Modelling the Effects of Immigration on Regional Economic Performance and the Wage Distribution: A CGE Analysis of Three EU Regions

Pouliakas, Konstantinos and Roberts, Deborah and Balamou, Eudokia and Psaltopoulos, Dimitris

University of Aberdeen Business School, University of Patras

30 November 2008

Modelling the Effects of Immigration on Regional Economic Performance and the Wage Distribution: A CGE Analysis of Three EU Regions

KONSTANTINOS POULIAKAS[*], DEBORAH ROBERTS*, EUDOKIA BALAMOU[§] and DIMITRIS PSALTOPOULOS[§]

**University of Aberdeen Business School, Edward Wright Building, Dunbar Street, Old Aberdeen, AB24 3QY, Scotland, UK. Emails: k.pouliakas@abdn.ac.uk, deb.roberts@abdn.ac.uk*
[§] University of Patras, Greece, University Campus, Rio 26500 Patras, Greece. Emails: ebalamou@upatras.gr, dempsa@upatras.gr

ABSTRACT

The paper uses a regional Computable General Equilibrium (CGE) model to analyse the effects of immigration on three small remote EU regions located within Scotland, Greece and Latvia. Two migration scenarios are assessed. In the first, total labour supply is affected. In the second, the importance of migratory flows by differential labour *skill types* is investigated. The results indicate significant differences in the extent to which regional economies are affected by immigration. They also suggest that remote regions are highly vulnerable to the out-migration of skilled workers ('brain-drain') while the in-migration of unskilled workers leads to widening wage inequality.

JEL- Codes: D33, D58, R13, R23

Key Words: Immigration, CGE, Skills, Wage Inequality, Brain-drain, Regional economies

INTRODUCTION

Much research has focused on the economic and social impact of immigration, primarily on the recipient national economies. This has reflected the increasing worldwide flow of migrant labour that has taken place in the past 50 years, as a result of the greater globalization of economic activity, more lenient immigration policies, the foundation of the European Single Market and, lately, EU enlargement. In the EU, in particular, the recent accession of eight Central and Eastern European countries (the Czech Republic; Estonia; Hungary; Latvia; Lithuania; Poland; Slovakia and Slovenia – the so-called A8 group) has spurred controversy regarding the macroeconomic, fiscal and labour market impacts of the large movements of workers from these countries on both the "receiving" and "exporting" economies[1].

In the face of these developments, particular attention has been paid to testing whether the widespread concerns that immigration harms domestic employment prospects and wages are justified. Studies have usually been conducted on the basis of national Labour Force Surveys or other census data, or have focused on cross-city comparisons. However, one would expect that immigration is likely to exert its most significant impact on economies at the regional level. BLANCHFLOWER *et al*. (2007, p. 12) show that there is an important regional element in the decision of individuals to migrate. Although they have a propensity to settle in urban centres (presumably because of higher wages, anonymity, less traditional lifestyle etc.), it has been asserted that the mere survival of many rural/peripheral economies in Europe, such as the Highlands of Scotland, has become largely dependent in recent years on migrant labour (ECONOMIST, 2007; GREEN *et al*., 2008). It follows that there is a need to examine the effect of migration at a sub-national/regional level in addition to national-level.

Further, in a study of internal migratory flows, ØSTBYE and WESTERLUND (2007) show that that the impact of migration depends not only on the level of migration but also on the human capital of the migrants involved, and show that the effects of in- and out-migratory flows may not be symmetric. The same arguments apply in the case of migrants into and from small regions. As the migratory flows associated with EU enlargement have been accused of leading to 'brain drain' effects in lagging regions (BALáZ *et al*., 2004), it follows that an analysis of the effects of immigration on host and source regions should explicitly account for the skills levels of migrants.

