



# Labour Supply Curves for EU Member and Candidate States

## An applied general equilibrium analysis

### ABSTRACT

This paper introduces a more sophisticated modelling of the labour market functioning of the European member and candidate states through the introduction of labour supply curves in an applied general equilibrium model. A labour supply curve offers a middle way in labour supply modelling, sitting between the two commonly adopted extremes of spare capacity and full employment. The first part of the paper outlines the theoretical foundation of the labour supply curve. Real world data is then used to derive labour supply curves for each member state, along with Croatia and Turkey. Finally, the impact of the newly specified labour markets on the results of an illustrative scenario involving reform of the common agricultural policy is explored. The results of computable general equilibrium analysis with the labour supply curve confirm the theoretical expectation that modelling the labour supply through an upwards-sloping curve produces results that lie between the extremes of spare capacity of the labour factor and fully employed labour. This specification captures a greater degree of heterogeneity in the labour markets of the member and candidate states, allowing for a more nuanced modelling of the effects of policy reform, including welfare effects.

FACTOR MARKETS Working Papers present work being conducted within the FACTOR MARKETS research project, which analyses and compares the functioning of factor markets for agriculture in the member states, candidate countries and the EU as a whole, with a view to stimulating reactions from other experts in the field. See the back cover for more information on the project. Unless otherwise indicated, the views expressed are attributable only to the author in a personal capacity and not to any institution with which she is associated.

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# **Labour Supply Curves for EU Member and Candidate States**

## **An applied general equilibrium analysis**

**Lindsay Shutes\***

**Factor Markets Working Paper No. 26/June 2012**

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### **1. Introduction**

The supply of labour endowments is often taken to be exogenous in computable general equilibrium (CGE) models, that is, determined outside the system by such factors as population growth. While this may be true in the longer term, in the shorter term the supply of labour to the market is influenced by the real wage. Higher wages increase the opportunity cost of being economically inactive and induce people to enter the labour force, while lower wages reduce the opportunity cost and lead to lower participation rates.

The relationship between real wages and labour supply is often modelled at the extremes in CGE modelling: either by assuming that firms can employ more workers with no impact on the wage rate (to reflect spare capacity) or by assuming that all extra demand for labour is translated into higher wages (reflecting full employment of labour). Given the more nuanced relationship between wages and the labour supply as detailed above, a middle way is required. A labour supply curve offers such a way as it defines a relationship between real wages and employment based upon the proximity of current demand levels to the maximum amount of labour available within an economy.

This paper presents the theoretical and empirical foundations of labour supply curves for the member and candidate states and their introduction to the MAGNET CGE model (formerly known as LEITAP). The paper begins with the theoretical specification of the labour supply curve and its properties. Labour supply curves are then derived for each country using real world data. An illustrative application of the new labour supply curves to reform of the common agricultural policy (CAP) is introduced in section 4, followed by the results of the scenarios. The results of a sensitivity analysis of the parameters of the labour supply curve are also presented in the penultimate section, with conclusions and future work outlined in section 5.

This paper forms deliverable 13.2 of the Factor Markets project entitled “First results of the extended LEITAP model, with actual data from WPs 11 and 12”. As indicated by the title, the original mandate for this study included the integration of actual data on the drivers of farm labour use (work package 11) and the effects of labour use in the agricultural sector (work package 12). Two challenges arise from this specification. First, the general nature of CGE models leads to demanding data requirements such that any new feature of the European labour market added to the model should be specified for all countries, an approach that is often inconsistent with more micro-level analysis like case studies. Second, the timing of the delivery of output from the two work packages is inconsistent with that of this paper, with the first output from work packages 11 and 12 not due until December 2012.

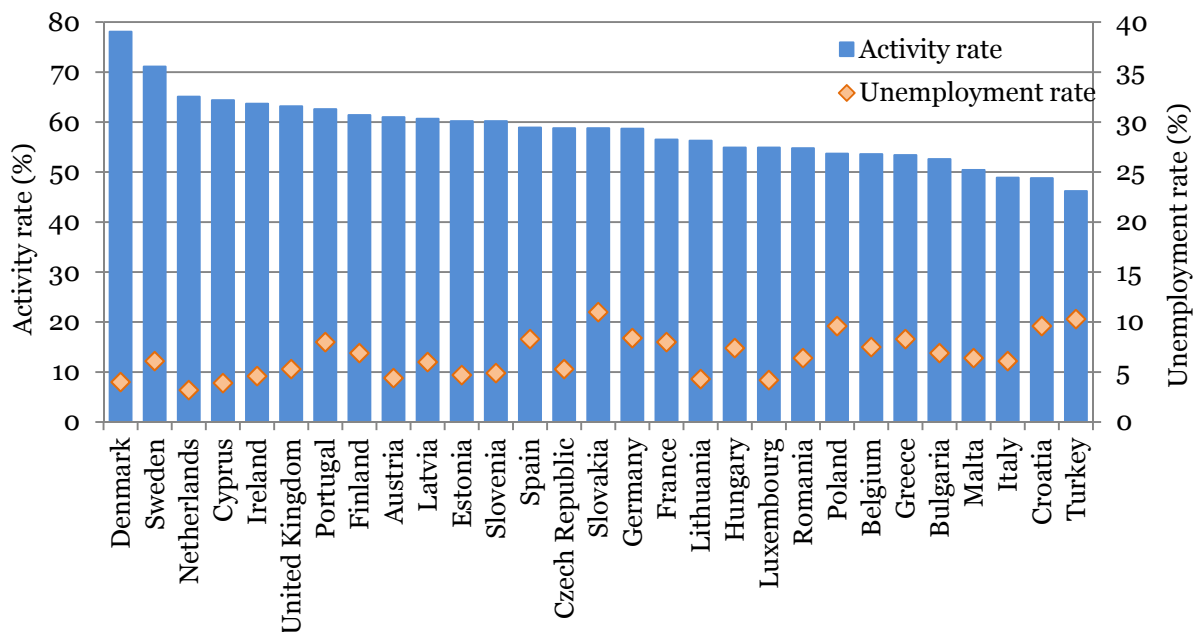
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## 2. Extending the modelling of the labour supply

An initial inspection of labour data for the EU indicates heterogeneous labour markets. Activity and unemployment rates vary greatly across the member and candidate states as shown in Figure 1. The activity rate is defined as the proportion of the working-age population who are in or who are actively seeking employment. Denmark had the highest activity rate in 2007 with 78.1% of the population economically active compared with only 46.2% in Turkey. There are also variations in the unemployment rate, defined as the share of the labour force not in employment, with only 3.2% of the Dutch over-15 population unemployed in 2007 but 11% of Slovenians. The two candidate countries included in the analysis, Croatia and Turkey, have the two lowest activity rates and among the highest unemployment rates (9.6% and 10.3% respectively). There also appears to be a broadly negative relationship between the activity rate and the unemployment rate, with countries that have the highest activity rates also having the lowest unemployment rates. The data are presented for 2007, as this is the base year of the MAGNET model and therefore the starting point for the general equilibrium analysis; clearly the European labour market position, particularly with regards to unemployment, will have changed in more recent years.

