3.58	3.10	3.65	6.31	6.55	6.76	6.88	7.00
Change in export	-33.77	-46.31	-37.86	-42.05	-65.60	-62.87	-60.41	-58.65	-56.84
Change in import	21.02	30.42	28.68	32.40	51.78	54.61	57.18	59.05	61.01
Impact on domestic production (%)	*4.85*	*4.44*	*4.46*	*4.68*	*5.11*	*5.30*	*5.47*	*5.57*	*5.67*
Investment Scenario									
New demand	57,90	80,52	69,49	77,93	123,51	139,49	157,54	177,93	200,95
Change in production	2,81	3,58	3,10	3,65	6,31	7,42	8,68	10,02	11,57
Change in export	-33,77	-46,31	-37,86	-42,05	-65,60	-70,81	-76,57	-83,59	-91,01
Change in import	21,02	30,42	28,68	32,40	51,78	61,86	73,37	85,86	100,54
Impact on domestic production (%)	*4,85*	*4,44*	*4,46*	*4,68*	*5,11*	*5,32*	*5,51*	*5,63*	*5,76*
Farmer Scenario									
New demand	58,14	81,06	70,38	78,97	125,16	141,35	159,65	180,31	203,64
Change in production	41,77	58,15	50,79	56,52	89,60	101,54	115,09	130,22	147,38
Change in final demand (households)	-29,34	-40,99	-35,46	-40,17	-63,48	-71,48	-80,47	-90,71	-102,24
Change in intermediate consumption of agricultural products	12,97	18,08	15,87	17,72	27,92	31,67	35,91	40,62	45,98
Impact on domestic production (%)	*71,84*	*71,73*	*72,16*	*71,58*	*71,59*	*71,84*	*72,09*	*72,22*	*72,37*

Not surprisingly, GDP and employment impacts are higher in the Farmer Scenario. Detailed results tables of the Farmer Scenario are presented in Appendix 2. Indirect GDP impacts are more than three times larger than in the Investment Scenario (see Figure 8). The indirect employment impact in 2020 is about 11240 persons, in contrast to the 2509 persons of the Investment Scenario. This is more than four times larger, which is really remarkable.

The large employment effect is mainly explained by the labor intensity of the domestic agriculture industry. As the main input of bioethanol is maize, of which production is more automatized than an average agriculture product, the relevant labor intensity would be lower. Therefore, the abovementioned employment impact can be interpreted as a high estimation.

Figure 8. Disaggregation of Indirect GDP Impacts (Farmer Scenario)