Against this background, this paper examines the effects of immigration on three distinct remote regions of the EU. These areas are found in Scotland (*East Highlands*), Greece (*Heraklion/Archanes*) and Latvia (*Latgale*), and were chosen on the basis that the former two have been recipients of primarily low-skilled labour in the past decade, while the latter has been an exporter of mainly high-skilled workers following its accession to the EU. Using a Computable General Equilibrium (CGE) model, the impact of different scales and of diverse skill-types of immigration on the GDP levels and wage distributions of these three regional economies are estimated. The CGE model used in the analysis is based on the framework developed by IFPRI (LOFGREN *et al.*, 2002), but it has been adapted to include several specific characteristics of the regional economies under consideration and captures the full range of economic interdependencies that exist within each region. Specially constructed regional Social

Accounting Matrices (SAMs) for each of the case study areas are used to calibrate the CGE models and two complementary economic scenarios are subsequently explored. In the first scenario (*basic*), there is either an increase or a reduction of 10% in the total amount of labour supplied to an area through migration. This is then followed by a *skills* analysis, designed to test the impact of the observed phenomena of 'brain drain' and 'brain gain' that sender and receiver countries experience, respectively, as a result of the flow of human capital across borders.

The rest of the paper is structured as follows: Section 2 provides a discussion of the theoretical underpinnings of the overall impact of immigration and summarizes the relevant literature. Section 3 describes the nature and specific characteristics of the CGE modelling framework used in the analysis and its application in this case. Section 4 provides brief background information on the three case study areas, based on information from the underlying SAMs. Section 5 presents the main results from the analysis while Section 6 engages in sensitivity analysis. Section 7 concludes.

THEORETICAL BACKGROUND AND LITERATURE REVIEW

In addition to focusing on the economic factors that determine immigration (NASKOTEEN and ZIMMER, 1980; ZORLU and MULDER, 2007; BORJAS, 2005), several studies have addressed the extent to which immigration has affected the employment and income outcomes of native workers. Popular fears about the adverse consequences of immigration are usually based on the standard economic paradigm, which would predict that an additional supply of workers into an economy is expected to reduce wages, *ceteris paribus*. It also follows that if wages are rigid, the unemployment rate should rise in response to an excess supply of labour, especially if immigrants and native labour are substitutes in production.

In addition to wage-setting mechanisms (BRUCKER and KOHLHAAS, 2004), the impact of migration will, in theory, depend on whether the economy is open to trade. In particular, according to the Heckscher-Ohlin-Samuelson (HOS) model, the effect of immigration on an open economy will depend on the relative prices of traded goods (the *STOLPER-SAMUELSON theorem*, 1941), or, given relative prices, on relative factor endowments (the *RYBCZYNSKI theorem*, 1955), which will ultimately

determine the optimal output-mix in the economy. It follows that changes in the volume and structure of trade and production can play a significant part in regulating the impact of an increasing labour supply to an economy. Specifically, in economies with large and diversified traded goods sectors, any initial depressive effect of immigration on wages is likely to be absorbed in the long-run by a changing output-mix towards those sectors that use intensively labour types that have become cheaper. *Long-run factor price insensitivity* (LEAMER and LEVINSOHN, 1995) is then likely to hold. Nevertheless, in economies with small and non-diversified traded goods sectors (as is most likely to be the case for the small regional economies that are analyzed in this paper), immigration is expected to lead to falling wages for certain skill types but also to rising returns for complementary skill groups. The reason is that the lack of flexibility in the output mix in the traded goods sector means that there are insufficient degrees of freedom to accommodate changes in the skill mix (DUSTMAN *et al*, 2005).

Another theoretical consideration is how the initial factor endowments are affected by the migratory flows. As explained in ØSTBYE and WESTERLUND (2007), if labour is homogenous, migration will increase the capital intensity in regions with net out-migration and decrease capital intensity in regions with net in-migration. Since, according to neoclassical growth theory, countries with low capital intensity grow faster than those with high capital intensity, migration in this case will lead to greater economic convergence *ceteris paribus*. In contrast, when labour is heterogeneous, the impact of migration on economic performance of the host and source regions is ambiguous, depending on the relative productivity of migrants and non-migrants. It follows that the effects of in-and out-migration are not necessarily symmetric. Of course, all of these conclusions are also moderated by other important determinants, such as differences in the level of technology, the existence of non-tradable goods sectors or the immobility of factors across sectors.

Given the above theoretical predictions, the weight of the empirical evidence suggests that at the national level "the impacts of immigration on non-immigrant employment and unemployment outcomes are minimal, but there is some evidence of wage effects" (BLANCHFLOWER *et al*., 2007, p. 18; DUSTMAN *et al*., 2005). For example, BORJAS and KATZ (2005) have shown that US workers lost on average about 3% of the real value of their wages because of immigration, and that this loss reached 9% for high school dropouts. These negative effects are larger than those reported by LONGHI *et al* (2005,

p. 472), whose meta-analysis of 348 estimates concluded that "a 1 percentage point increase in the proportion of immigrants in the labour force lowers wages across the investigated studies by only 0.119%". Considering the impact of different skill types of migration on the wage distribution, CORTES (2005) has also found that immigration generates a redistribution of wealth by reducing the real income of low-skilled natives and raising that of the high-skilled.