Figure 1. Activity and unemployment rates in the member and candidate states (2007)



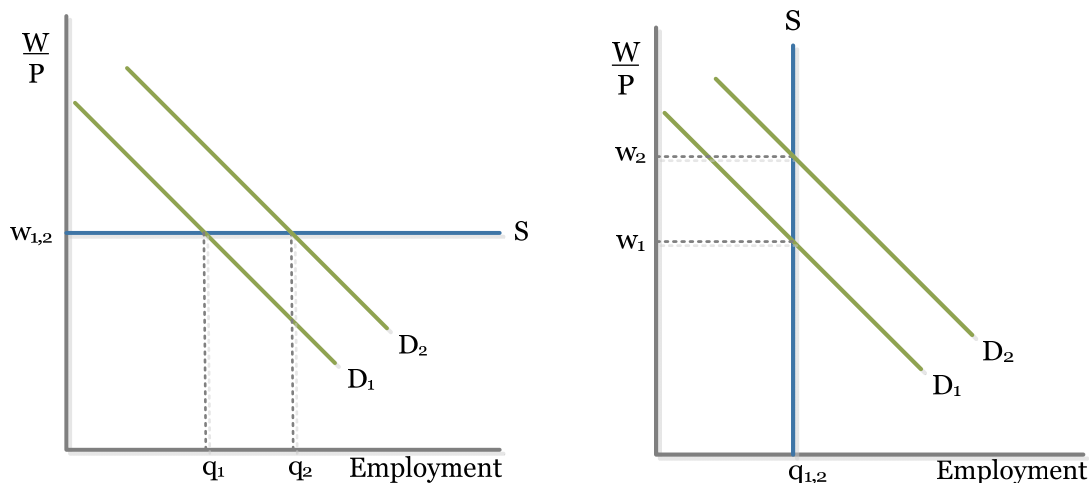
Source: ILO Labour Statistics.

As discussed in Shutes et al. (2012), the modelling of labour markets in the MAGNET model does not fully capture the heterogeneous nature of labour markets across the European member and candidate states. Shutes et al. provide an overview of possible extensions to labour market modelling in MAGNET, drawn from developments in existing global and national CGE models, to assist with the selection of an extension to better capture labour market functioning across the EU. A labour supply curve is selected as an extension to labour market modelling in MAGNET because it allows the relationship between real wages and employment to be better depicted and captures the differences in this relationship across the member and candidate states. Moreover, such an extension is possible due to the relevant data being available through the Labour Force Surveys of the EU countries.

### 2.1 Current specification

Typically, the relationship between the supply of labour and the real wage is modelled in one of two ways in CGE models. The two specifications operate at the extremes of labour market functioning: either by assuming an infinite supply of workers at a fixed wage or a fixed supply of workers with flexible wages. A visual representation of these two labour market specifications is given in Figure 2. The diagram on the left reflects an assumption of spare capacity in the labour market. A rightwards shift in the demand curve for labour under this assumption is met fully by an increase in the number of workers employed with no impact on the wage rate. The diagram on the right shows the opposite extreme, in which all labour is fully employed and any additional demand is immediately translated into higher wages.

Figure 2. Labour market functioning in standard CGE models

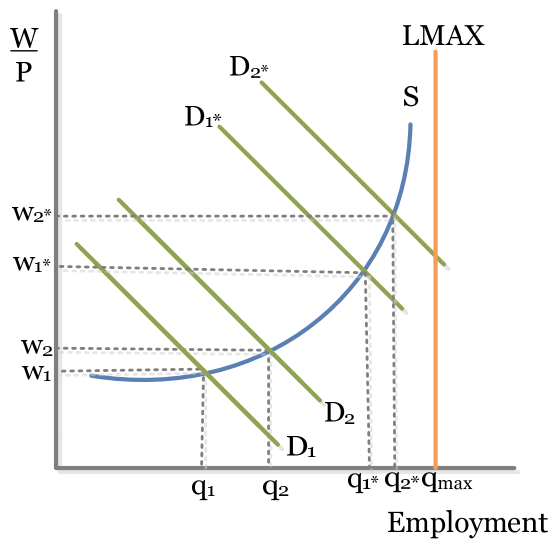


### 2.2 Labour supply curve

The labour supply curve offers an intermediate choice in which increases in the demand for labour increase both the real wage and employment. The extent to which increases in demand are translated into wage increases depends upon the proximity of the current employment level to the total amount of available labour, reflecting the scarcity of labour. The functioning of a labour market with an upwards-sloping labour supply curve is shown in Figure 3. Countries whose current employment levels are relatively far from the maximum available amount of labour (*LMAX*) have labour markets with relatively shallow labour-supply curves while countries with employment levels close to the maximum available amount of labour operate with steeper labour-supply curves to reflect the scarcity of the labour factor.

Defining the relationship between wages and labour supply in this way captures cross-country heterogeneity in the scarcity of labour. This enables the heterogeneous response to the same increase in demand to be captured. As shown in Figure 3, the same increase in demand has different effects for countries that are on the shallower part of the supply curve compared with those on the steeper part. For countries with relative spare capacity in labour, the increase in demand is met by an increase in supply with only a small effect on wages, albeit more than under the strict spare capacity assumption shown in Figure 2. In contrast, the same increase in demand in countries with relatively scarce labour (nearing full employment) leads to only small increases in employment with large increases in the wage needed to attract the additional workers into the labour market.

Figure 3. Labour market functioning under an upwards-sloping labour supply curve



The specification of a labour supply curve for inclusion in the MAGNET CGE model follows that of the land supply curve in van Meijl et al. (2006) and the labour supply curves for minority groups in Berritella (2012):

$$LabourSupply = LMAX + \frac{\beta}{wage^\alpha} \quad (1)$$

where *LabourSupply* is the number of employed workers at the given wage rate, *LMAX* is the total population of working age,  $\beta$  is a negative parameter calibrated on the current level of employment and wages, and  $\alpha$  is the power of the function. The equilibrium wage rate and employment determines the vertical position of the curve while the proximity of the equilibrium employment level to the maximum available number of workers and the power of the function determine the shape of the curve.

### 2.3 Empirical labour-supply curves for the European states

Empirically derived supply curves are presented in this section for the supply of unskilled labour in member states and two of the three candidate countries identified in the project outline: Croatia and Turkey.<sup>1</sup> The curves are derived from 2007 data, as this is the starting year of the MAGNET model.<sup>2</sup> Four sets of data are required to derive the labour supply curve for each country: the labour supply by skill type (employment), the total population of working age by skill type, the real wage and the value of the power of the function ( $\alpha$ ). The value of the  $\beta$  parameter can then be calculated from these values. Employment data for the member and candidate states are extracted from the ILO LabourSta database<sup>3</sup> along with data on the population of working age. Real wages are calculated as the total value of payments to labour divided by the number of employees in each sector.