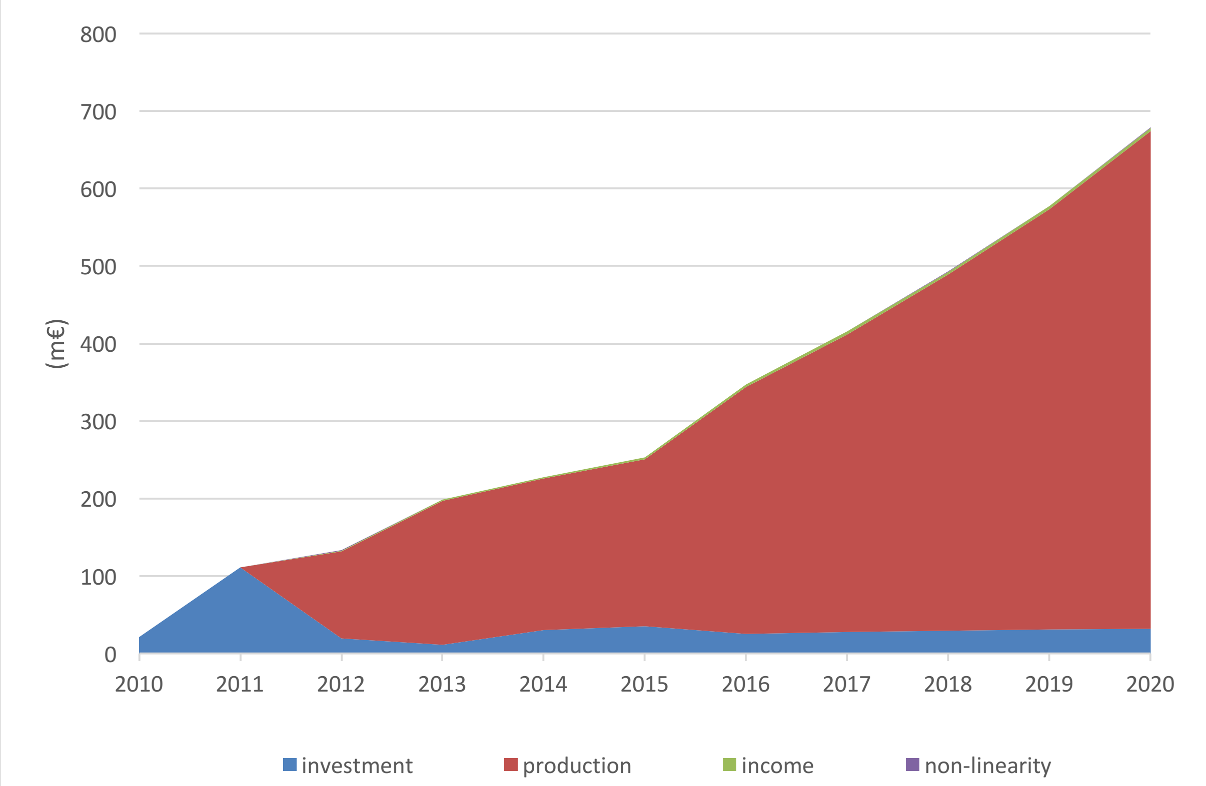
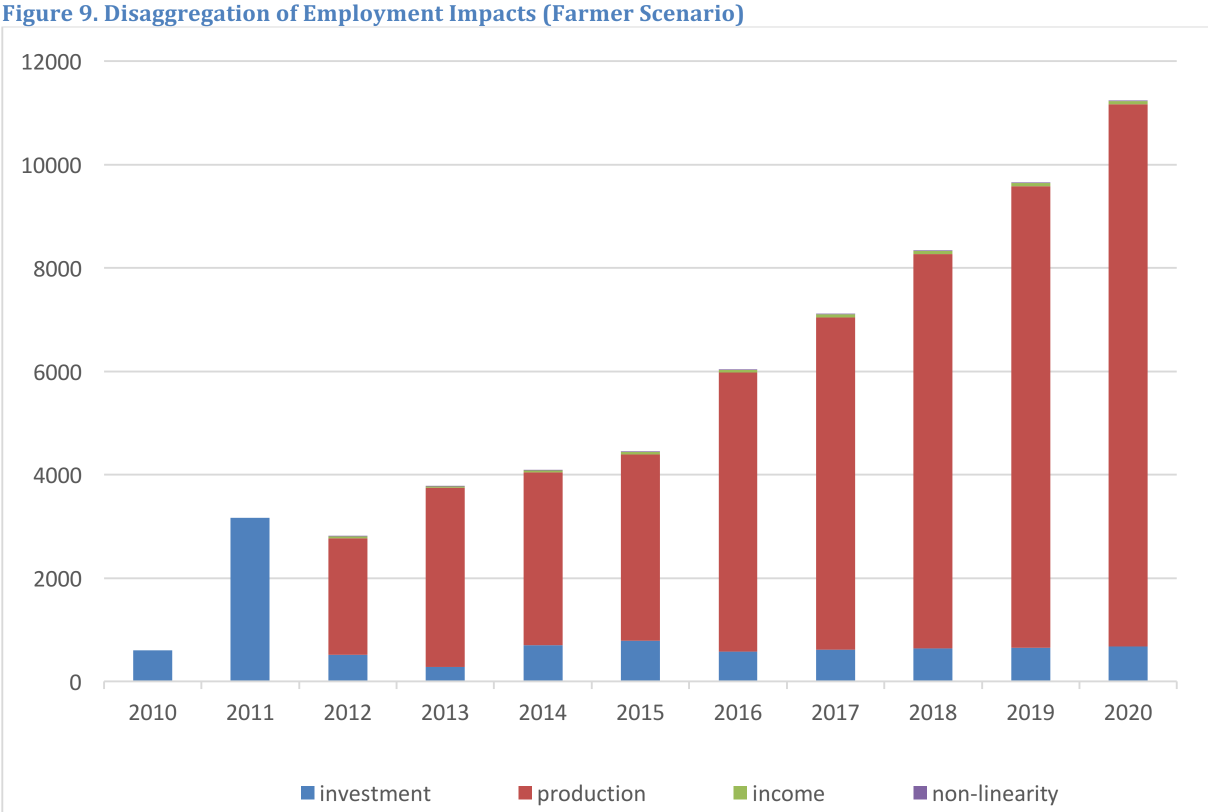


Figure 9. Disaggregation of Employment Impacts (Farmer Scenario)



