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## The regional economic consequences of Less Favoured Area support in Poland: a regional general equilibrium analysis.

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### Abstract

Upon its accession to the EU in 2004, Poland became eligible for Common Agricultural Policy (CAP) support. Poland joined the EU mid-way through the 2000–2006 CAP funding round, hence the 2007–2013 CAP scheme is the first under which Poland receives funding for the duration of a full CAP budgetary period. In this paper, we model the national and regional economic consequences of the largest CAP Pillar II measure, namely, Less Favoured Areas (LFA) support. Understanding the impact of the 2007–13 scheme is important in the context of both the EU's plans to reform the CAP for the 2014 – 2020 round<sup>1</sup>, and the current review of the existing LFA scheme as the EC considers possible criteria for a new delimitation of these areas<sup>2</sup>.

We analyse the regional economic consequences of the Less Favoured Area (LFA) measure, which in Poland is the biggest part of Pillar II within the Rural Development Programme 2007–2013. We look at the impact for all 16 NUTS2 regions in Poland. Our research approach is a regional computable general equilibrium model POLTERM, tailored for rural and agricultural analyses. In particular, for the present analysis we have adapted POLTERM to include i) 11 agricultural sectors, ii) 8 food sectors, iii) 14 disaggregated non-agricultural sectors of manufacturing and services iv) a separate land input, iv) two types of households, rural and urban. Regions in the model are linked by trade flows, capital flows, population movements, changes in relative prices, and transfer payments. We take into account emigration, an important factor in the analyses of employment movements for this policy in Poland. The study contributes to the state of art in the respects that it is the first regional CGE analyses of LFA impact on New Member States (such as Poland), thus complimenting the existing LFA literature which tends to be at the national level and focuses on Old Member States (e.g. Scotland, see Geland and Schwarz, 2008).

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**JEL Classification:** P50, C68, O18

**Keywords:** Comparative Economics, Computable General Equilibrium Models, Regional and Rural policy

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<sup>1</sup> For a good overview of CAP reform see Bureau and Mahé (2008)

<sup>2</sup> See DG AGRICULTURE [http://ec.europa.eu/agriculture/rurdev/lfa/index\\_en.htm](http://ec.europa.eu/agriculture/rurdev/lfa/index_en.htm)

## 1. INTRODUCTION

In areas designated as "less-favoured", agricultural production or activity is rendered difficult by natural handicaps, such as difficult climatic conditions, steep slopes in mountainous areas, and low soil productivity in other less favoured areas. This situation entails a high risk of land abandonment and thus increased risk of biodiversity loss, desertification and forest fires. An ostensible aim of the Less Favoured Areas (LFA) payment scheme is to mitigate these risks. The majority of Member States have provided significant support to the scheme. For example, in Poland and Finland, the scheme represents about 50% of the Pillar 2 budget. At the EU level, the amount of European Agricultural Fund for Rural Development (EAFRD) for the years 2007-2013 dedicated to the scheme is € 12.6 billion, corresponding to 13,9% of EAFRD or 32% of Axis 2 (i.e. the environmental part of Rural Development Policy). Under this measure, farmers who manage agricultural land in LFA and undertake to pursue their activity for a period of 5 years receive annual compensation for additional costs and income foregone, with this compensation related to the natural handicap (EC, 2008). In 2005 approximately 1.4 million farms, representing about 13% of the total number of farms in the EU25 received support under LFA scheme<sup>3</sup>.

LFA payments were introduced in 1975. By introducing a regional dimension<sup>4</sup> and initiating area-based annual payments to farmers, the LFA was perceived as a major change in the nature of the Common Agricultural Policy (CAP). This idea of decoupled payments later expanded to encompass other measures with later CAP reforms (Dax, 2005). Over time, the spatial importance of the measure has expanded with the eligibility of new EU regions. In 1975 LFA constituted 32.9% of the EU's total agricultural land. By 2005 it had expanded to 56.5%, with the entry of such countries as Finland (with 100% of the country classified as LFA) and Poland (with 52.4% of the country classified as LFA) (CEU, 2005).

The ostensible objectives of the LFA have changed and proliferated over the past three decades. In the original Council Directive 75/268/EEC, the LFA had one main objective and two sub objectives specified as follows: "ensure the continuation of farming in the areas, thereby maintaining a minimum population level and conserving the countryside". Then, with Council Regulation EC 1257/1999 new LFA objective appeared, such as "maintenance of a viable rural community". The current LFA objectives, according to the most recent EC regulation 1968/2005, are "through the continued use of agricultural land", contribute to "maintaining the countryside" as well as "maintaining and promoting sustainable farming systems". Social objectives (such as reducing rural depopulation) have disappeared, while concern for the maintenance of agricultural land use and environmental protection have increased (IEEP, 2006).

The LFA measure is in 2010 under revision both at the EU and country levels. This followed a critical report in 2003 by the European Court of Auditors, which accused LFA policy of lack of targeting of aid (OJ, 2003). In response to this the Commission ordered an evaluation study of LFA (later published in November 2006, IEEP, 2006), and set up an inter-service steering group (ISSG) which launched public consultations on the economic, social and environmental impact of the LFA support published in June 2008 (Consultations, 2008). Then in April 2009 European Commission issued a formal Communication to the European Parliament and to the Council (CC, 2009) in which it summarised the main issues justifying a current revision of the LFA scheme: inconsistencies in delimitation of LFA areas between countries and regions, extreme diversity of the LFA criteria among countries and regions which led to unequal treatment of

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<sup>3</sup> See official website of DG AGRICULTURE at: [http://ec.europa.eu/agriculture/rurdev/lfa/index\\_en.htm](http://ec.europa.eu/agriculture/rurdev/lfa/index_en.htm)

<sup>4</sup> This was the first time in the history of the CAP that a measure was applied based on delimitation of certain eligible areas among the regions.

beneficiaries, and insufficient targeting of the aid which led to weak effectiveness of the support. Therefore there is a political agreement to revise the LFA measure and implement a new system by 2014. New classification tends to much narrow and equalize among regions and countries the definition of LFA, so it will not be such a widespread measure as it was so far (it covered 57% of overall Utilized Agricultural Area in EU). Hence we ask ourselves a question what would be an impact of total removing LFA scheme from the Rural Development Programme. How much of agricultural land would have been abandoned and what would be other economic consequences for regions and sectors (both agricultural and non-agricultural). We analyse it on example of Poland which is one of the most agricultural countries in EU, with about 15% of population employed in agriculture.

In particular we quantify the economic impacts of LFA at the regional and national levels for the years 2007-2013. We analyse all 16 NUTS 2 regions in Poland. An output of our modelling is the amount of land removed from agriculture in the absence of the LFA support. As such, our paper elucidates the effectiveness of LFA in achieving one of its ostensible objectives, namely, maintaining agricultural production in the areas under question. We investigate how LFA affects land rental prices, supply of agricultural land, employment, and agricultural prices and production. We also investigate the indirect effects of LFA support for such variables as food prices, employment, GDP and population.

## **2. LFA MEASURES IN POLAND**

Less favoured areas encompass over 56 per cent of Poland's farmland (see Map 1). Poland's high LFA land share is due to weak and acidified soil, low precipitation and a short growing season. Agricultural soil conditions in Poland are typically lower than the EU average. For example, the percentage of light soils on average in EU15 is 31.8, while in Poland it is 60.8.