<sup>1</sup> The Former Yugoslav Republic of Macedonia is part of a large aggregated region called the “Rest of Europe” in the GTAP database that underlies the MAGNET model. Similarly, the newer candidate countries, those accepted since the definition of the project, are also in aggregate regions. Serbia and Montenegro are likewise in the Rest of Europe region and Iceland is combined with Liechtenstein in the rest of EFTA (European Free Trade Association) region.

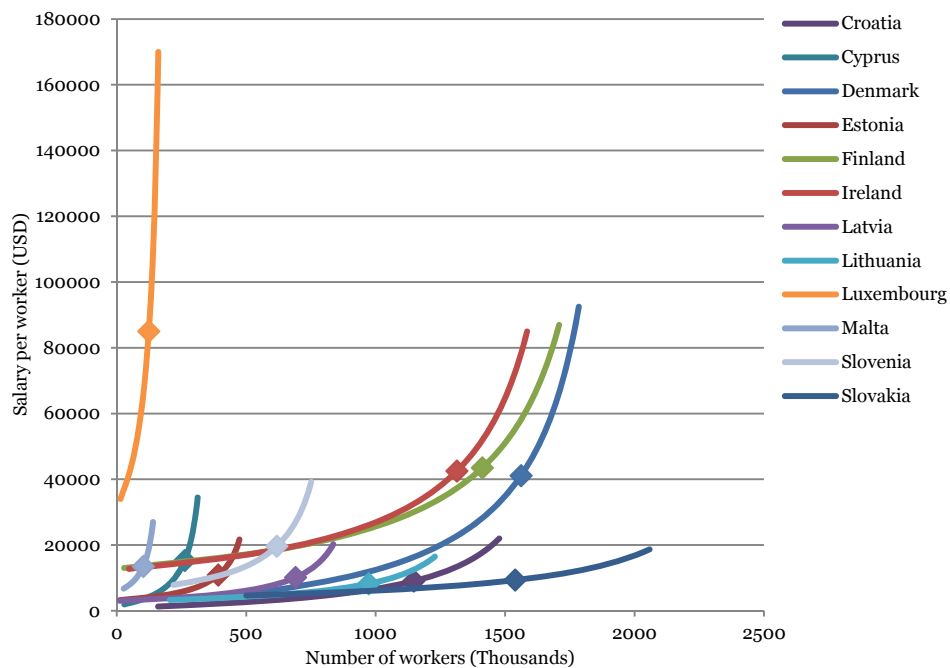
<sup>2</sup> The early base year of the MAGNET model meant that the data could not be drawn from the project’s labour market questionnaire, which includes data for more recent years.

<sup>3</sup> The download date was 2.5.2012.

The specification of labour supply curves by skill type requires the employed and working-age populations to be identified by skill type. The ILO dataset includes employment by occupation group and labour force by occupation group; however, both of these datasets are incomplete. In order to allocate all workers to either the skilled or unskilled category, the share of known skilled and unskilled labour in total employment is applied to all uncategorised workers.<sup>4</sup> The split of the total population of working age into skilled and unskilled workers in the total population of working age is taken from the occupational classification of the labour force. To the extent that the skills profile of the economically inactive differs from that of the economically active, this will be inaccurate. One area for further work is therefore to improve the skills profile of the economically inactive using information on educational attainment.

Calibrating the labour supply function of unskilled labour (1) with data for the member and candidate states yields labour supply curves for each country, grouped by size of country in Figures 4 to 6.<sup>5</sup> Each curve is shown for a range of wage rates of between 30% of the equilibrium wage and twice the equilibrium wage. Plotting the curves in this way displays the portion of the curve around the 2007 equilibrium position. The number of people employed in 2007 in each country is indicated on the curves with a diamond-shaped marker. The set of supply curves is calibrated based on the assumption that the power of the function ( $\alpha$ ) is equal to one – an assumption that is retained for the illustrative scenarios in the following sections but varied in the sensitivity analysis in section 4.2.

Figure 4. Labour supply curves for small European member and candidate states



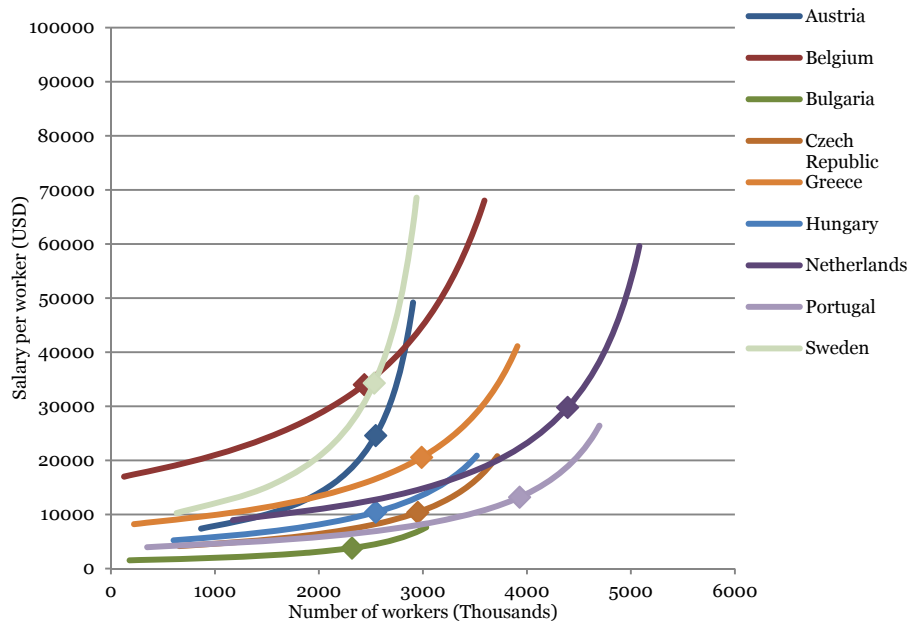
<sup>4</sup> The skilled labour category used in the GTAP database corresponds to ILO categories 1-3 containing managers and administrators, professionals, and para-professionals. The unskilled category corresponds to ILO categories 4-9, which includes tradespersons, clerks, salespersons and personal service workers, plant and machine operators and drivers, labourers and related workers, and farm workers (Dimaranan & Narayanan, 2007). The armed forces are currently allocated to the unskilled labour group although this could easily be revised if more data become available.

<sup>5</sup> In this context, ‘small’ countries have a working-age population of fewer than 2.5 million, ‘medium’ countries have between 2.5 million and 5 million members of working age, and ‘large’ countries more than 5 million.

Among the small European countries, the new member states have systematically lower wages than the EU-15 countries. The vast majority of the smaller European countries are constrained in the supply of unskilled labour as shown by the strong upwards slope of the curves. The exceptions to this are Slovakia, Croatia and Lithuania, which are on the flatter part of the curve indicating that only small increases in the wage would be needed to bring about an increase in the supply of unskilled workers. The clear outlier of this group of small countries is Luxembourg, which has a high equilibrium wage but also near full employment of the working-age population. Very large increases in wages are therefore needed to induce even small increases in the labour supply.