Appendix 1. Hétfa-CGE model of the Hungarian Economy

We apply a dynamic CGE model to estimating the impact of Pannonia Ethanol on the Hungarian economy. The core of the model is a standard, static CGE model which has been modified for the purpose of this analysis in the following aspects:

1. Firms utilize three primary factors in production, namely skilled and unskilled labor and capital. However, unlike in a standard CGE model, in our application capital is not mobile across sectors. Capital is given by past investment and depreciation in each sector, only the labor input is free to adjust to the shocks.
2. The market for skilled labor is modelled following efficiency wage theories, which make it possible to simulate the impact on (involuntary) unemployment, as well. The market for unskilled workers is modelled by assuming minimum (real) wages.
3. Recursive dynamics have been added to follow how investment decisions influence the path of capital.

Finally, 10 sectors (and therefore 10 products) have been distinguished by the application, these are (1) agriculture, (2) manufacturing, (3) chemistry, (4) energy, (5) water, (6) construction, (7) trade, (8) logistics, (9) services and (10) public services. Construction, water and public services are non-tradable, the other industries are tradable.

The core CGE model

The core of the CGE model is a set of static equations describing the behavior of the agents, namely their decisions about consuming or producing goods and services. As a result of their decisions, the flows are completely determined and influence the time path of the stock variables as it is shown in the section on dynamics.

Household behavior

The representative household shares its income between savings and consumption. The primary income of the household equals the income generated in production, since the household is the only owner of factors of production. It pays tax on the income of primary factors of production, and furthermore, it receives a transfer from the government. In the static CGE framework savings are exogenous; however, in our application the savings rate is driven by the past real interest rate. Disposable household income is therefore given as the difference of primary income and savings, transfers and taxes. We assume that labor supply is given by the value of the initial year. Therefore, household decisions focus on the basket structure of consumption. The utility level of aggregate consumption is a CES aggregate of all goods.

Production block

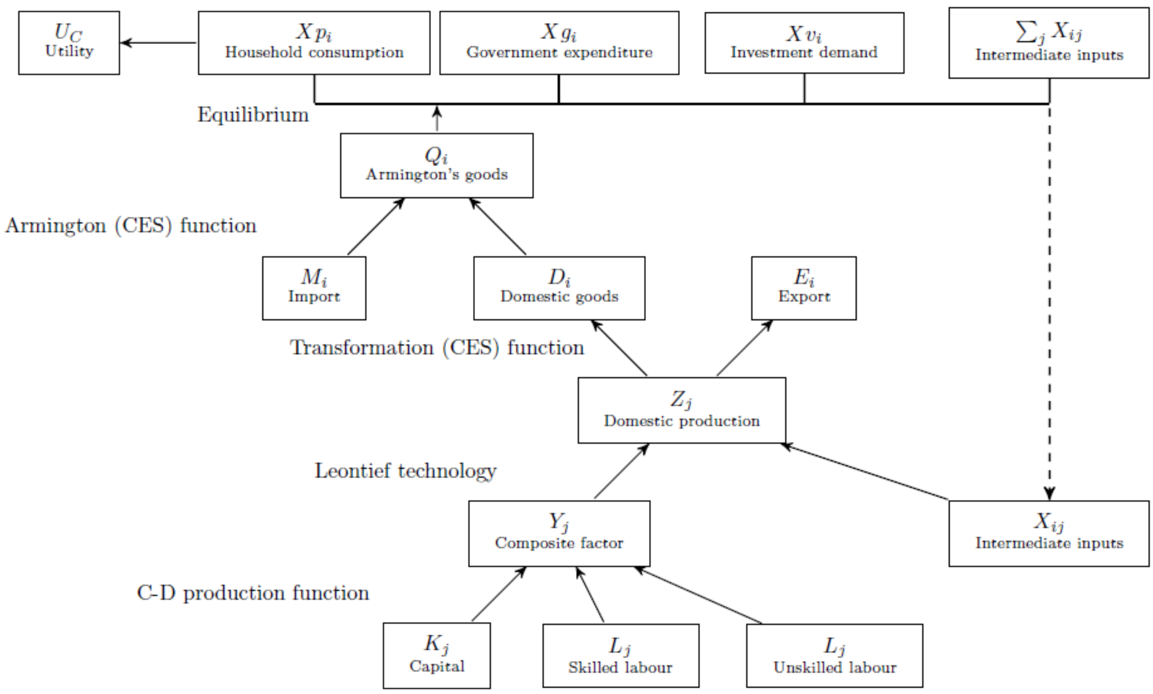
The relationships between factors of production and the goods produced follow the structure of standard CGE models. Therefore, the products of different sectors are used for intermediate inputs and for final use, as well. The structure of the relationships is shown in Figure 10.