Some studies have suggested that the inflow of foreign labour can fuel a nation's economic growth and GDP, primarily by raising the supply potential of the economy, alleviating any skill bottlenecks and by raising the domestic rate of productivity growth (ERNST and YOUNG, 2007). However evidence suggests only very small impacts of immigration on GDP per capita (HOUSE OF LORDS, 2008, p. 25).

Migration has also been found to have a positive and growing impact on public finances (HOME OFFICE, 2007, p. 8), thus reducing the burden on social security funds. However, estimates of the fiscal impacts are critically dependent on who counts as an immigrant (or as a descendant of an immigrant) and on what items to include under costs and benefits (op cit., 2008, p. 40). Finally, the overall impact of immigration on inflation is not clear-cut, as immigrants are both consumers and workers/producers, so immigration affects both aggregate supply and demand (BLANCHFLOWER *et al*., 2007, p. 23).

The above implies that there are a multitude of factors that need to be taken into consideration when examining the overall effect of immigration on a national economy or region. CGE models seem well-suited for undertaking this task, as they simultaneously consider the plethora of economic mechanisms and avenues which would determine the ultimate impact of changes in labour supply on economic activity. As argued recently by LEE (2007, p. 13), "a meaningful exploration of immigration and wages requires a clear understanding and treatment of the general equilibrium mechanisms at play".

Previous studies that have considered the role of immigration using a general equilibrium approach include OTTAVIANO and PERI (2005) and BRUCKER and KOHLHAAS (2004). A shortfall of such studies is that they have been conducted at a national or cross-city level despite evidence that migrants are usually concentrated in certain occupations *and in certain areas of their host countries* (HOME OFFICE, 2007, p. 16). It follows that an inflow of migrant labour is likely to have its most marked influence on economic and social cohesion at the sub-national level. However, capturing the impact of immigration on local labour market outcomes has been problematic in econometric research, as many

survey data sets do not include detailed (or sufficient) spatial information so as to construct measures of regional concentration of immigrants (DUSTMAN *et al*., 2005). Those wishing to undertake CGE analyses have also been hindered by the lack of regionally-specific Social Accounting Matrices (SAMs) required to calibrate such models. The SAMs and CGE models that are developed in this paper have nonetheless been specifically adapted to address the regional element that is inherent in the analysis of the economic impact of immigration and also to explore the potential differences in impacts associated with the skills levels of migrants.

THE MODELLING FRAMEWORK

Over the last few decades CGE models have become a common tool of empirical economic and policy analysis in both developed and developing countries and a standard methodology has been developed in particular to formulate, calibrate and solve such models. The CGE model implemented for this paper draws especially on one of the standard frameworks made available by IFPRI (LOFGREN *et al*., 2002). Starting with this basic structure, a number of necessary modifications have been made, so that the model is adapted to reflect specific characteristics of the three study regions.

The regional SAMs

All CGE models (at least implicitly) use a SAM to provide the base year values which, in conjunction with other data (e.g. physical quantities, elasticities), are used to calibrate the CGE model. Figure 1 illustrates the basic SAM structure used for the purposes of this analysis. The figure shows that the productive activities of firms, the factors of production (labour, land and capital) and the household accounts have been spatially disaggregated into the urban and rural parts of each region. In contrast, the commodities accounts have been kept identical across the whole study region. Also important in terms of interpreting the figures in the SAM and associated CGE model, the Rest of the World (ROW) account covers transactions with both the rest of the national economy and foreign imports/exports.

[INSERT FIGURE 1 HERE]

Based on this structure, SAMs were constructed for each case study region using a combination of primary and secondary data and mechanical and manual methods. The construction process differed somewhat between the three regions as did the base year of the matrices (2005 for East Highlands and Latgale, 2004 for Archanes-Heraklion) but all three involved the regionalization of national tables, superiorisation of entries in the regionalized tables based on extensive household, business and key informant surveys, and finally the use of cross-entropy methods to balance the superiorised SAMs (ROBINSON *et al.*, 2001). Further details of the construction process and the regional SAMs are given in POULIAKAS *et al.* (2008).