A similar although less pronounced pattern can be observed in the empirical labour supply curves of medium-sized European countries as shown in Figure 5. The new member states had lower wages in 2007 than the medium-sized EU-15 countries, with the exception of Portugal. The curves of the new member states are also slightly shallower than those of the older member states. The equilibrium employment points of both Sweden and Austria are near the vertical portion of the labour supply curve, suggesting that increased demand for unskilled labour in these countries would be mainly translated into higher labour prices. The candidate country of Croatia had one of the lowest average wage rates but slightly higher than EU member states Slovakia and Lithuania.

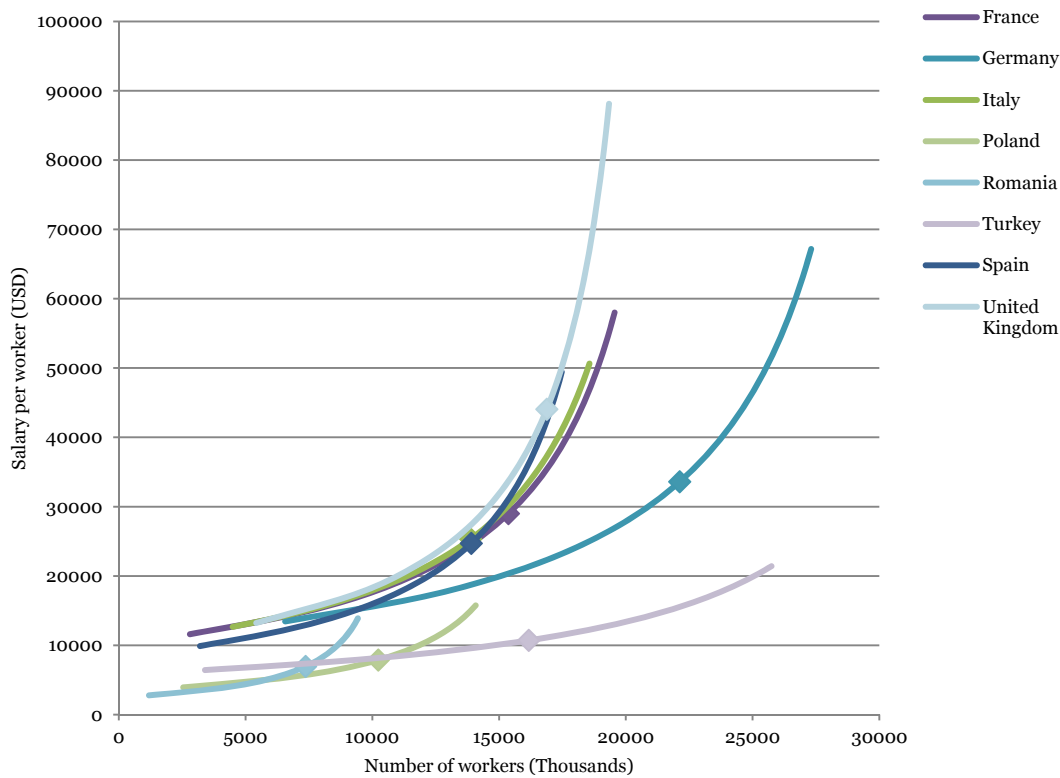
*Figure 5. Labour supply curves for medium European member and candidate states*



The disparity between wage levels among the EU-15 countries and the new and candidate states is even more distinct among the larger European countries. The labour supply curves for the larger countries as shown in Figure 6 are clearly clustered into two groups: the upper group of EU-15 member states with higher wages and steeper labour-supply curves and the lower group of new and candidate member states with lower wage levels and shallower supply curves. This analysis shows a clear difference in the average wage levels of EU-15 and newer member states, and highlights that the market for unskilled labour in the new and candidate states shows some spare capacity while that of the older member states is more closely approaching full employment. As such, an increase in the demand for unskilled labour in the new member states will have less impact on wage rates than the same increase in the EU-15 countries. Interestingly, Turkey had a slightly higher average wage than Poland and Romania in 2007 but was less labour-constrained, as reflected by the shallower supply curve.



Figure 6. Labour supply curves for large European member and candidate states



### 3. Scenarios & model specification

The specification of a labour supply curve for each EU member and candidate state offers an alternative way of modelling the labour supply compared with the two extremes of spare capacity and full employment. This middle way is incorporated into the MAGNET CGE model to improve the degree to which the model can capture the heterogeneous nature of European labour markets. This extension, and its impact on the results of a standard CAP reform scenario, is introduced in this section.

#### 3.1 Scenario specification

The new labour-supply curves are integrated into the MAGNET model and tested with a set of three scenarios to show the effect of changes in the representation of the labour market on the impact of a change in the CAP budget. Specifically, the scenarios are defined as follows:<sup>6</sup>

- scenario 1 ‘spare capacity’ – a 50% reduction in first pillar support to all EU member states under the assumption of spare capacity in the supply of unskilled labour. Skilled labour in all regions as well as unskilled labour in the rest of world region is assumed to be fully employed.

<sup>6</sup> The model ‘closure rules’ that determine the specification of the unskilled labour market in each scenario are the following:

- scenario 1 – endogenous unskilled labour supply (qo) and exogenous unskilled wage (pfactreal);
- scenario 2 – endogenous unskilled labour supply and wages with exogenous asymptote (p\_labasympt); and
- scenario 3 – endogenous unskilled wage with exogenous unskilled labour supply.

- scenario 2 ‘labour supply curve’ – a 50% reduction in first pillar support to all EU member states under the assumption of an upwards-sloping labour supply curve for unskilled labour. Skilled labour in all regions as well as unskilled labour in the rest of world region is assumed to be fully employed.
- scenario 3 ‘full employment’ – a 50% reduction in first pillar support to all EU member states under the assumption of fully employed unskilled labour. Skilled labour in all regions as well as unskilled labour in the rest of world region is also assumed to be fully employed.

The scenarios thus differ only in the specification of the unskilled labour market in the EU with scenario 3. It should be noted that full employment refers to the total use of the factor across the whole economy, rather than sector-specific use. As such, the quantity demanded by sectors may change but any extra labour use must be attracted from other sectors through higher wages. Conversely, any reduction in demand by one sector will increase the availability of labour, lowering wages to ensure that other sectors increase their demand and that all workers are fully employed.

### ***3.2 Model specification***

All three scenarios are implemented in a comparative static version of the MAGNET model starting from a base year of 2007. The MAGNET model is a global CGE model calibrated to Version 8 of the GTAP database, which includes 129 countries/regions, 57 commodities and 5 factors of production: land, unskilled labour, skilled labour, capital and natural resources. The MAGNET system has at its core the GTAP model, which, through a set of tailor-made modules, can be extended with a number of features. Current MAGNET modules include endogenous land supply, an extended production structure, bilateral tariff rate quotas, biofuels, the common agricultural policy and alternative specifications for consumption and investment. The development of the labour supply curve as part of the Factor Markets projects forms a further module.