1. First, primary factors of production (capital, skilled and unskilled labor) are aggregated to a composite factor of production using the Cobb-Douglas production function. Thus, the elasticity of substitution between labor and capital is assumed to be unity.

2. The domestic supply of goods is produced using the composite factor and intermediate inputs for production. We assume Leontief technology at this level. Therefore, both the composite factor and the intermediate inputs are used in fixed shares in the production of goods.
3. Domestic output is sold both at home and abroad. The usual transformation function is used to split domestic production between domestic sales and exports. The transformation function utilizes the price differences between domestic sales and foreign sales, and it assumes final elasticity of substitution, thus avoiding perfect specialization.
4. The goods finally consumed are either produced domestically or imported. Goods for final use are aggregated by Armington's aggregation functions from domestic goods and import goods. This method is similar to the transformation function approach: by introducing final price elasticities, domestic and foreign goods are considered as not perfect substitutes to each other.
5. The composition of domestic demand is the following: private consumption, government expenditure, investment demand and intermediate inputs.

Technically, the production decision is modelled in a nested structure. Firms take the prices of inputs and the prices of their products as given at every decision level. At the first level, firms use primary factors of production (labor and capital) to obtain the composite factor. The technology of production is described by a CES production function. The demand of the different sectors for primary inputs can be derived from the profit maximization of the firms. At the second level, firms produce their goods from the composite factor of production and intermediate inputs. At this level aggregation is modelled by Leontief technology, assuming that the composite factor and the intermediate inputs are used at fixed ratios in production. The demand function of factors and the supply function of products are derived from the profit maximization decisions.

Figure 10. Production and use of goods in tradable industries



It is assumed that the amount of capital is given by past decisions on investment and depreciation (however, the whole process is completely exogenous). Therefore, there is no market for capital in the model. The income share of the capital is modelled as gross operating profit and is given to the households, it forms part of their primary income.

Foreign trade is modelled assuming that Hungary is a small, open economy. Therefore, by assumption the world price of export and import goods are exogenous and given in foreign currency. The foreign savings is also expressed in foreign currency.

Goods produced domestically and imported goods are not perfect substitutes; therefore, it is important to define composite goods that express the relationship between domestic and imported goods. Therefore, for tradable goods, the so-called Armington aggregation functions are used, where a parameter shows the substitutability of foreign and domestic goods. From these functions demand for domestic and imported goods can be derived.

Domestic goods are either consumed in the country or are exported. These two types of use are expressed by a transformation aggregation function where the elasticity of substitution is described by a parameter. The domestic supply and the supply for exports can be derived from this function.

Government

Government income is determined endogenously, while the real expenditures are exogenous. Government income comes from two parts: indirect taxes stemming from the use of products and direct taxes levied on the primary factors of production. Expenditures of the government are governmental consumption and transfers paid to households. The primary balance of the budget is the difference of the incomes and expenditures, whch is expressed as a percentage of GDP.

Labor market

In standard CGE models labor markets and other markets clear due to the adjustment of the real wage, and thus unemployment occurs only voluntarily. However, in the last decades several ways of modelling labor market rigidities were implemented in the CGE framework; for an excellent summary of these methods see Boeters & Savard (2012). In the present model, labor market rigidities are introduced following efficient wage theory.

In the efficient wage model, the equilibrium wage is determined as the intersection of the labor demand curve and the wage curve. Since this wage level is not necessarily the one where labor supply and demand are equal, there is an oversupply of labor in the market; thus, there is unemployment. The wage curve is the result of an incentive situation stemming from the information asymmetry between employers and employees. The firm wants to determine a wage at which workers are incentivized to work hard; therefore, the utilities of workers from working must be at least the utility from shirking. The parameterization of the labor market follows Boeters & Savard (2012).

For unskilled labor, we assume that there is a special form of wage rigidity on the market. The real wage of unskilled labor can not go below the initial level. As there has been a remarkable increase in the (nominal value of the) minimum wage in Hungary between 2010 and 2015, we calculated the actual increase in the real value of the minimum wage. It is assumed that the employment of unskilled labor is completely determined by the demand for unskilled labor as long as there is unemployment and the real wage remains at the minimum level.