Of all 23 Pillar II measures planned for 2007-2013 in Poland, LFA has the largest amount devoted to it, representing 14.7% of the Pillar II budget. This is equivalent to 1, 203.4 million PLN (about 280 million EUR) annually (see Table 1).

The main objectives of the current LFA scheme are defined in Council Regulation (EC) No 1698/2005 as follows (Recital 33):

"Natural handicap payments in mountain areas and payments in other areas with handicaps should contribute, through continued use of agricultural land, to maintaining the countryside, as well as to maintaining and promoting sustainable farming systems."

LFA support comes in the form of annual flat rate payments (compensatory allowances) per hectare of agricultural land remaining in agricultural use, where that land is situated in mountain areas and other less-favoured areas. The rates of payment for farming in mountain areas and other less-favoured areas are specified separately for different types of LFA.

The distribution of LFA support by region is not predetermined, but rather, depends on eligibility criteria, demand from the farmers, and the quality of farmers' applications for support. Nevertheless, given the similarity of LFA areas between 2004-2006 and 2007-2013, we assume that the structure of the regional distribution will be approximately the same (see Table 2).

### 3. REGIONAL PICTURE OF POLAND

Before describing the model for the policy analysis, we first present Polish regions in a typology that shows their rurality and dependence on agriculture. The simplest regional rural typology is the OECD classification of predominantly rural (PR), intermediate/significantly rural (IR) and predominantly urban (PU) regions. This typology is based on the percentage of the population living in rural areas. The OECD classification is recognised across the EU, and has proved effective for many regional and policy studies (Terluin, 2006). However, here we extend the OECD typology, adding one more dimension, namely, the dependence of rural population on agriculture. This is represented by the percentage of the rural population employed in the primary sector. Adopting a similar cut-off to the OECD typology, we define predominantly agricultural (PA) regions as those in which more than 50% of the rural population is employed in agriculture. We define intermediate agricultural (IA) regions as those in which between 50% and 15% of the rural population is employed in the primary sector. We define regions as predominantly non-agricultural (PN) when agriculture accounts for less than 15% of rural employment. Such a presentation gives a more detailed picture of *rurality* across regions, and together with the OECD typology, generates 9 types<sup>5</sup> of regions, as in Figure 1 and Table 3. The advantage of the typology is that it visualises rural population distribution according to the place of living and the occupation among the regions. We use the typology to bring our results closer to what they mean for rural people who, after all, should be main beneficiaries of rural policy. This typology makes the comparison between various regions and easier.

### 4. POLTERM: A BOTTOM-UP MULTI-REGIONAL MODEL OF POLAND

#### 4.1 Overview of POLTERM: A Polish implementation of the TERM model.

POLTERM is an implementation of the TERM model (Horridge, *et al.*, 2005) to the Polish economy.<sup>6</sup> Our explanation of results from POLTERM in Section 6 relies on familiar economic mechanisms, not a detailed knowledge of TERM's theoretical structure. As such, we provide below an overview of the TERM model, while referring readers interested in the detailed structure of the model to Horridge, *et al.* (2005).

TERM is a bottom-up multi-regional CGE model. A defining feature of TERM is its compact data structure, which allows it to deal with the detailed behaviour of many economic agents within many regions while still being sufficiently compact that it can be solved on a high-end desktop computer. TERM's computational efficiency, relative to some other detailed bottom-up multi-regional CGE models, arises from its compact data structure, made possible by a number of simplifying assumptions. For example, TERM assumes that all users in a particular region of a particular commodity source their purchases of that commodity from other regions

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<sup>5</sup> In practice, type 7 (Predominantly Urban-Predominantly Agricultural) and 8 (Predominantly Urban – Intermediate Agricultural) are not likely to appear, so generally we distinguish 7 meaningful types or regions.

<sup>6</sup> Previous implementations of the TERM model include Australia (Wittwer, 2009; Horridge, Madden, Wittwer, 2005), China (Horridge and Wittwer, 2008), Finland (Kinnunen, Marttila and Honkatukia, 2009), Indonesia (Pambudi, 2005), Brazil (de Souza Ferreira Filho dos Santos and do Prado Lima, 2007) and South Africa.

according to common proportions<sup>7</sup>. The data structure is the key to TERM's strengths. It has allowed the same detailed bottom-up multiregional treatment of economic agents employed in other large-scale regional CGE models to be included in a model with many more regions.

TERM explicitly captures the behaviour of industries, households, investors, government and exporters at the regional level. In the Polish version of the model, economic activity in the 16 NUTS2 regions is modelled. The industrial and commodity dimensions of POLTERM have been tailored for rural and agricultural analyses. In its full disaggregation, the model has 86 sectors, of which 20 relate to agricultural production and 8 to food production.

The theoretical structure of TERM follows the familiar neoclassical pattern common to many applied general equilibrium models. Producers in each region are assumed to maximize profits subject to a production technology that allows substitution between primary factors (labour, capital and land) and between geographical sources of supply for specific intermediate inputs. A representative household in each region purchases goods in order to obtain the optimal bundle in accordance with its preferences and disposable income. Investors seek to maximize their rate of return, while demand by foreigners is modelled via export demand functions that capture the responsiveness of foreigners to changes in export supply prices.

In TERM, economic agents decide on the geographical source of their purchases according to relative prices and a nested structure of substitution possibilities. The first choice facing the purchaser of a unit of a particular commodity is whether to buy one that has been imported from abroad or one that has been produced in Poland. If a Polish product is purchased, a second decision must be made as to the particular region the commodity originates from. For instance, in the purchase of a Polish-made agricultural tractor a purchaser will need to choose, say, between an URSUS manufactured in Mazowieckie and a PRONAR made in Podlaskie. It is assumed that Polish-made brands are considerably more substitutable, than is a Polish brand with a foreign brand. In order for goods to reach a customer located in a particular region, certain margin services must also be purchased. Thus the price to the regional purchaser will include a margin to the retailer and wholesaler of the good (i.e. the trade margin) and the transporter(s) of the good. For instance, a Skaryszew (Mazowieckie) purchaser of a good manufactured in Warsaw might find that the sale price includes a margin for a Warsaw distributor for rail freight to Radom, then road transport to Skaryszew and a Skaryszew retailer. It is assumed that substitution between the source of the margins may be affected by a change in the relative price of margins sourced from different geographical localities, particularly with regard to transport. Thus, for instance, Skaryszew, Radom, and Warsaw trucking companies are assumed to compete with each other to carry goods from Warsaw airport to Skaryszew. TERM contains a large database which keeps track of the flow of international and interregional purchases of each commodity from each region of origin to each destination region. It also keeps track of the associated margin payments and the geographical location of the suppliers of those margins. In the case of each regional user, TERM also keeps track of the taxes payable on the purchase.