The modular nature of the MAGNET model allows the form of the model to be specified for the research question at hand. The illustrative nature of the scenarios included in this analysis suggests a relatively simple model set-up to highlight the effect of changing the labour market specification. The MAGNET model used for this analysis is therefore the GTAP core plus endogenous land supply in all regions, the common agricultural policy in EU member states and the labour-supply curve module (in scenario 2). The endogenous land-supply curve is used because the policy scenario pertains to the agricultural sector and specifying a land supply curve allows the amount of land and its price to vary, rather than keeping the total amount of land used fixed across the agricultural sector.<sup>7</sup>

### ***3.3 Model aggregation***

The latest version of the GTAP database covers 129 regions and 57 commodities. As with the model specification, the choice of aggregation over which regions and commodities to include separately also depends on the research question. The focus here on the results of CAP reform under alternative labour market functioning in the EU necessitates a geographical focus on Europe and a commodity focus on agricultural commodities. A full list of the regions used in the model is shown in Table 1, with a list of the commodities included in the model given in Table 2.

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<sup>7</sup> Agricultural sectors are the only users of land in the GTAP database.

*Table 1. Country aggregation*

Country/region	Short name	Country/region	Short name	Country/region	Short name
Austria	aut	Germany	deu	Poland	pol
Belgium	bel	Greece	grc	Portugal	prt
Bulgaria	bgr	Hungary	hun	Romania	rou
Croatia	hrv	Ireland	irl	Slovakia	svk
Cyprus	cyp	Italy	ita	Slovenia	svn
Czech Republic	cze	Latvia	lva	Spain	esp
Denmark	dnk	Lithuania	ltu	Sweden	swe
Estonia	est	Luxembourg	lux	Turkey	tur
Finland	fin	Malta	mlt	UK	gbr
France	fra	Netherlands	nld	Rest of world	row

*Table 2. Commodity aggregation*

Commodity	Short name	Composition
Cereals	cer	Wheat, maize, rice, other grains
Vegetables & fruit	v_f	Vegetables, fruit, nuts
Animal products	anpr	Bovine cattle, sheep and goats, horses, raw milk, wool, silk-worm cocoons, other animal products
Other crops	ocp	Oil seeds, sugar cane, sugar beet, plant-based fibres, other crops
Manufacturing	mnfc	All manufacturing, including food processing, fishing and forestry
Services	serv	All services, including utilities and transport

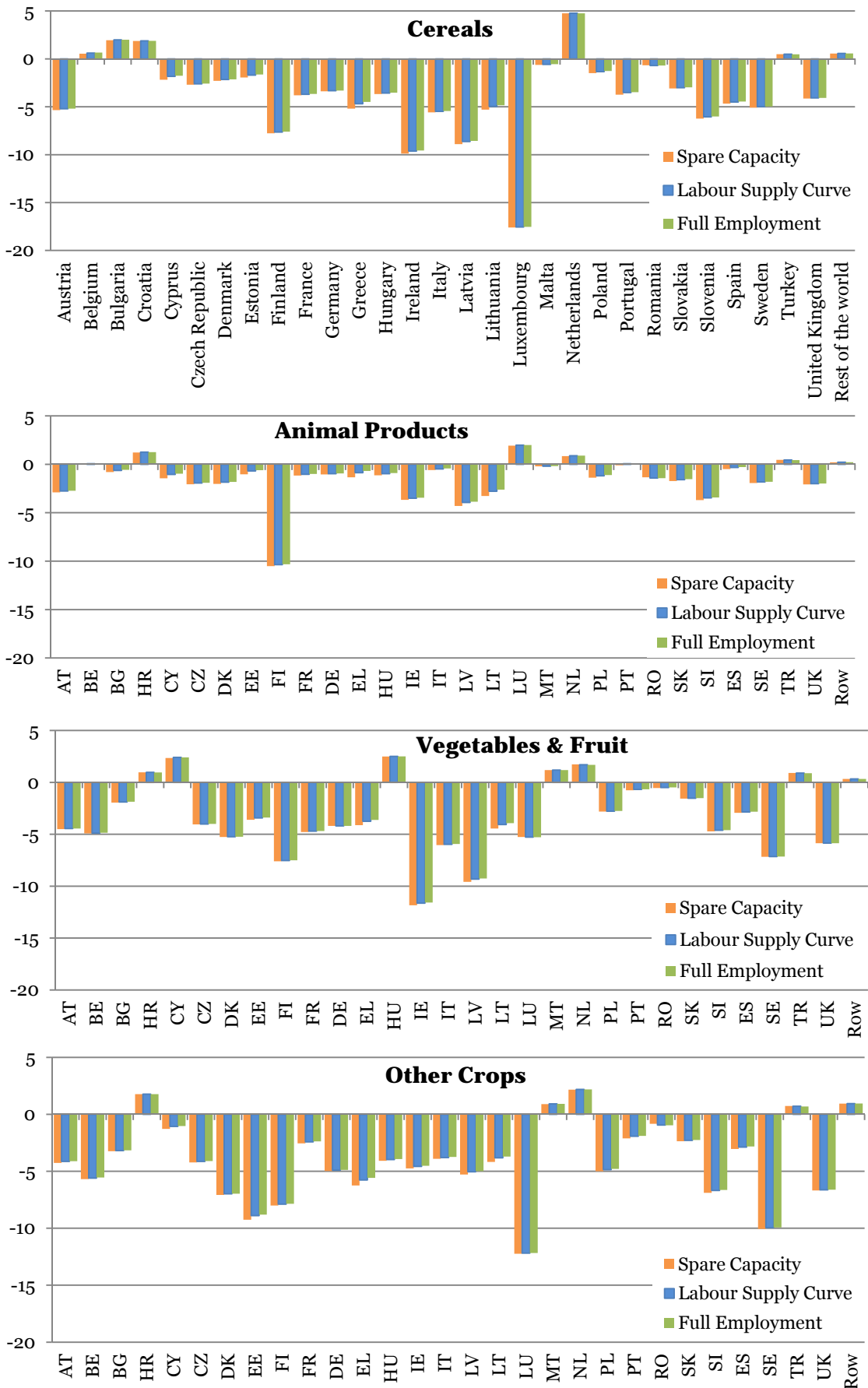
#### **4. Effects of changes in the labour market specification on the results of a CAP reform scenario**

The supply of endowments in an economy and the ability to take on or shed workers in response to economic shocks and policy changes are important determinants of macroeconomic performance. Factors comprise a significant share of production costs for firms and form the major source of income for households. As such, the supply of factors provides a link between the production and consumption sides of an economy and, to the extent that GDP is measured by value added, is the primary determinant of national income. Given the key role of factors in the economy, it is expected that changing the labour market specification will change the outcome of policy simulations.

##### **4.1 Scenario results**

The results of three simulations in which the same change in CAP policy is analysed with different labour market assumptions are presented in this section. A priori expectations suggest that a 50% reduction in first pillar support in member states will increase production costs, resulting in a contraction of the agricultural sector. This expectation is largely borne out in all countries and agricultural sectors across the EU as shown in Figure 7. The large contractions are seen in the Luxembourg cereals and crops sectors (17% and 12% respectively), the Irish vegetables and fruit sector (12%) and the Finnish animal sector (10%). The average contraction across the EU member states is greatest in the crops sector (4.5%) and lowest in the animal products sector (1.6%), with cereals, vegetables and fruit falling between these two extremes.