Market equilibrium

As the present model has a general equilibrium framework, equilibrium must hold in all markets; therefore, total consumption of every tradable good must be equal to the sum of the supplies of the import and domestic production. As for non-tradable goods, domestic supply must equal to domestic demand. The trade balance and the balance of the capital account add up to determine savings of the rest of the world. The investment-savings balance holds as domestic investment can only be financed from domestic savings and foreign savings.

Equilibrium must hold in the market of production factors, as well. However, in the labor market it means that the difference between labor demand (as is defined by the sum of sectoral labor demand) and the labor supply (from household utility maximization) defines unemployment. However, this unemployment rate must be consistent with the wage specified by the wage curve.

Closure rule

The macroeconomic aggregates of a static CGE model are not fully determined. As it is usual in this modelling environment, a so-called “closure rule” is applied. The closure rule entails identifying which macroeconomic variable is considered as being exogenous in order to fully specify the macro level of the model. In our application, the investment-driven closure rule is applied. We assume that the model simulations aim at measuring the impact of a short-run event without having any significant impact on future plans, including investment. Therefore, (sectoral) investment demands are taken as exogenous.

The numeraire is the real exchange rate. By using this usual small country assumption we suppose that the shock has no overall impact on the real exchange rate. Moreover, by assuming exogenous world prices for the export and import goods, the prices of foreign goods in domestic currency is completely exogenous. This assumption means that the supply of foreign goods is fully flexible and given in any amount at any domestic prices.

Dynamics

The characteristics of the system described above determine the static equilibrium of the model. However, for describing the time path of the economy, dynamics should be added. Dynamics of a model can either be forward-looking or backward-looking. In the present model recursive dynamic relationships are used; therefore, past and present values determine the initial values of the next period.

These recursive relationships are the following: (1) capital stock increases with investments and decreases due to depreciation. (2) Net foreign debt of the country is the debt of the previous period increased by payable interests and decreased by redemption, which is expressed by the balance of trade of the country. Real interest rates are determined by the foreign real interest rate. Risk premium related to the debt of the country is a nonlinear function of the indebtedness of the country, and is modelled by a so called linex function that punishes high indebtedness strongly. The household savings rate is exogenous; however, it may change in time due to the changes in the real interest rate. In this model it is assumed that the lagged value of the real interest rate affects the household savings rate.

Appendix 2. Tables.

A2.1 Base scenario

Table 6. GDP Impact (m€)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Direct impact	0	0	9.7	18.3	12.7	38.5	66.9	66.9	66.9	66.9	66.9	413.6
Indirect impact	19.5	101.6	37.5	57.4	82.7	88.5	69.3	73.8	77.3	80.9	85.3	773.8
Total impact	19.5	101.6	47.2	75.7	95.4	126.9	136.2	140.7	144.2	147.8	152.2	1187.4

Table 7. Employment Impact (persons)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Direct impact	1	8	94	103	112	147	147	147	147	147	147
Indirect impact	572	2954	866	1061	1489	1590	1067	1122	1165	1209	1268
Total impact	573	2962	960	1164	1601	1737	1214	1269	1312	1356	1415

Table 8. Budget Impact (m€)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Direct impact	0.03	0.26	2.23	2.98	2.58	5.69	7.53	7.53	7.53	7.53	7.53	51.42
Indirect impact	6.33	33.03	9.27	12.01	17.84	19.21	11.78	12.63	13.31	13.68	14.21	163.29
Total impact	6.35	33.29	11.50	14.99	20.42	24.90	19.31	20.16	20.84	21.21	21.74	214.72

Table 9. Output Impact (m€)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
agriculture	-0.3	-1.3	9.3	13.0	11.4	13.0	21.7	22.3	22.8	23.1	23.5	158.5
manufacturing	31.3	164.1	50.2	62.5	90.6	103.7	63.2	66.8	69.6	72.2	75.5	849.7
services	6.9	35.0	18.9	42.9	58.8	57.5	55.4	58.4	60.7	63.5	66.9	524.9
trade	2.5	12.9	4.7	7.2	10.4	11.5	9.1	10.0	10.7	11.4	12.3	102.8

Table 10. Value Added Impact (m€)

Income by sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
agriculture	-0.4	-2.3	5.5	7.5	6.2	7.2	13.2	13.6	13.9	14.1	14.3	92.8
manufacturing	10.8	56.7	15.3	16.2	26.4	30.4	14.8	15.7	16.4	17.0	17.8	237.6
services	3.7	18.5	8.9	22.9	33.0	32.2	30.0	32.2	33.9	35.8	38.2	289.3
trade	1.1	5.9	1.7	2.4	3.9	4.6	3.0	3.5	3.9	4.3	4.8	39.2