As an EU member state, Poland has an open labour market with the rest of the EU. Indeed post EU accession, the level of Polish emigration was substantial. In modelling Poland's labour market in POLTERM, we allow the size of the Polish working age population to respond endogenously to movements in the Polish real wage. In doing so, we set the elasticity of Poland's

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<sup>7</sup> Thus, for instance, both households and food-products manufacturers in region  $r$  are assumed to purchase the same proportion of their vegetables from region  $l$ .

working age population to the real wage at 0.10. This is consistent with the level of Polish emigration following EU accession<sup>8</sup>

## 4.2 Modelling the LFA measure in POLTERM

LFA payments take the form of an annual per hectare grant. From a modelling perspective, we view this as a land rental subsidy. Any given Polish region,  $r$ , will tend to have producers cultivating both LFA and non-LFA land areas (see Figure 2). In POLTERM, we model this by distinguishing two types of land: LFA land and non-LFA land. The ostensible purpose of LFA funding is to increase farmer incentives to farm more LFA land than they would otherwise (see Section 1 above). Implicit in this aim is a belief that agricultural activity in LFA areas would decline in the absence of the support. There is survey evidence that the LFA measure has had some success in this regard<sup>9</sup>. To model this, we allow the supply of LFA land to respond endogenously to movements in the post-tax rental price of LFA land. We set the elasticity of the supply of LFA land to movements in the post-tax rental price of LFA land ( $\eta_r^{(S)LFA}$ ) at 0.2. For non-LFA land, we set the corresponding elasticity ( $\eta_r^{(S)non-LFA}$ ) at 0, as we know there is no fallow land in Poland which can be easily turned into arable non-LFA land. These elasticities are within relevant ranges reported in van Meijl, et al. (2006) and Abler (2003). Van Meijl *et al.* (2006) places the land supply elasticity within the EU in the range 0.01 to 0.2. This range of land supply elasticities is within the 0.0 to 0.2 interval found by Abler (2003). Van Meijl *et al.* (2006) note that land supply elasticities for developing countries can be higher than this range, in the vicinity of 0.5. We conjecture that for LFA land in Poland, a land supply elasticity at the upper end of the EU range reported in van Meijl *et al.* (2006) is appropriate. For non-LFA land, we set the supply elasticity at the lower-end of the Abler (2003) range, at 0.

Figure 2 describes the modelling of regional agricultural land supply and land demand. At the bottom level of this diagram, regional endowments of LFA and non-LFA land ( $X_r^{LFA}$  and  $X_r^{non-LFA}$  respectively) are potentially supplied to agricultural industries 1 – N in region  $r$ . Land supply functions across land users are modelled via constant elasticity of transformation (CET) functions<sup>10</sup>. In modelling the behaviour of owners of agricultural land, we assume they seek to maximise land rentals subject to constrained land transformation possibilities described by CET functions. At the top level of Figure 2, users of agricultural land are assumed to face imperfect

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<sup>8</sup> To our knowledge, there are no econometric estimates of the elasticity of Poland's working age population with respect to the Polish real wage relative to the real wage in the rest of the EU. For the simulations reported in this paper, we set this elasticity at 0.10. This value is consistent with the size of Polish emigration following EU accession in 2004. In the years 2004-08, 2.2 m. Polish workers emigrated abroad (GUS, 2009, p.2). This represented approximately 9% of the Polish workforce of 24.6 m. (GUS-BDR, 2009). Prior to EU accession in 2004, opportunities for Polish labour to work in the EU were limited. At the time of EU accession, in the year 2004, the average Polish wage was 2290 zloty (GUS, 2010), the equivalent of approximately 573 EUR. The main destination for Polish emigrant labour post-accession was the UK (GUS, 2009, p.3). There, the majority of Polish workers earned the minimum UK wage of 1084 EUR (EUROSTAT, 2004, p.2). As such, Poland's EU accession made available, to workers willing to emigrate, wages 90 per cent higher than those possible in Poland. This generated a 9 per cent reduction in the Polish workforce. So our working age population supply elasticity of 0.10 is consistent with this historical outcome, according to elasticity formula  $-9/((1084-573)/573*100) = -0.10$ .

<sup>9</sup> A survey carried out as part of an ex-post evaluation of the Rural Development Plan 2004-2006 found that 25% of LFA support recipients would have given up farming if they had not received LFA support. See: Ex-post evaluation of RDP 2004-2006 at <http://www.minrol.gov.pl/index.php?/pol/content/download/669/3797/file/RAPORT>

<sup>10</sup> For a description of the application of the CET function in CGE modelling, see Dixon *et al.* (1992: 128-133).

substitution possibilities between LFA and non-LFA land, with these substitution possibilities described by constant elasticity of substitution (CES) functions<sup>11</sup>. In modelling the behaviour of users of agricultural land, we assume they minimise the cost of acquiring a given input of land by substituting across land types, subject to the constraints posed by the CES functions. Equations (E1) – (E5) describe, in percentage change form, the system of supply, demand and unit-cost functions implicit in the structure of land supply and demand represented by Figure 2.<sup>12</sup> Equations (E1) and (E2) describe the operation of the land supply nests at the bottom level of Figure 2. In (E1), the percentage change in the supply of land type  $n$  to agricultural user  $j$  in region  $r$  ( $x_{j,r}^{(S)n}$ ) depends on both the availability of land type  $n$  in region  $r$  ( $x_r^{(S)n}$ ) and the relative land rental received when supplying to user  $j$  ( $p_{j,r}^n - p_r^n$ ). The average rental on land type  $n$  in region  $r$  ( $p_r^n$ ) is defined by (E2) as the revenue share weighted sum of the percentage changes in rentals received from each user of land type  $n$  in region  $r$ . Equations (E3) and (E4) describe the operation of the land demand nests at the top level of Figure 2. In (E3), the percentage change in the demand for land type  $n$  by agricultural user  $j$  in region  $r$  ( $x_{j,r}^{(D)n}$ ) depends both on the demand for land in general by such users ( $x_{j,r}^{Land}$ ) and the relative user price of land type  $n$  ( $p_{j,r}^n - p_{j,r}^{Land}$ ). The percentage change in the average cost of agricultural land to user  $j$  in region  $r$  is defined by (E4) as the cost share weighted sum of the percentage changes in the rental prices of the LFA and non-LFA land employed by user  $j,r$ . Together, (E1) and (E3) define percentage changes in user-, region- and land-specific land supply and demand. Equation (E5) imposes a market clearing condition on these user-, region- and land-specific land markets, thus allowing endogenous determination of land rental prices ( $p_{j,r}^n$ ). Equation (E6) defines the percentage change in net land rentals received by land owners. In the original levels form, (E6) expresses net land rentals as the product of pre-subsidy land rentals and the power (one plus the rate) of land subsidy. In (E6), the percentage change in the land subsidy appears as  $s_r^n$ . It is  $s_r^n$  that we shock when modelling LFA payments in Sections 5 and 6. Equation (E7) defines the supply of land type  $n$  in region  $r$ . Under (E7), the percentage change in the supply of land type  $n$  in region  $r$  is positively related to the land's real post-subsidy rental rate. The strength of the land supply response to changes in the post-subsidy rental rate depends on the supply elasticity  $\eta_r^{(S)n}$ . As discussed in the introduction to this section, we set  $\eta_r^{(S)LFA} = 0.2$  and  $\eta_r^{(S)non-LFA} = 0$ .