The regional CGE model

The model comprises of a set of (linear and nonlinear) simultaneous equations. Production and consumption behaviour is captured by a number of nonlinear profit and utility maximization optimality conditions. The equations also include a set of constraints that have to be satisfied by the system as a whole, covering markets (for factors and commodities) and macroeconomic aggregates (balances for Savings-Investment, the government, the current account and the ROW). The description which follows presents key features of the model. The model equations, along with the GAMS code and elasticities used to calibrate the base year SAM data, are available from the authors upon request.

Production behaviour

Production is based around activities, where each activity is based in either the rural or urban part of the region and produces one or more commodities in fixed proportions per unit of activity (shown by activity row entries in the commodity columns of the SAMs). Production is modeled as a two-layered structure, as seen in Figure 2. At the top level, technology is specified by a constant elasticity of substitution (CES) function of the quantities of value-added and aggregate intermediate input. At the bottom level each activity uses composite commodities as intermediate inputs, where intermediate demand is determined using fixed Input-Output (I-O) coefficients. Value added is a CES function defined over factors of

production which are spatially specific. Profit maximizing behaviour implies a derived demand for the factors of production up to the point where the marginal revenue product of the factor is equal to its price.

[INSERT FIGURE 2 HERE]

Factor payments accrue to the owners of the factors (households) as reflected in the base SAMs. The CGE model requires certain assumptions in relation to the way in which supply and demand in factor markets comes about. The results presented below are based on the assumption that the economies have segmented labour markets in terms of skilled and unskilled employment but both of these are integrated across space (as workers are likely to be mobile between the urban and the rural areas of the regions). It has also been necessary to assume a neoclassical closure rule, which reflects the assumption of a closed labour market with an endogenous (flexible) wage rate which clears the factor market.[ii] In contrast, the fixed regional supplies of the two non-labour factors of production (capital and land) are treated as immobile between activities. All of these assumptions were deemed to be realistic descriptions of the conditions that characterize the small regional economies under study, and sensitivity analysis was conducted to test the extent to which they influence the magnitude and qualitative nature of the findings.[iii]

Commodities

Commodities (either produced within the region or imported) enter markets, and activity-specific commodity prices serve to clear the implicit market for each disaggregated commodity. As shown in Figure 3, at the first stage regional (domestic) output is produced from the aggregation of output of different activities within the region of a given commodity. At the next stage, the aggregated regional output is split into the quantity of regional output sold domestically and of that exported via a constant elasticity of transformation (CET) function.

[INSERT FIGURE 3 HERE]

An Armington function is used to prevent over-specialization and to better reflect the empirical realities of the regions. This approach assumes imperfect substitutability between imports, exports and commodities produced within the region (LOFGREN *et al*., 2002, p. 11). Regional market demands are thus assumed to be for a composite commodity made up of imports and regional output, as captured by a

CES aggregation function.[iv] The model assumes that export and import demands are infinitely elastic at given world prices. Flexible prices are also assumed to equilibrate demands and supplies of domestically marketed domestic output.

Institutions

Institutions are represented by households, the government and the Rest of World (ROW). Each household type receives income from factors (in proportions fixed at the base year level), transfers from the government and the ROW. They use their income to pay direct taxes, save and make transfers to other institutions and the remaining income is spent on the consumption of marketed commodities. Household consumption is allocated across commodities according to linear expenditure system (LES) demand functions, derived from maximization of a Stone-Geary utility function.

A combined government account (representing both central and local government activity) collects taxes (direct taxes from households, activity taxes from production sectors, indirect tax on commodities and transfers from ROW) and receives transfers from other institutions. It then uses this income to purchase commodities for its consumption and for transfers to other institutions. Government savings are the residual given by the difference between government income and spending. Finally, from the ROW account one can deduce the amount of foreign savings (or the current account deficit) as the difference between foreign currency spending and receipts.[v]

Macroeconomic Closure rules

The model includes three macroeconomic balances: the government balance, the external balance and the Savings-Investment Balance. In common with other CGE models of small regions (JULIA-WISE *et al.*, 2002; WATERS *et al.*, 1997), in all three (Scottish, Greek and Latvian) models the government balance was achieved by allowing government savings to adjust endogenously within the model while direct tax rates were fixed. The external balance was achieved through flexible foreign savings while the real exchange rate was assumed fixed. Finally, in order to achieve the Savings-Investment Balance, it was assumed that the economies under analysis were savings-driven (the value of investment adjusts) with fixed MPS for all non-government institutions.