Table 11. Sector Employment Impact (persons)

Employment by sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
agriculture	-17	-86	134	176	132	150	297	303	309	311	313
manufacturing	589	3059	624	492	892	1049	262	283	298	313	335
services	-36	-199	74	371	420	325	487	501	513	528	549
trade	35	181	35	21	44	66	22	34	45	56	70

Table 12. Sector Additional Demand, simulation parameters

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Investment demand (m€)												
Construction	7.6	39.6	7.4	3.7	8.5	9.6	0	0	0	0	0	76.34
Manufacturing	7.6	39.6	7.4	3.7	8.5	9.6	0	0	0	0	0	76.34
Intermediate materials for production (m€)												
Agriculture	0	0	57.9	80.5	69.5	77.9	123.5	123.5	123.5	123.5	123.5	903.4
Chemistry	0	0	2.1	9.3	8.0	11.7	6.7	6.7	6.7	6.7	6.7	64.7
Energy	0	0	11.0	16.0	15.8	15.9	23.7	23.7	23.7	23.7	23.7	177.2
Logistics	0	0	4.6	7.2	7.2	7.1	10.1	10.1	10.1	10.1	10.1	76.5
Additional demand from salaries (m€)	0	0	1.2	1.3	1.4	2.0	2.5	2.5	2.5	2.5	2.5	18.2
Total demand shock (m€)	15.1	79.3	91.6	121.6	118.8	133.8	166.5	166.5	166.5	166.5	166.5	1392.7
as % of GDP	0.023	0.119	0.118	0.169	0.172	0.184	0.214	0.210	0.207	0.204	0.201	

Table 13. Crowding Out Effect (m€)

Crowding out effect	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
1. Extra demand of Pannonia Ethanol	19.7	102.5	98.7	144.6	155.7	168.6	195.0	197.4	199.5	200.9	202.5	1685.1
Impact on												
2. consumption	6.6	34.1	13.6	22.7	32.2	34.7	30.5	33.9	36.5	39.5	43.5	327.6
3. investment	0	0	0	0	0	0	0	0	0	0	0	0
4. government expenditure	2.5	13.1	5.5	9.7	14.8	15.9	12.9	13.7	14.4	15.3	16.6	134.5
5. export	3.4	17.6	-37.0	-54.0	-42.9	-43.2	-78.6	-74.7	-71.4	-69.2	-66.8	-516.9
6. import	12.6	65.7	43.1	65.7	77.0	87.6	90.4	96.5	101.6	105.7	110.4	856.6
7. trade balance (5.-6.)	-9.3	-48.2	-80.2	-119.7	-120.0	-130.8	-169.0	-171.2	-173.0	-174.9	-177.2	-1373.5
Total indirect impact on GDP (1.+2.+3.+4.+7.)	19.5	101.6	37.5	57.4	82.7	88.5	69.3	73.8	77.3	80.9	85.3	773.8

A2.2 Investment Scenario

Table 14. GDP Impact (m€)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Direct impact	0	0	9.7	18.3	12.7	38.5	66.9	74.8	83.7	93.8	105.2	503.5
Indirect impact	19.5	101.6	37.5	57.4	82.7	88.5	91.6	105.7	120.5	136.8	156.4	998.3
Total impact	19.5	101.6	47.2	75.7	95.4	126.9	158.5	180.5	204.2	230.6	261.6	1501.8

Table 15. Employment Impact (persons)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Direct impact	1	8	94	103	112	147	147	147	147	147	147
Indirect impact	572	2954	866	1061	1489	1590	1586	1789	2002	2231	2509
Total impact	573	2962	960	1164	1601	1737	1733	1936	2149	2378	2656

Table 16. Budget Impact (m€)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Direct impact	0.03	0.26	2.23	2.98	2.58	5.69	7.53	8.13	8.80	9.56	10.41	58.19
Indirect impact	6.33	33.03	9.27	12.01	17.84	19.21	18.42	20.96	23.61	25.97	28.77	215.41
Total impact	6.35	33.29	11.50	14.99	20.42	24.90	25.95	29.09	32.41	35.52	39.18	273.61

Table 17. Output Impact (m€)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
agriculture	-0.3	-1.3	9.3	13.0	11.4	13.0	21.4	25.0	28.9	33.3	38.2	191.9
manufacturing	31.3	164.1	50.2	62.5	90.6	103.7	96.6	109.2	122.2	135.9	152.2	1118.4
services	6.9	35.0	18.9	42.9	58.8	57.5	63.3	73.4	84.1	96.6	111.6	649.1
trade	2.5	12.9	4.7	7.2	10.4	11.5	11.9	13.9	16.1	18.4	21.3	130.7