(E1) Land supply response functions

$$x_{j,r}^{(S)n} = x_r^{(S)n} + \phi_j^n (p_{j,r}^n - p_r^n) \quad (n \in \text{LANDTYPE})(j \in \text{AGRIND})(r \in \text{REGION})$$

(E2) Average rental price of land

$$p_r^n = \sum_j B_{j,r}^n p_{j,r}^n \quad (n \in \text{LANDTYPE})(r \in \text{REGION})$$

(E3) Demand function for land cultivated on LFA areas under activity  $j$  in region  $r$

$$x_{j,r}^{(D)n} = x_{j,r}^{Land} - \sigma_{j,r} (p_{j,r}^n - p_{j,r}^{Land}) \quad (n \in \text{LANDTYPE})(j \in \text{AGRIND})(r \in \text{REGION})$$

<sup>11</sup> For a description of the application of the CES function in CGE modelling, see Dixon *et al.* (1992: 124-126).

<sup>12</sup> For a formal derivation of these percentage change forms from economic problems such as those described by Figure 2, see Dixon *et al.* (1992).



(E4) Average user price of land

$$p_{j,r}^{Land} = \sum_{n \in LANDTYPE} S_{j,r}^n p_{j,r}^n \quad (j \in AGRIND)(r \in REGION)$$

(E5) Land market clearing conditions

$$x_{j,r}^{(D)n} = x_{j,r}^{(S)n} \quad (n \in LANDTYPE)(j \in AGRIND)(r \in REGION)$$

(E6) Net land rentals received by landowners

$$pps_r^n = p_r^n + s_r^n \quad (n \in LANDTYPE) (r \in REGION)$$

(E7) Land supply functions

$$x_r^{(S)n} = \eta_r^{(S)n} (pps_r^n - p_r^{GDP}) \quad (n \in LANDTYPE) (r \in REGION)$$

where:

- $x_r^{(S)n}$  is the percentage change in the supply of land type  $n$  in region  $r$ ;
- $\eta_r^{(S)n}$  is the elasticity of supply of land type  $n$  with respect to its real post-tax rental price;
- $pps_r^n$  is the percentage change in the post-subsidy rental price of land type  $n$  in region  $r$ .
- $p_r^{GDP}$  is the percentage change in the regional GDP deflator for region  $r$ .
- $p_r^n$  is the percentage change in the pre-subsidy rental price of land type  $n$  in region  $r$ ;
- $s_r^n$  is the percentage change in the power (1 plus the rate) of the land rental subsidy on land type  $n$  in region  $r$ ;
- $x_{j,r}^{(S)n}$  is the percentage change in the supply of land type  $n$  in region  $r$  to agricultural industry  $j$ ;
- $\phi_r^n$  is the elasticity of transformation of land type  $n$  in region  $r$  between alternative agricultural uses  $j$ ;
- $p_{j,r}^n$  is the percentage change in the price faced by agricultural producer  $j$  in region  $r$  for land type  $n$ ;
- $B_{j,r}^n$  is the share of type  $n$  land rentals in region  $r$  generated by agricultural industry  $j$ ;
- $x_{j,r}^{(D)n}$  is the percentage change in demand for land type  $n$  by agricultural user  $j$  in region  $r$ ;
- $x_{j,r}^{Land}$  is the percentage change in demand for land (undistinguished by land type) by agricultural industry  $j$  in region  $r$ ;
- $\sigma_{j,r}$  is the elasticity of substitution between different land types faced by agricultural industry  $j$  in region  $r$ ;
- $p_{j,r}^{Land}$  is the percentage change in the average user price of land faced by agricultural industry  $j$  in region  $r$ ;

$S_{j,r}^n$  is the share of industry  $(j,r)$ 's total land costs represented by rentals on agricultural land type  $n$ ;

LANDTYPE (LFA land, non-LFA land).

REGION (regions 1 through 16. See Table 6).

AGRIND (Wheat, Rye, Barley, Other cereals, Oil seeds, Vegetables and fruit, Other crops, Other animals, Pigs, Poultry, Cattle).

## 5. SIMULATION DESIGN: MODELLING LFA IN POLTERM

LFA payments will have immediate impacts on rates of return, regional wage relativities and output prices. Our aim is to investigate the economic consequences of LFA payments after all market adjustments to these immediate LFA-induced relative price changes have taken effect. That is, our concern is long-run. Hence we use a closure of POLTERM that is a variant of the standard long-run TERM closure. This closure defines a long-run solution year with the following characteristics:

- Investors in each industry in each region have had sufficient time to adjust regional industry capital stocks in response to the policy change. Thus changes in demand for capital are manifest as changes in capital supply, not as changes in rental rates. We implement this by allowing capital to be in elastic supply to each regional industry at exogenous rates of return.
- Supply of LFA land is positively related to post-tax land rental rates. Supply of non-LFA land is exogenous.
- We assume that long-run national employment is weakly positively related to the Polish real wage. This reflects Poland's open labour market with the remainder of the EU. As discussed in Section 4.1, we calibrate the labour supply elasticity to reflect Poland's emigration experience following EU accession.
- Since our focus is long-run, we allow labour to move between regions in response to regional wage differentials. However, we recognise that household locational preferences constrain labour movements even in the long-run. We model this by allowing regional employment to be endogenous, but sticky. Stickiness in regional labour supply is achieved by allowing the gap between the regional wage and the national wage to be weakly positively related to the movement in regional employment. In terms of our model results, this closure has the effect of ensuring that long-run regional labour market pressures mostly manifest as movements in regional employment, with only limited movement in relative regional wage rates.
- We assume that the desired rate of capital accumulation in each regional industry in the long-run solution year is independent of the policy shock. We implement this via exogenous determination of regional industry investment/capital ratios. With movements in long-run regional industry capital stocks largely determined by the first closure assumption above, this effectively links long-run movements in regional industry investment to movements in regional

industry capital stocks. National investment is determined as the sum of regional industry investments.

- We constrain movements in the long-run balance of trade to reflect two features of solution year net foreign financing: net receipts of LFA payments by Poland, and the need to finance changes in solution year capital stock. Ceteris paribus, LFA payments received by Poland allow the balance of trade to move towards deficit. In financing the solution year capital stock, we assume that 60 per cent of capital rentals arising from new capital are sent to foreign capital owners via an appropriate movement towards balance of trade surplus. With the solution year balance of trade constrained in this way, we allow private and public consumption to be determined endogenously. This closure can be interpreted as allowing domestic consumption to move with national income, where LFA payments represent an addition to national income, and servicing of foreign financed capital accumulation a gross subtraction from national income. Subject to this national constraint, we assume regional private consumption is a fixed proportion of regional income.
- We assume that long-run regional public consumption spending will follow movements in the long-run regional distribution of economic activity. Regions in which long-run population, employment and consumption are rising (falling) receive a rising (falling) share of national public consumption spending. We model this via exogenous determination of region-specific ratios of real public consumption spending to real private consumption spending.

Our shocks to the POLTERM model are region-specific LFA payments. The aggregate value of Polish LFA payments under CAP funding round 2007-13 is reported in row 1 of Table 1. The regional distribution of these payments is reported in Table 2. These values are used to calibrate shocks to region-specific land subsidy variables, represented by  $s_r^t$  in equation (E6).

## **6. THE NATIONAL, SECTORAL AND REGIONAL EFFECTS OF LFA SUPPORT**

We discuss the national, sectoral and regional economic consequences for Poland of LFA support payments. Our interpretation of the POLTERM results is comprised of a sequence of cross-referenced discussions, each of which relies on familiar economic mechanisms, not details of POLTERM's theoretical structure. As such, readers do not need to be familiar with POLTERM's many equations to follow our discussion of results.