Figure 7. Percentage change in the output of agricultural sectors



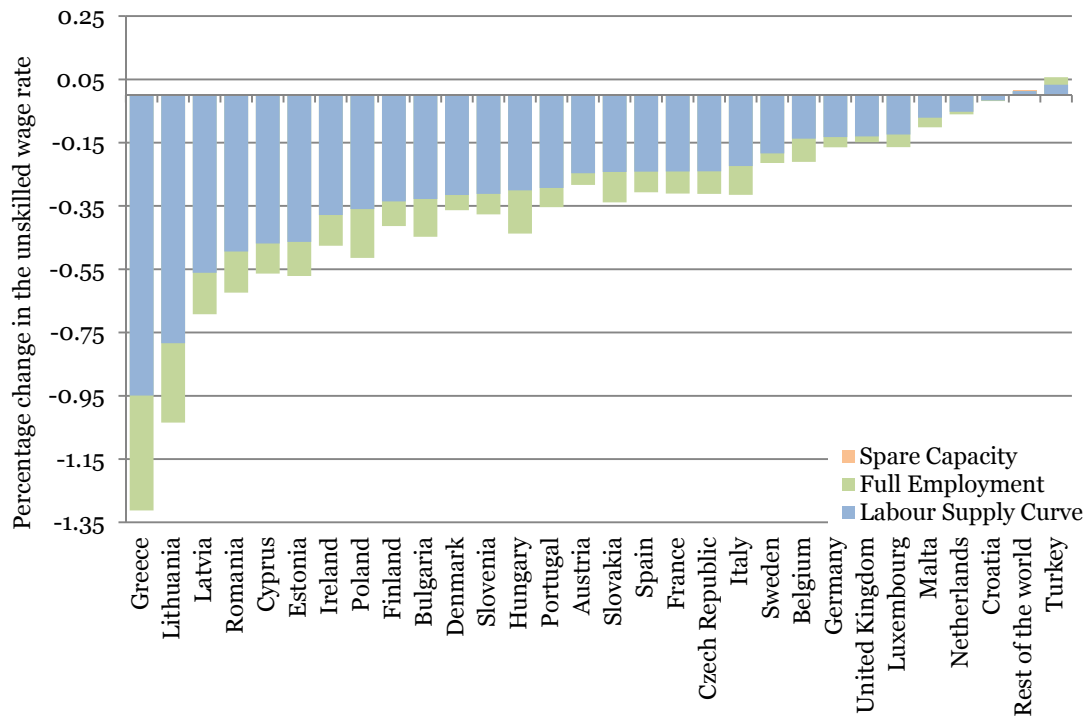
Although the general pattern is one of contraction in the agricultural sectors, the reduction in first pillar support increases production in some sectors in some countries. The agricultural sector in Croatia, Turkey and the rest of world region expands as rising costs in the EU leads to relatively cheaper prices in these regions, boosting demand. A similar effect drives the expansion in agriculture in some of the smaller countries, such as the Netherlands and Malta. The expanding countries, although member states, are recipients of lower levels of initial support from the common agricultural policy. Cutting the support to these countries therefore leads to smaller increases in production costs, making their agricultural products relatively cheaper. The 4.8% expansion of the cereals sector in the Netherlands, for example, is due to export-led growth brought about by relatively cheaper prices compared with other member states.

The change in the output of the agricultural sectors from the CAP reform scenario is also shown for each of the labour market specifications in Figure 7. While the change in labour market functioning does not alter the overall conclusions from the results, it does lead to different results. An assumption of full employment in unskilled labour leads to smaller contractions in all agricultural sectors in all countries than the assumption of spare capacity. This stems from the assumption of mobile unskilled labour across sectors. Under full employment, the wage rate adjusts to ensure that all labour that is released from the agricultural sector is employed by other sectors. The assumption of mobile labour, however, means that this reduction in wages is equalised across all sectors and it also reduces the wage bill in agriculture. This reduction in wage costs means that production costs and thus output contracts by less than in the case of spare capacity where the released workers return to the inactive pool having no effect on the equilibrium wage rate.

The introduction of a labour supply curve produces results that fall strictly between those of the spare capacity and full employment scenarios as expected. The proximity of the result under the assumption of an upwards-sloping labour supply curve depends upon the shape of the curve: countries with flatter curves and therefore more spare capacity in unskilled labour experience changes in the agricultural sector closer to the spare capacity results. Conversely, countries with steeper labour-supply curves experience changes in the agricultural sectors that are closer to the full employment results. As such, the introduction of a labour supply curve for unskilled labour slightly dampens the effects of the cut in the budget of the common agricultural policy compared with the standard model specification of fully employed unskilled labour.

While the largest difference in the expansion of the agricultural sectors under the various scenarios is still relatively small (0.7% for the cereals sector in Greece), the impact of changing the labour market specification on the supply of labour and wages is more marked. The percentage change in the wages of unskilled labour resulting from a 50% cut in first pillar support to member states is shown in Figure 8. The reduction in support to agriculture reduces the demand for unskilled labour and lowers wages in the member states, as more unskilled labour is available for use in other sectors. Wages increase by more under the assumption of full employment as other sectors enticed to 'mop up' the excess labour. As expected, wages under the labour-supply curve assumption also increase but by less than the full employment scenario to reflect the fact that the economy can also adjust the total number of people in employment. Wages do not alter under the assumption of spare capacity, as all adjustment is made through the number of people employed. Countries near full employment (such as the Netherlands) show changes in wages that are similar under the full employment and labour-supply curve assumptions.

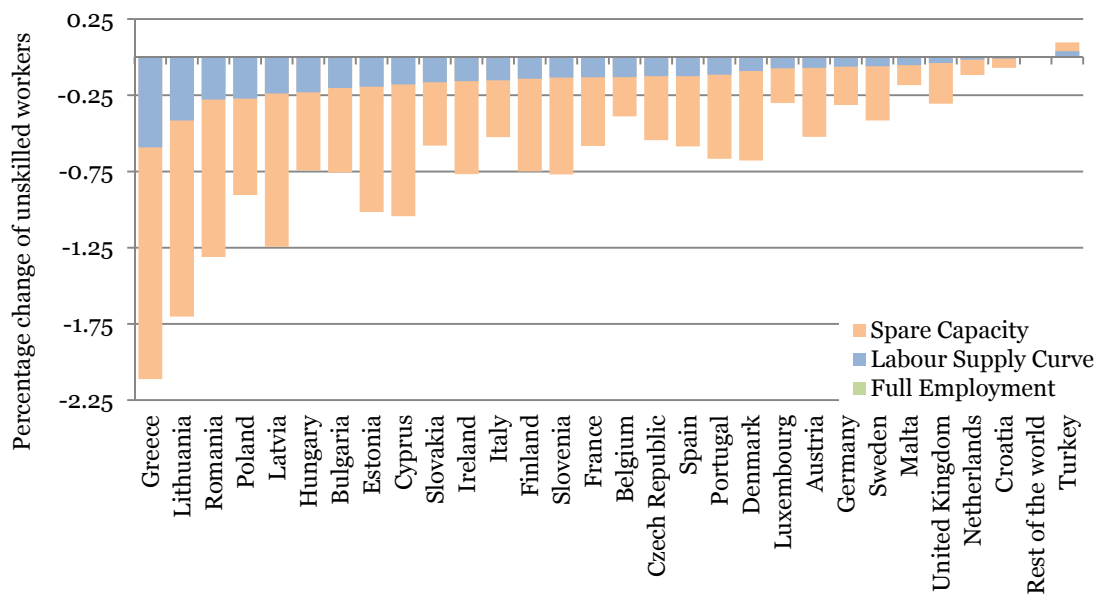
Figure 8. Percentage change in the unskilled wage rate



Note: Results are ranked by the size of the labour-supply curve effect and overlaid rather than stacked.