Table 18. Value Added Impact (m€)

Income by sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
agriculture	-0.4	-2.3	5.5	7.5	6.2	7.2	12.7	14.9	17.4	20.1	23.2	112.2
manufacturing	10.8	56.7	15.3	16.2	26.4	30.4	27.1	30.4	33.6	36.9	40.8	324.7
services	3.7	18.5	8.9	22.9	33.0	32.2	34.5	40.6	47.0	54.5	63.6	359.5
trade	1.1	5.9	1.7	2.4	3.9	4.6	4.4	5.3	6.2	7.2	8.4	51.1

Table 19. Sector Employment Impact (persons)

Employment by sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
agriculture	-17	-86	134	176	132	150	282	329	382	440	505
manufacturing	589	3059	624	492	892	1049	816	887	955	1018	1095
services	-36	-199	74	371	420	325	437	508	587	680	794
trade	35	181	35	21	44	66	52	65	78	93	115

Table 20. Sector Additional Demand, simulation parameters

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Investment demand (m€)												
Construction	7.6	39.6	7.4	3.7	8.5	9.6	7	7	7	7	7	111.66
Manufacturing	7.6	39.6	7.4	3.7	8.5	9.6	7	7	7	7	7	111.66
Intermediate materials for production (m€)												
Agriculture	0	0	57.9	80.5	69.5	77.9	123.5	139.5	157.5	177.9	201.0	1085.3
Chemistry	0	0	2.1	9.3	8.0	11.7	6.7	7.6	8.6	9.7	11.0	74.6
Energy	0	0	11.0	16.0	15.8	15.9	23.7	26.8	30.2	34.1	38.5	212.1
Logistics	0	0	4.6	7.2	7.2	7.1	10.1	11.4	12.9	14.5	16.4	91.4
Additional demand from salaries (m€)	0	0	1.2	1.3	1.4	2.0	2.5	2.5	2.5	2.5	2.5	18.2
Total demand shock (m€)	15.1	79.3	91.6	121.6	118.8	133.8	180.6	201.9	225.8	252.9	283.5	1704.9
as % of GDP	0.023	0.119	0.118	0.169	0.172	0.184	0.237	0.260	0.286	0.316	0.348	

Table 21. Crowding Out Effect (mu)

Crowding out effect	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
1. Extra demand of Pannonia Ethanol	19.7	102.5	98.7	144.6	155.7	168.6	215.9	244.3	275.9	310.6	350.0	2086.6
Impact on												
2. consumption	6.6	34.1	13.6	22.7	32.2	34.7	38.1	45.3	52.5	60.9	71.5	412.0
3. investment	0	0	0	0	0	0	0	0	0	0	0	0
4. government expenditure	2.5	13.1	5.5	9.7	14.8	15.9	16.1	18.7	21.4	24.9	29.2	172.0
5. export	3.4	17.6	-37.0	-54.0	-42.9	-43.2	-75.5	-81.1	-87.5	-95.6	-104.1	-600.0
6. import	12.6	65.7	43.1	65.7	77.0	87.6	103.0	121.5	141.8	164.0	190.2	1072.3
7. trade balance (5.-6.)	-9.3	-48.2	-80.2	-119.7	-120.0	-130.8	-178.6	-202.6	-229.3	-259.5	-294.2	-1672.3
Total indirect impact on GDP (1.+2.+3.+4.+7.)	19.5	101.6	37.5	57.4	82.7	88.5	91.6	105.7	120.5	136.8	156.4	998.3

A2.3 Farmer Scenario

Table 22. GDP Impact (m€)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Direct impact	0	0	9.7	18.3	12.7	38.5	66.9	74.8	83.7	93.8	105.2	503.5
Indirect impact	21.1	111.5	133.0	198.8	227.8	253.4	347.3	415.8	493.2	577.7	679.0	3458.4
Total impact	21.1	111.5	142.7	217.1	240.4	291.8	414.2	490.6	576.9	671.5	784.2	3961.9

Table 23. Employment Impact (persons)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Direct impact	1	8	94	103	112	147	147	147	147	147	147
Indirect impact	606	3171	2805	3780	4080	4446	6037	7111	8335	9656	11240
Total impact	607	3179	2899	3883	4192	4593	6184	7258	8482	9803	11387