### **6.1 The impact of LFA support on the national macroeconomy**

#### **6.1.1 LFA payments induce a small increase in LFA land supply**

Table 4 reports the effects of LFA support on selected national macroeconomic indicators. At the national level, Poland's annual receipt of PLN 1.2 b. of LFA funds represents approximately

18 percent of the value of pre-LFA land rentals accruing to LFA-designated land<sup>13</sup>. We model the LFA support as a per-hectare subsidy to landowners (see section 4.2 above). In our macroeconomic results, this direct effect of LFA payments is manifested as a 17.8 percentage point gap (=11.8 - -6.0) between the LFA land rental rate received by landowners (row 29) and the LFA land rental rate paid by land users (row 26). LFA payments produce a fall in the user-price of LFA land (row 26) because we allow the supply of LFA land to be a positive function of the post-tax rental value of LFA land (see equation E7 above).

As discussed in section 4.2 above, we set the LFA land supply elasticity at 0.2. With the post-tax rental price of LFA land rising by 11.8 per cent (row 29), this accounts for the increase in the aggregate supply of LFA land by 2.26 per cent (row 5). As discussed in section 4.2, our land use theory allows agricultural producers to substitute between LFA and non-LFA land. With the supply of LFA land increased, the user-price of LFA land must fall (row 26) to induce land users to absorb the increase in LFA land supply.

### **6.1.2 The real wage rises, inducing an increase in the size of the Polish workforce**

For a given level of employment, the increase in the supply of agricultural land (see 6.1.1 above) causes the marginal product of labour to rise. This tendency towards a higher marginal product of labour is reinforced by the rise in the capital stock (see 6.1.3 below) and the terms of trade (see 6.1.9 below). The rise in the marginal product of labour accounts for the movement in the real wage, which rises by 0.16% relative to what it would otherwise have been.

As discussed in Section 4.2 above, recognising that Poland has an open labour market with the rest of the EU<sup>14</sup>, we allow Polish labour supply to vary with the real wage. With the real wage rising relative to basecase, this accounts for the small rise in Polish employment (row 2).

### **6.1.3 The rise in land supply, employment and the terms of trade causes the capital stock to rise relative to basecase**

As discussed in Section 5, we assume Poland can obtain capital at given exogenous rates of return. With land supply and employment higher than basecase (see 6.1.1 and 6.1.2 above), for a given level of capital, the marginal physical product of capital must rise. With the terms of trade higher than basecase (see 6.1.9 below), for a given level of capital, the value of the marginal physical product of capital must rise. However, with rates of return exogenous, scope for the value of the physical marginal product of capital to rise is limited. Hence, the capital stock must expand relative to basecase (row 3).

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<sup>13</sup> In 2005, LFA land rentals were approximately PLN 6.6 b. according to own estimations based on official data from Polish Main Statistical Office.

<sup>14</sup> With some limitation and transition periods in case of some countries

#### **6.1.4 With factor supplies higher than basecase, so too is Polish real GDP**

The LFA payments induce small increases in aggregate land use (see 6.1.1 above), employment (see 6.1.2 above) and capital (see 6.1.3 above). This accounts for the small increase in real GDP relative to what it would otherwise have been (row 1).

#### **6.1.5 LFA payments allow the rise in real consumption to exceed the rise in real GDP**

The increase in national real consumption (rows 8 and 9) is substantially higher than the increase in real GDP (row 1). This reflects a rise in real (CPI-deflated) national income relative to real GDP. Real national income rises by more than real GDP for two reasons. First, the terms of trade improves relative to what it would otherwise have been (see 6.1.9 below). Second, and more importantly, the LFA funds received by Poland are financed almost entirely by the rest of the EU, and thus represent a net rise in Polish national income. Aggregate real consumption rises by 0.2 per cent (row 7). This is comprised of a 0.19 per cent rise in private consumption (row 8) and a 0.22 per cent rise in public consumption (row 9). The larger increase in public consumption relative to private consumption is due to differences across regions in the ratio of public to private consumption. As discussed in section 5, we assume that region-specific real public/private consumption ratios are exogenous. The initial levels of these ratios differ across regions. LFA payments stimulate consumption in regions with relatively high public/private consumption ratios. When outcomes for region-specific real public consumption are aggregated to the national level, the result is an outcome for national real public consumption (row 9) that is slightly higher than the outcome for national real private consumption (row 8).

#### **6.1.6 The rise in the capital stock induces a small rise in real investment**

As discussed in section 5, we assume that solution year investment/capital ratios by regional industry are exogenous. As such, the percentage change in real investment for each regional industry is the same as the percentage change in its physical capital stock. At the national macroeconomic level, this is reflected in a similar outcome for national real investment (row 10) as the national capital stock (row 3).

#### **6.1.7 The rise in GNE exceeds the rise in GDP, moving the trade balance towards deficit**

The outcome for real investment (+0.06 per cent), is quite close to the outcome for real GDP (+0.07 per cent). However the outcome for national real consumption (+0.2 per cent) substantially exceeds the outcome for real GDP (see 6.1.5 above). Together, the outcomes for real investment and real consumption generate a rise in real GNE (row 11) that exceeds the outcome for real GDP. With the outcome for real GNE exceeding the outcome for real GDP, the real balance of trade must move towards deficit. This accounts for the contraction in real export volumes (row 12) and expansion in real import volumes (row 13).

### **6.1.8 The movement towards trade deficit requires real exchange rate appreciation**

The movement in export volumes and import volumes implicit in the movement towards balance of trade surplus (see 6.1.7) requires a rise in the price of Polish goods relative to foreign goods. That is, it requires the real exchange rate to appreciate (row 15). Appreciation of the real exchange rate facilitates export contraction by rendering Polish goods relatively more expensive in foreign markets. Appreciation of the real exchange rate facilitates import expansion by rendering Polish goods relatively more expensive relative to competing imports within the domestic Polish market.

### **6.1.9 The contraction in export volumes causes the terms of trade to rise**

In POLTERM, commodity-specific export volumes are modelled as inversely related to commodity-specific foreign currency prices. The contraction in export volumes (see 6.1.7 above) thus requires a rise in foreign currency export prices. This accounts for the rise in the terms of trade, relative to what it would otherwise have been (row 14).

## **6.2 The impact of LFA support on national industrial outcomes**

Table 5 reports national results for output by sector. The largest beneficiaries of the LFA funds are agricultural industries (rows 1-11, Table 5). This reflects the expansion in LFA land generated by the LFA funds (see 6.1.1 above). Food processing industries (rows 15-20, Table 5) are indirect beneficiaries of the expansion in agricultural land supply. By lowering the prices of agricultural output, expansion of agricultural production stimulates output of food processing industries by lowering input costs. At the same time, food processing industries receive a demand-side fillip to their output via the expansion in real household consumption spending (see 6.1.5 above). Expansion in real consumption, both private and public, also accounts for expansion in the output of such industries as hotels and restaurants (row 26), dwellings (row 29), education (row 30), public administration (row 31), health (row 32) and other services (row 33). Note that traded goods sectors, such as forestry (row 12), mining (row 14) and other manufacturing (row 21) are adversely affected by Poland's receipt of LFA payments. This reflects the appreciation of the real exchange rate (see 6.1.8 above).