THE CASE STUDY AREAS

This section provides a brief outline of some of the key features of the three case study economies with Table 1 presenting some basic summary statistics as derived from the regional SAMs.

[INSERT TABLE 1 HERE]

The Greek study area consists of the urban centre of *Heraklion* (NUTS 5 area) and the closely linked rural municipality of *Archanes*, both of which are part of the Prefecture of Heraklion, located in North Central Crete, Greece. Per capita GDP in the region in the base year SAM (2004) was 10,711 euros, with per capita GDP (by place of work) in the rural part of the Greek study area being 35% higher than the urban. With respect to migration patterns, the population of Archanes (amounting to 4548 people) has increased by 6.3 percent during the 1991-2001 period, with most immigrants being employed in the agricultural and tourism sectors. The increase in the population of the urban city of Heraklion (amounting to 137,711 inhabitants) has been more pronounced since 1991. Specifically, it has increased by approximately 14.2%, primarily due to in-migration of unskilled labour from the surrounding rural areas of the Prefecture. Immigrant labour in Heraklion is mostly employed in the secondary sector as well as in the provision of tourism-related services.

The Scottish case study area, the *East Highlands*, is a NUTS 3 region (UKM42) and consists of an urban centre, Inverness, and its surrounding rural hinterland. According to the OECD typology, the region as a whole is a "rural-leading" region reflecting its remote geographical position and at the same time its relatively strong performance compared to other rural areas in the EU. In 2005, the base year of the analysis, per capita GDP in the region was the highest of the three regions considered at 23,734 euros. Per capita GDP in the rural part of the study area was less than half that in the urban core of the region reflecting high levels of rural to urban commuting in the region.

The Highlands of Scotland has, historically, been characterised by out-migration. However from the mid-1990s this trend has been reversed due to in-migration from both the rest of the UK and, increasingly, overseas. Data issues make it difficult to gauge the precise level of in-migration. Information from the General Register Office for Scotland (based on GP registrations and moves) suggests an overall population increase of 4,670 (2.2%) from 2001 to 2005 (HIGHLAND COUNCIL,

2007) but this measure excludes most short-term overseas migrant workers. Home Office records suggest that a total of 5,505 such overseas workers moved to the Highlands between April 2001 and March 2006, increasing from 225 in 2001/02 to 2590 in 2005/06. Of these, 2750 were from EU Accession States (1870 from Poland), with the East Highlands (Inverness in particular) constituting by far the most popular workplace in the Highlands (HIGHLAND COUNCIL, 2006). Only Edinburgh, Glasgow and Aberdeen (the largest three cities in Scotland) received greater numbers over the same period.

Although they may have high levels of human capital, data suggests that the vast majority of migrant workers fill unskilled jobs in the region, primarily as process operatives, kitchen and catering assistants, maids/room attendants or waiter/waitresses (ibid., 2006). Importantly, 80% of the migrant workers moving to the Highlands were aged between 18 and 34, with very few dependents declared. This type of migration movement thus represents a major departure from the typical youth out-migration that characterises remote rural areas in the UK (STOCKDALE, 2006). It is also distinct from the in-migration of older cohorts to rural areas, drawn by quality of life considerations.

Finally, the Latvian case study area is *Latgale*, a NUTS3 region situated in the eastern part of the country, bordering with Russia and Belarus. The urban part of the region includes two cities (Rēzekne and Daugavpils), while the rest of the region is classified as rural. Using the OECD typology, it is a predominantly rural-lagging region with low population density.

As shown in Table 1, per capita GDP in the region is far lower than in the Western European counterparts. Agriculture and forestry still dominate production activity in the rural region, with transport, storage and communications having a disproportionately important role in the region, compared to the country as a whole, due to its geographic location. While the Greek and Scottish areas have been experiencing population growth driven primarily by in-migration of foreign labour in the past decade, a negative migration balance has predominated in Latgale since its accession to the EU. Importantly, in the Latvian case not only has out-migration resulted in a downward trend in its overall population, but the average level of skills in the country has also deteriorated as it has been primarily highly educated people who have decided to leave ('brain-drain').