The changes in the quantity of the unskilled labour employed tell a similar story as shown in Figure 9. The quantity of labour adjusts most under the spare capacity assumption where all adjustment takes place through the employment level. Some reduction in employment also takes place under the labour-supply curve assumption as expected. There is no change in employment under the full employment assumption, where all adjustment takes place through the wage rate.

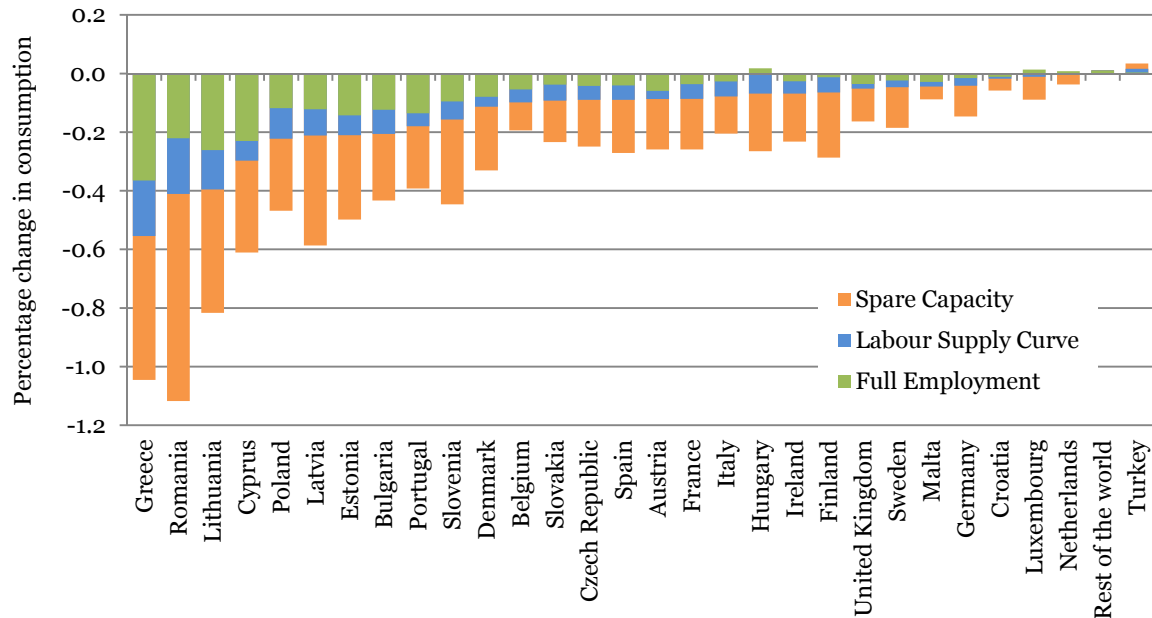
Figure 9. Percentage change in the quantity of unskilled labour



Note: Results are ranked by the size of the labour-supply curve effect and overlaid rather than stacked.

These relatively large changes in employment and wages in some countries have important implications for welfare as shown in Figure 10. Consumption by households, considered here as a proxy for welfare, is reduced in all the contracting member states. The reduction in welfare is more pronounced under the assumption of spare capacity, as some workers will have been made unemployed as a result of the CAP reform.

Figure 10. Percentage change in consumption by households (welfare)



Note: Results are ranked by the size of the labour-supply curve effect and overlaid rather than stacked.

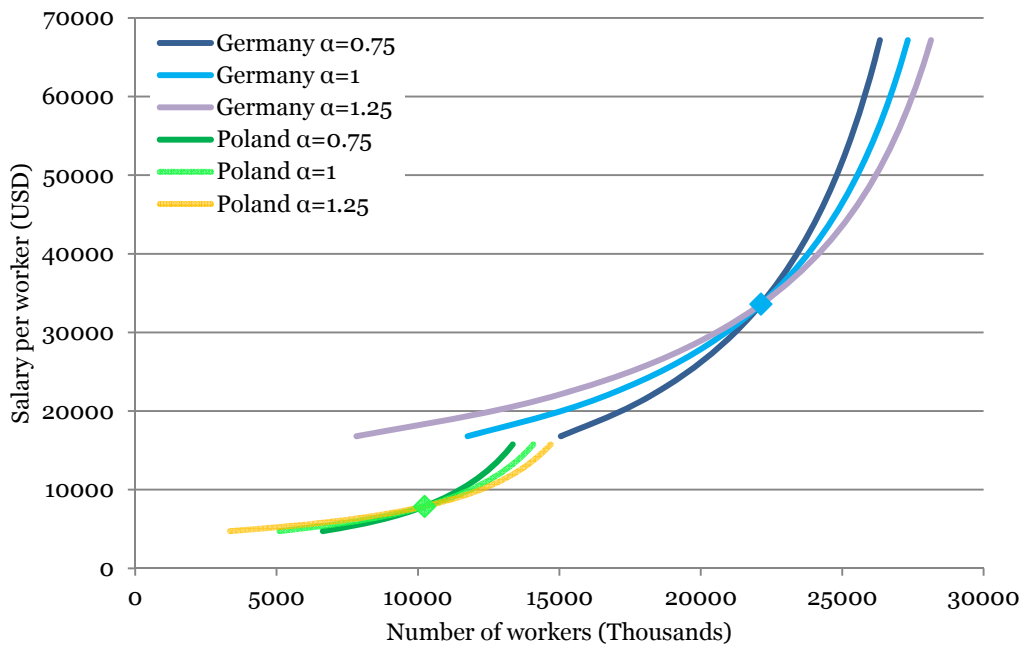
The specification of the labour market therefore has a small effect on the impact in the agricultural sector but a relatively large impact on the welfare effect of a cut in first pillar support. Improving the modelling of factor markets in the member and candidate states is thus important for capturing not only the heterogeneity of labour markets, but also the welfare effects of policy reform.

#### 4.2 Sensitivity analysis

The above analysis is conducted with the power of the labour supply function ( $\alpha$ ) set equal to one. This parameter is the only component of the labour supply function that is not specified from real world data. As such, it is important to consider how sensitive the results of the scenarios are to the choice of this parameter.