## **6.3 The impact of LFA support on Poland's regional economies**

We report regional macroeconomic outcomes in Table 6. In Figure 1, we mark regions experiencing the highest real GDP gains due to LFA with the numbers 1, 2, and 3. We classify two of these regions (Podlaskie and Lubelskie) as Predominantly Agricultural, and two of the regions (Lubelskie and Warminsko-Mazurskie) as Predominantly Rural. Lubelskie is one of the poorest regions in the whole EU.

The chief determinant of relative regional GDP outcomes is the relative importance of LFA funding expressed as a share of regional GDP (Figure 3). LFA funding as a share of regional GDP is reported in the first column of Table 6. Figure 3 reports POLTERM results for real regional GDP outcomes. It also reports a predicted regional real GDP outcome based on a regression equation estimated by regressing the POLTERM results for real regional GDP (column 2, Table 6) against the ratio of regional LFA receipts to regional GDP (column 1, Table 6). In Figure 3 we find the predicted real GDP outcomes closely match the POLTERM real regional GDP outcomes.

As discussed in Section 5, national employment is weakly positively related to the real wage. However, despite national employment being endogenous, it remains sufficiently constrained that long-run expansion in employment in one Polish region will typically be at the expense of long-run employment in other Polish regions. By expanding land supply and agricultural production in some regions more than others, LFA funds cause a regional redistribution of national employment. In Table 6, we find employment tends to shift from the most urban regions (such as Slaskie, Dolnoslaskie, Opolskie) to more rural regions (Podlaskie, Warminsko-Mazurskie, Lubelskie).

Column 6 of Table 6 reports percentage changes in LFA land supply relative to what it would have been in the absence of the LFA policy. Column 8 reports the percentage change in total agricultural land area by region. Together, these columns indicate the extent of land that would be released from agricultural use in the absence of the LFA policy. Hence, the results in columns 6 and 8 are a measure of the success of the Polish LFA in meeting its ostensible aim of maintaining land in agricultural use. In the absence of the LFA program the region that would release the most land from agricultural use is Podlaskie (row 10), the most agricultural region in Poland. The regions least affected in terms of agricultural land use would be Slaskie, Dolnoslaskie and Opolskie. These are among the most urban regions in Poland.

## **7. CONCLUDING REMARKS**

We analyse the largest EU Rural Development Policy instrument in Poland, namely support for Less Favored Areas (LFA). Poland's receipt of LFA payments allows real national consumption spending to be 0.2 per cent higher than it would otherwise have been. As such, Poland is a net beneficiary of the LFA program. However these large transfers from EU cause the Polish real exchange rate to appreciate. This Dutch Disease effect has an adverse impact on trade-exposed sectors. At the regional level, we find some evidence that the policy contributes to its ostensible aim, namely, retention of marginal agricultural land use in predominantly agricultural and rural regions.

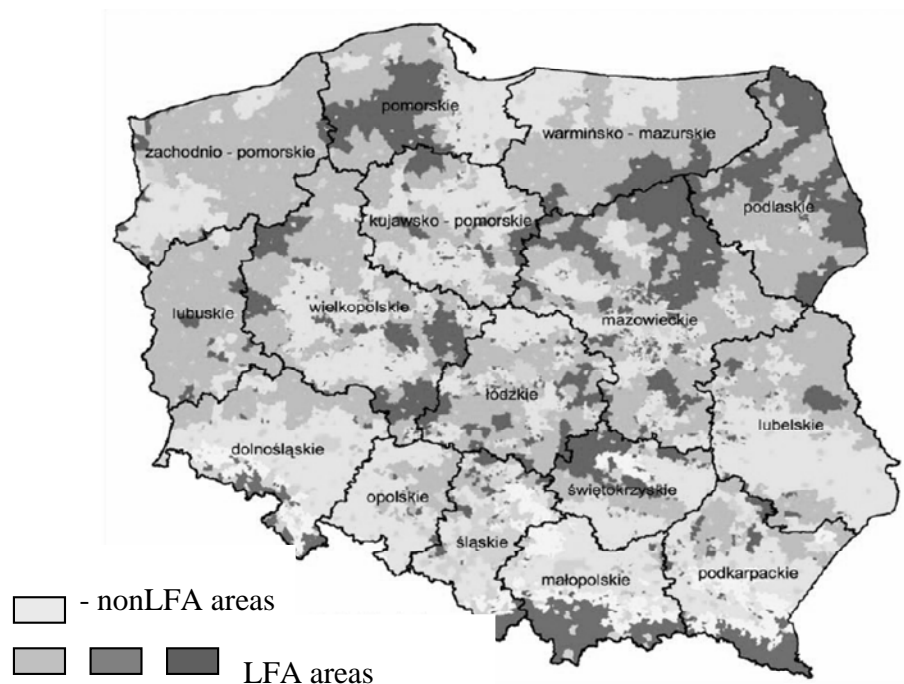
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Map 1 LFA area in Poland across NUTS2 regions



Source: RDP 2007-2013

**Table 1 Amounts and shares of Pillar II measures, sorted by size**

		Mio. NAC*	%
	Short name of measure		
1	LFA (Less favoured areas)	1203.4	14.7
2	Agri-Environmental programs	1132.1	13.9
3	Early Retirement	1007.9	12.3
4	Modernization of farms	820.0	10.0
5	Basic Services	677.9	8.3
6	Added Value	506.8	6.2
7	Micro-Enterprises	471.6	5.8
8	Afforestation	321.1	3.9
9	Development of Infrastructure	276.4	3.4
10	Village Renewal	271.6	3.3
11	Semi-subsistence farms' support	202.7	2.5
12	Young Farmers support	193.5	2.4
13	Technical Assistance	163.8	2.0
14	Advisory	161.3	2.0
15	Diversification	159.2	1.9
16	Restoring Forest	68.8	0.8
17	Producer Groups	64.5	0.8
18	Food quality systems	46.1	0.6
19	Training	18.4	0.2
20	Information and Promotion	13.8	0.2
21	LEADER (1+2+3)	387.0	4.7
<b>23</b>	<b>Total</b>	<b>8168.0</b>	<b>100.0</b>

\* National currency, Polish zloty, PLN (1 PLN  $\approx$  0.25 EUR)