FINDINGS FROM THE CGE ANALYSIS

Migration simulations

The migration simulations take the form of (exogenous) changes in labour supply. This is justified on the basis that migrants to and from the three case study areas described are predominantly those in the active labour market age group. Both the effect on the local economies of changes in the *overall* supply of labour and the economic impact of migration by differential *skill types* of labour are analysed.

Specifically, the *basic* analysis focuses on two hypothetical scenarios whereby there is either an increase or a reduction of 10% in the total amount of labour available to a region. This is then followed by a *skills* analysis, whereby there is either (*i*) a -20% change in total labour supply modelled such that the reduction only occurs from the *skilled* labour category of workers. This is likely to reflect the Latvian type of situation; or (ii) a +20% change in total labour supply modelled such that the increase is confined purely to the *unskilled* labour category of workers. This should reflect in-migration from new accession or other (mainly Balkan and African) countries as evidenced recently in many Scottish and Greek territories.

Findings from the CGE analysis

The comparative output of the labour supply simulations is presented in the Tables below in the form of percentage (%) changes from base year levels on a number of important variables.

The Basic Analysis

The basic analysis involves an exogenous $\pm$ 10% change in the total amount of labour supplied to the local area via migration, compared to the base year level.

As can be seen from Table 2, the CGE models predict that a change in total labour supply is likely to have similar effects on the aggregate level of real gross domestic product (GDP) of the three case study areas. Specifically, an increase of 10% in the quantity of active labour is expected to have a positive impact on GDP, ranging from 4.6% in Greece to 5.9% in Latvia. Slightly larger negative effects on GDP

are found when there is out-migration of 10% of the labour force. So the evidence presented here supports the argument that a growing working population, due to additional migrant labour, should fuel domestic demand and, hence, expand domestic output (OECD, 2006).

The total size of an economy, however, is not an indicator of prosperity or of citizens' living standards. Instead, the level of *per capita income*, a measure which takes into consideration the concurrent increase in each region's population, or, alternatively, the level of *per capita income of the resident population*, seem more appropriate for assessing the impact of immigration on welfare (HOUSE OF LORDS, 2008, p. 23). In this analysis, attention focuses on the former measure as the model does not separate the incomes of the "pre-existing" workers from those of the "new" workers that are added to the regional economies via the simulations. Percentage changes in per capita GDP are reported at the final row of Table 2. An expanding labour force is predicted to have modest but positive consequences on the level of real GDP per head. Specifically, the findings of the CGE model reveal a small beneficial impact on Greek (0.4%) and Scottish (0.8%) living standards, while a more sizeable effect of approximately 3% is reported for the Latvian study area. Greater negative outcomes on the GDP per capita levels of the three regional economies are also found in response to emigration.

[INSERT TABLE 2 HERE]

Table 2 also illustrates the decomposition of the GDP effects into the various components of national output, namely private consumption, investment and net exports. As immigrants are consumers as well as producers in their host country, they are predicted to raise (decrease) aggregate consumption demand by approximately 3-5% when they move into (out of) the country.[vi] Investment also adjusts accordingly to match the rising (falling) level of savings that follow the increasing (decreasing) income levels caused by the positive (negative) employment shocks. Finally, "foreign" savings (or the regions' current account deficits), defined as the difference between foreign currency spending and receipts, are found to increase (decrease) when there is a rise (fall) in labour supply, with Greece experiencing the most marked effect.

Tables 3 confronts the important question regarding the impact of immigration on local wages. Previous studies have found minimal effects of immigration flows on native wage outcomes, in accordance with the ambiguous theoretical prediction of economic models that take both the structure of

the tradeable goods sectors and the flexibility of labour markets into account. However, in relation to the former, small regional economies are less flexible and tend to be less diversified in their productive activities relative to a national economy (e.g. the East Highlands exports are dominated by a particular manufacturing activity while the tourism sector is key to the Greek area). The conventional economic paradigm would thus predict that immigration to small local economies is expected to lead to falling returns to (particular skill types of) labour and rising returns to complementary factors or skill groups.