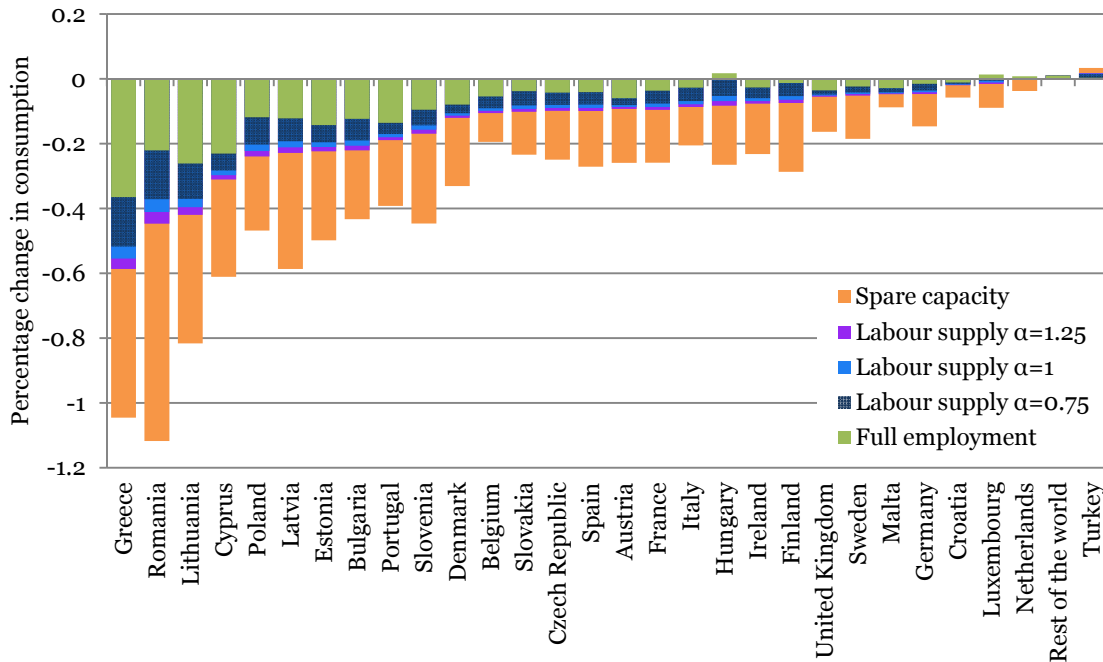
The power of the labour supply function governs the impact of a change in wages on employment. Changes in the power hence change the slope of the curve, with lower powers reducing the sensitivity of employment to changes in the wage rate as reflected by a steeper curve. Conversely, higher powers increase the employment response to a change in wages, as shown by more shallow curves. The impact of changing the power of the labour supply functions is illustrated for two countries, Germany and Poland, in Figure 11. These two countries are shown as they reflect initial situations of relative full employment (Germany) and relative spare capacity (Poland) in the unskilled labour market. In each case, reducing the power of the labour supply function by 25% or increasing it by 25% pivots the curve around the initial equilibrium point.

Figure 11. The impact of changing the power of the labour supply function



The results of a sensitivity analysis of the power of the labour supply function are presented in Figure 12. The labour supply scenario is rerun with values of the power at -25% and +25% of the initial value for all regions. The pattern of the welfare results is consistent with that of the other results of the model. More specifically, changing the power of the labour supply function and therefore the shape of the labour supply curve produces results that are closer to the spare capacity results for increases in the power and close to the full employment results for decreases in the power.

Figure 12. Impact of sensitivity analysis on welfare results



Note: Results are ranked by the size of the labour-supply curve effect (α=1) and overlaid rather than stacked.



Changes in the power of the function of plus and minus 25% have a fairly symmetrical impact on the results: the increase in the power leads to welfare results that are on average 13.7% below the standard labour-supply results, and a decrease in the power leads to welfare results that are 15.1% higher than the standard results. Therefore, although changes in the power of the function lead to results that are fully consistent in that they lie within the extremes of the labour market specification, the results are still relatively sensitive to changes in this parameter. To this end, any analysis using the new labour-supply curve specification should either use an econometric estimation of this parameter or report results with bounds based on a range of values of the power of the function.

## **5. Conclusions and future work**

This paper introduces an extension to the MAGNET CGE model to better capture the heterogeneous nature of labour markets across the member and candidate states. Specifically, the model is extended by introducing a labour supply curve for each country to allow for a more sophisticated relationship between labour supply and the real wage beyond the two extremes of spare capacity and full employment that are normally considered in CGE models.

The paper introduces the theoretical foundations of the labour supply curve and then empirically derives unskilled labour-supply curves for all member states along with Croatia and Turkey. The analysis of these supply curves shows that the new member and candidate states have systematically lower average wages than the EU-15 countries and are often less labour-constrained. Integrating the labour supply curves into the MAGNET CGE model and using the extended model to evaluate the impact of CAP reform under different labour-market assumptions shows that the addition of labour supply curves is a valuable one. The new specification produces results that fall between the two extremes of spare capacity and full employment, capture the relative flexibility of the labour markets across Europe and produce more nuanced welfare results.

There is considerable scope for extending the analysis presented here, with this paper presenting the first results of this new area of work. Future plans include a similar analysis on the skilled labour market across Europe, the integration of this approach with the segmented, agricultural labour markets that already exist in the model and extending the approach across time in a dynamic framework. Econometric estimation of the parameter governing the power of the labour supply function would also be a valuable area for further research.

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## Comparative Analysis of Factor Markets for Agriculture across the Member States

245123-FP7-KBBE-2009-3

### The Factor Markets project in a nutshell

<b>Title</b>	Comparative Analysis of Factor Markets for Agriculture across the Member States
<b>Funding scheme</b>	Collaborative Project (CP) / Small or medium scale focused research project
<b>Coordinator</b>	CEPS, Prof. Johan F.M. Swinnen
<b>Duration</b>	01/09/2010 – 31/08/2013 (36 months)
<b>Short description</b>	<p>Well functioning factor markets are a crucial condition for the competitiveness and growth of agriculture and for rural development. At the same time, the functioning of the factor markets themselves are influenced by changes in agriculture and the rural economy, and in EU policies. Member state regulations and institutions affecting land, labour, and capital markets may cause important heterogeneity in the factor markets, which may have important effects on the functioning of the factor markets and on the interactions between factor markets and EU policies.</p> <p>The general objective of the FACTOR MARKETS project is to analyse the functioning of factor markets for agriculture in the EU-27, including the Candidate Countries. The FACTOR MARKETS project will compare the different markets, their institutional framework and their impact on agricultural development and structural change, as well as their impact on rural economies, for the Member States, Candidate Countries and the EU as a whole. The FACTOR MARKETS project will focus on capital, labour and land markets. The results of this study will contribute to a better understanding of the fundamental economic factors affecting EU agriculture, thus allowing better targeting of policies to improve the competitiveness of the sector.</p>
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<b>Partners</b>	17 (13 countries)
<b>EU funding</b>	1,979,023 €
<b>EC Scientific officer</b>	Dr. Hans-Jörg Lutzeyer