Source: Based on Polish RDP 2007-2013

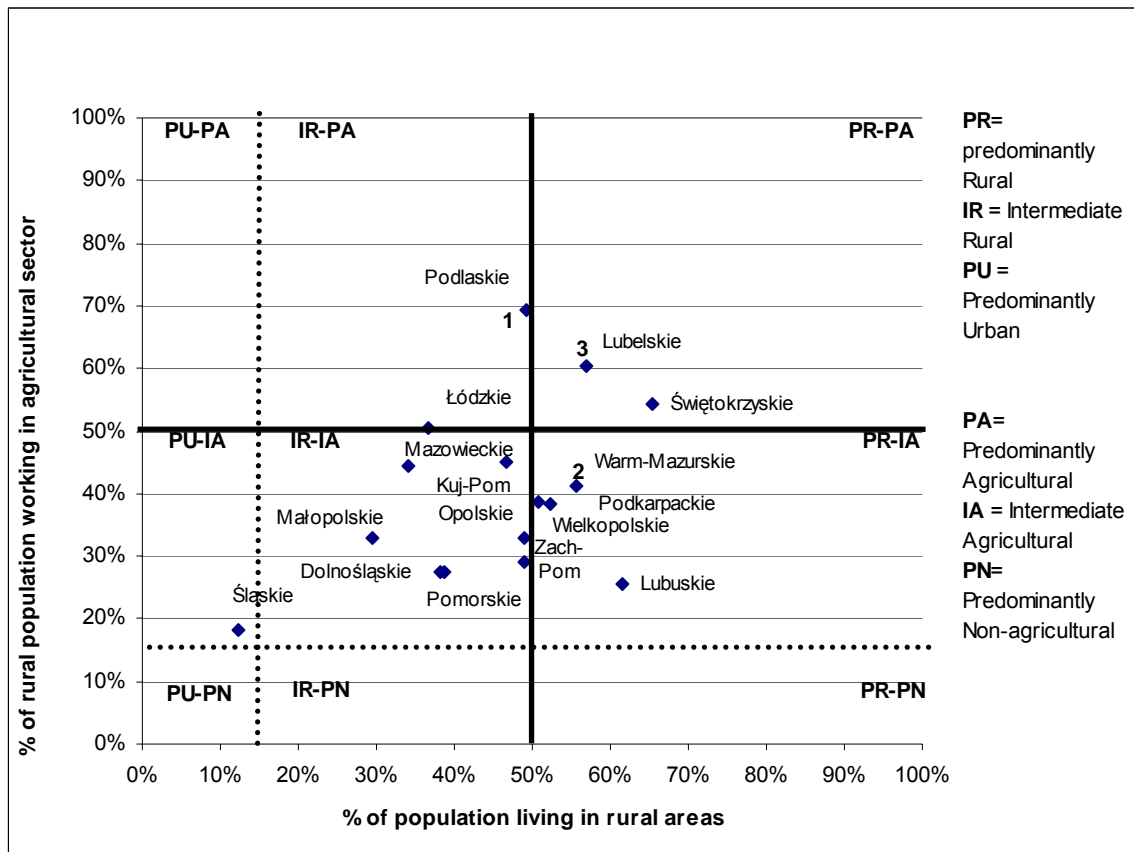
**Table 2 Regional structure of annual LFA payments in Poland (millions of national currency, NAC\*)**

	Annual spend	% of LFA support	million NAC
1 DOLNOSLASKIE		0.036	43.7
2 KUJPOMORSKIE		0.053	64.4
3 LUBELSKIE		0.067	80.7
4 LUBUSKIE		0.03	36.6
5 LODZKIE		0.075	90.8
6 MALOPOLSKIE		0.04	48.7
7 MAZOWIECKIE		0.185	222.1
8 OPOLSKIE		0.008	10
9 PODKARPACKIE		0.032	39.1
10 PODLASKIE		0.134	160.9
11 POMORSKIE		0.049	58.6
12 SLASKIE		0.015	17.6
13 SWIETOKRZYSK		0.028	33.4
14 WARMMAZURSKI		0.074	88.9
15 WIELKOPOLSKI		0.128	153.9
16 ZACHPOMORSKI		0.045	53.9
<b>Total</b>		<b>1</b>	<b>1203.4</b>

\*National currency, Polish zloty, PLN (1 PLN  $\approx$  0.25 EUR)

Source: Own calculations based on Polish RDP 2004-2006

Figure 1 Rural Typology of Polish NUTS2 regions

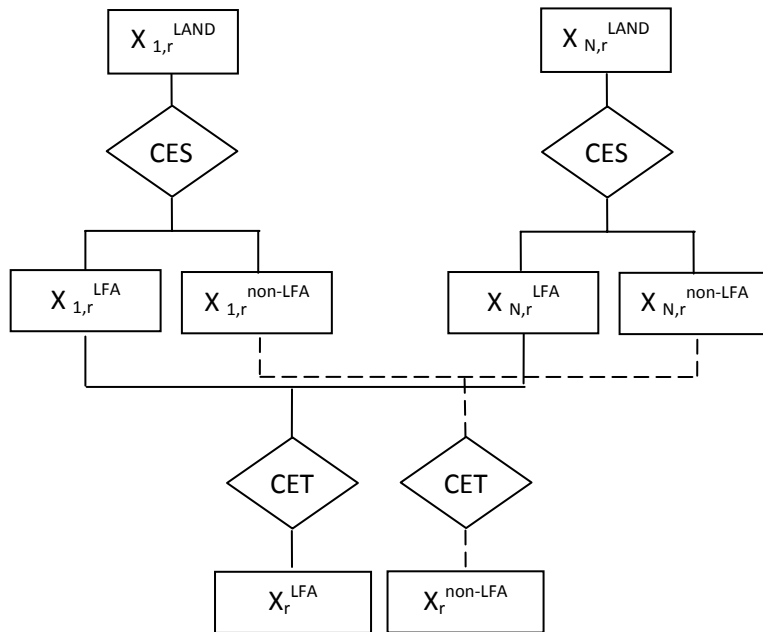


Source: Authors own calculations

Table 3. Two-dimensional OECD based rural typology of regions.

		% employed in agricultural sector		
		Predominantly Agricultural Above 50%	Intermediate Agricultural Between 15-50%	Predominantly NonrRural Below 15%
% share in total population	<b>RURAL POPULATION:</b>			
	Predominantly Rural Above 50%	<b>Type 1</b> <b>PR-PA</b>	<b>Type 2</b> <b>PR-IA</b>	<b>Type 3</b> <b>PR-PT</b>
	Intermediate Rural Between 15-50%	<b>Type 4</b> <b>IR-PA</b>	<b>Type 5</b> <b>IR-IA</b>	<b>Type 6</b> <b>IR-PT</b>
	Predominantly Urban Below 15%	<b>Type 7</b> <b>PU-PA</b>	<b>Type 8</b> <b>PU-IA</b>	<b>Type 9</b> <b>PU-PN</b>

Figure 2: Agricultural land supply and agricultural land demand in POLTERM



**Table 4: Impact of LFA support at the national level<sup>(a)</sup>**

National macroeconomic indicator:	% change
1. Real GDP at market prices	0.07
2. Aggregate employment (wage bill weighted)	0.02
3. Aggregate capital stock (rental weighted)	0.06
4. Aggregate land supply - all land (rental weighted)	1.19
5. Aggregate land supply - LFA land (rental weighted)	2.26
6. Aggregate land supply - non-LFA land (rental weighted)	0.00
7. Real consumption (private & public)	0.20
8. Real private consumption	0.19
9. Real public consumption	0.22
10. Real investment	0.06
11. Real GNE	0.17
12. Real exports	-0.23
13. Real imports	0.07
14. Terms of trade	0.06
15. Real exchange rate	0.08
16. Nominal exchange rate (foreign currency/PLN)	0.00
17. Consumption deflator (private & public)	0.06
18. Private consumption price deflator	0.04
19. Public consumption price deflator	0.13
20. Investment price deflator	0.05
21. GDP deflator (market prices)	0.08
22. GDP deflator (factor cost)	0.08
23. Real wage	0.16
24. Rental price of capital	0.05
25. Average user price of land - all land (rental weighted)	-2.20
26. Average user price of land - LFA land (rental weighted)	-6.02
27. Average user price of land - non-LFA land (rental weighted)	2.18
28. Average owner price of land - all land (rental weighted)	7.33
29. Average owner price of land - LFA land (rental weighted)	11.8
30. Average owner price of land - non-LFA land (rental weighted)	2.18

(a) Results are reported as annual percentage changes away from where the economy would otherwise have been in the absence of LFA support.