Table 24. Budget Impact (m€)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Direct impact	0.03	0.26	2.23	2.98	2.58	5.69	7.53	8.13	8.80	9.56	10.41	58.19
Indirect impact	6.42	33.93	14.39	19.65	26.26	28.64	33.38	40.23	47.99	54.51	62.30	367.71
Total impact	6.44	34.19	16.62	22.64	28.85	34.33	40.91	48.36	56.79	64.06	72.72	425.90

Table 25. Output Impact (m€)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
agriculture	1.8	10.3	139.1	199.6	189.3	212.5	337.0	399.7	471.2	548.9	640.3	3149.7
manufacturing	32.2	171.4	105.2	146.0	181.1	206.7	253.9	302.8	357.4	414.5	482.9	2654.1
services	7.5	38.9	55.1	97.0	115.9	123.2	163.4	194.7	230.0	270.4	319.1	1615.2
trade	2.7	14.3	18.1	26.8	30.3	34.3	47.2	56.5	67.1	78.7	92.5	468.5

Table 26. Value Added Impact (m€)

Income by sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
agriculture	0.9	5.5	93.3	133.9	127.0	142.6	227.7	271.1	320.7	374.5	438.0	2135.1
manufacturing	10.7	56.8	9.1	8.8	22.7	26.8	19.4	23.1	26.8	30.1	34.3	268.6
services	4.0	20.3	25.2	47.9	61.2	64.9	83.6	101.3	121.2	144.2	172.4	846.3
trade	1.2	6.4	5.9	8.7	10.7	12.5	16.4	20.0	24.1	28.5	33.9	168.3

Table 27. Sector Employment Impact (persons)

Employment by sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
agriculture	21	125	2386	3312	2994	3290	5286	6231	7309	8470	9824
manufacturing	582	3042	120	-169	392	511	-109	-137	-181	-248	-306
services	-35	-193	131	433	477	387	515	607	721	862	1043
trade	38	196	168	203	217	258	345	410	486	571	678

Table 28. Sector Additional Demand, simulation parameters

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Investment demand (m€)												
Construction	7.6	39.9	7.4	3.7	8.6	9.7	7	7	7	7	7	112.65
Manufacturing	7.6	39.9	7.4	3.7	8.6	9.7	7	7	7	7	7	112.65
Intermediate materials for production (m€)												
Agriculture	0	0	58.1	81.1	70.4	79.0	125.2	141.4	159.6	180.3	203.6	1098.6
Chemistry	0	0	2.1	9.3	8.1	11.9	6.8	7.7	8.7	9.8	11.1	75.5
Energy	0	0	11.1	16.2	16.0	16.1	24.0	27.1	30.6	34.6	39.1	214.7
Logistics	0	0	4.7	7.2	7.2	7.2	10.2	11.6	13.1	14.7	16.6	92.5
Additional demand from salaries (m€)	0	0	1.2	1.3	1.5	2.0	2.5	2.5	2.5	2.5	2.5	18.5
Total demand shock (m€)	15.1	79.7	92.0	122.4	120.3	135.6	183.0	204.6	228.9	256.3	287.3	1725.2
as % of GDP	0.023	0.121	0.141	0.205	0.213	0.229	0.310	0.352	0.400	0.451	0.509	

Table 29. Crowding-out effect (m€)

Crowding out effect	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
1. Extra demand of Pannonia Ethanol	19.9	105.2	118.3	176.4	195.1	213.2	285.9	336.4	393.4	453.8	524.5	2822.1
Impact on												
2. consumption	7.6	40.3	66.7	99.9	109.5	122.7	175.7	210.8	251.0	295.5	349.4	1729.0
3. investment	0	0	0	0	0	0	0	0	0	0	0	0
4. government expenditure	2.7	14.4	16.9	27.6	34.9	39.3	50.9	61.1	72.3	86.5	103.8	510.6
5. export	3.4	17.9	-35.5	-51.9	-41.7	-41.6	-77.1	-86.4	-97.8	-111.2	-126.3	-648.1
6. import	12.6	66.3	33.4	53.4	70.0	80.3	88.2	106.0	125.7	146.9	172.5	955.3
7. trade balance (5.-6.)	-9.2	-48.4	-68.9	-105.2	-111.8	-121.9	-165.2	-192.4	-223.6	-258.1	-298.8	-1603.4
Total indirect impact on GDP (1.+2.+3.+4.+7.)	21.1	111.5	133.0	198.8	227.8	253.4	347.3	415.8	493.2	577.7	679.0	3458.4