Source: Authors' calculations using POLTERM.



**Table 5 Impact of LFA support on output by sector**

Sector	Percentage change in output
1. Wheat	0.35
2. Rye	0.42
3. Barley	0.34
4. Other cereals	0.38
5. Oil seeds	0.33
6. Vegetables and fruit	0.40
7. Other crops	0.38
8. Other animals	0.46
9. Pigs	0.36
10. Poultry	0.35
11. Cattle	0.40
12. Forestry	-0.01
13. Fishing	0.12
14. Coal, ore and other mining	-0.02
15. Beef meat manufacturing	0.13
16. Pork meat manufacturing	0.11
17. Dairy products	0.11
18. Other food products	0.14
19. Beer manufacturing	0.16
20. Other beverages	0.27
21. Manufacturing n.e.c.	-0.13
22. Electricity (coal generated)	0.06
23. Other electricity	0.06
24. Construction	0.06
25. Trade	0.03
26. Hotels and restaurants	0.14
27. Transport	0.00
28. Finance	0.03
29. Dwellings	0.10
30. Education	0.18
31. Public administration	0.21
32. Health	0.21
33. Other services	0.11

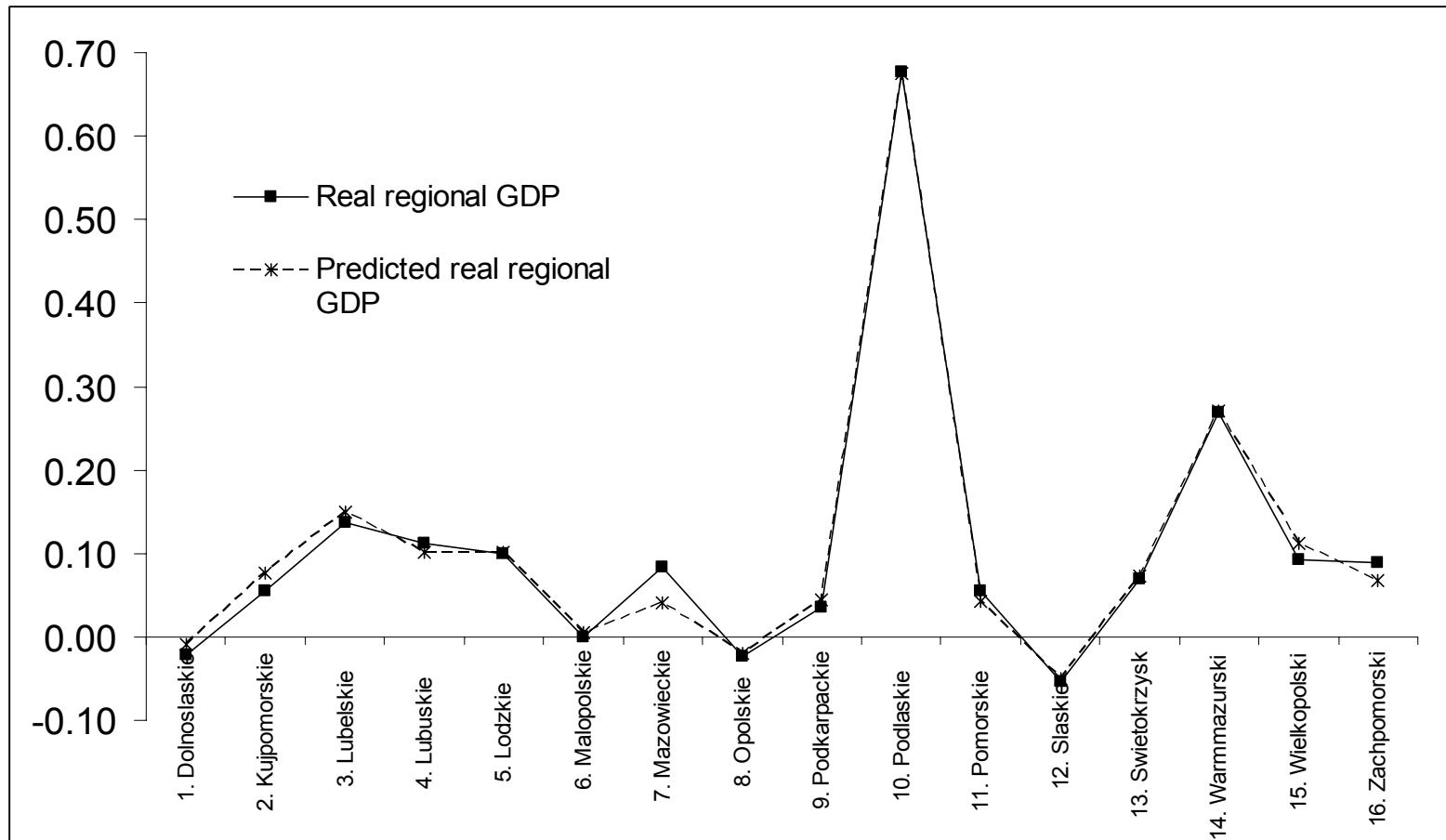
*Source: Results of the POLTERM model. Regional industry results aggregated to the national level.*

**Table 6 Regional impact of LFA support**

Region	LFA funds as a per cent of regional GDP	Real GDP	Real Consumption	Employment	Capital stock	Land supply		Total Land Supply
						LFA Land	Non-LFA Land	
1. Dolnoslaskie	0.05	-0.02	0.02	-0.05	-0.02	1.66	0	0.41
2. Kujpomorskie	0.14	0.06	0.20	0.01	0.05	2.96	0	0.86
3. Lubelskie	0.21	0.14	0.37	0.09	0.12	2	0	0.98
4. Lubuskie	0.16	0.11	0.29	0.05	0.10	2.08	0	1.97
5. Lodzkie	0.16	0.10	0.27	0.04	0.09	1.7	0	1.35
6. Malopolskie	0.07	0.00	0.06	-0.03	0.00	2.5	0	0.73
7. Mazowieckie	0.1	0.08	0.19	0.02	0.09	2.6	0	2.06
8. Opolskie	0.04	-0.02	0.01	-0.04	-0.02	1.2	0	0.24
9. Podkarpackie	0.11	0.04	0.15	0.00	0.03	2.1	0	0.82
10. Podlaskie	0.73	0.68	1.52	0.47	0.59	4.33	0	4.1
11. Pomorskie	0.1	0.06	0.17	0.01	0.06	2.15	0	1.59
12. Slaskie	0.01	-0.05	-0.06	-0.08	-0.04	0.73	0	0.11
13. Swietokrzyskie	0.13	0.07	0.21	0.02	0.06	1.6	0	0.95
14. Warmmazurski	0.33	0.27	0.65	0.17	0.23	2.46	0	2.08
15. Wielkopolski	0.17	0.09	0.27	0.03	0.08	2.03	0	1.2
16. Zachpomorski	0.13	0.09	0.23	0.03	0.09	1.87	0	1.48

Source: Results from the POLTERM model

Figure 3: Real regional GDP and predicted real regional GDP compared (percentage change from base-case, long-run solution)



Source: Authors' calculations using POLTERM output. Predicted real regional GDP is calculated from the linear regression of the POLTERM result for real regional GDP against region specific LFA / GDP ratios.