[INSERT TABLE 3 HERE]

This hypothesis is confirmed in Table 3, which shows that an increase (decrease) in total labour supply is associated with a reduction (rise) in the region-wide wage of labour. Specifically, it is found that a 10% influx of labour decreases the wages of both skilled and unskilled workers in all three regions. The extent of the change differs, however, with the UK seeing the largest reductions in the rents of labour (13-16%), Greece experiencing more modest impacts (4-5%) and Latvia lying somewhere in between (7-10%). Accordingly, a reduction of 10% in total labour supply increases the wages of skilled and unskilled labour by approximately 5-18%, depending on the country in question. The greater sensitivity of the Scottish study area to the migration shocks is explained, in part, by the combination of initial factor endowments and lower substitutability between labour and capital in production. However, other region-specific characteristics such as sectoral mix, import dependence, and household consumption patterns will also have influenced the results.

Finally, Tables 4(a) and 4(b) show the impact of the regional labour supply shocks on producer and consumer prices. Economic theory would suggest two avenues via which a change in the supply of labour could affect the price level. On the one hand, a positive employment shock should contain any inflationary pressures in the economy by tempering wage demands while the reverse should hold in response to an adverse change in labour supply. On the other hand, immigration affects the demand side of the economy as well, and the positive (negative) output consequences following an increase (decrease) in total labour supply could result in inflationary (deflationary) pressures. Indeed, the results of our empirical analysis confirm that, at least in real terms, any link between migration and prices is not clear-cut with price impacts varying by commodity type and by region.

[INSERT TABLE 4(a) HERE]
[INSERT TABLE 4(b) HERE]

The Skills Analysis

The skills analysis permits the study of the compositional consequences of specific types of labour migration that have occurred in the diverse regional economies of the EU in recent years.

Columns (1), (3) and (5) of Table 5 display the effects of a 20% reduction in the supply of the skilled labour category on the aggregate GDP of the regional economies. It is clear that those areas that experience out-migration of highly educated labour are likely to suffer from considerable output losses, ranging from 5% in Greece to a sizeable 11-12% in Latvia and the UK. It is acknowledged, however, that these negative brain-drain effects may be somewhat mitigated by the potentially beneficial contribution of emigrant remittances sent back to households residing in the exporting regions. Data limitations have not allowed the explicit integration of this channel into the CGE analysis of this paper.

[INSERT TABLE 5 HERE]

A key finding that emerges from the comparison of the two simulations in Table 5 is that the magnitude of the change in GDP that is associated with a shock to the *skilled* type of labour is *larger* than the impact on the regional GDP levels when the *unskilled* category is altered. This asymmetric income effect is reflected in the GDP per capita measures. It is evident from Table 5 that emigration of skilled labour is associated with a marked reduction in living standards (that reaches 6% in the case of Latvia and the UK). In contrast, the modest contribution to output following in-migration of unskilled workers is outweighed by the rising population in the cases of Greece and the UK, resulting in a decline of GDP per head. Only in Latvia is immigration of unskilled labour associated with a slight positive impact on welfare.

As far as the distribution of factor incomes is concerned, Table 6 indicates that a skill deficiency in any regional economy is associated with a marked increase in the wages of the highly educated workers that remain in the territory. Moreover, as the proportion of unskilled workers in the areas increases, and given that the narrow economic base of the regional economies prevents substantial reorganization of the

productive activities towards low-skilled intensive activities, the rents accrued to unskilled workers fall. In a similar manner, a clear-cut decrease in the wages of unskilled workers is observed when the supply of such workers increases. It is therefore evident from Table 6 that immigration of low-skilled labour is expected to result in a widening of the skilled/unskilled wage gap (the so-called 'skilled wage premium').

[INSERT TABLE 6 HERE]

SENSITIVITY ANALYSIS

The sensitivity of the results is explored to different assumptions regarding the elasticity of substitution between factors of production, the mobility and accumulation of capital and the degree of substitution between skilled and unskilled workers. Discussion in the first two cases focuses on the first migration shock (10% growth in total labour supply) while the latter considers the case of unskilled migration into one of the study regions only.

Changing elasticity of factor substitution

To explore the sensitivity of the results to the elasticity of factor substitution at the bottom of the technology nest, the elasticity values in each of the base models were doubled. In particular, in the UK they were manipulated from the assumed 'basic' model value of 0.3 to 0.6 and in Latvia from 0.8 to 1.6. In the case of Greece, whereby the elasticity of factor substitution varies for each sector of the economy within the range 0.5-1.5, each individual value was doubled accordingly.

As shown in Tables 7(a)-7(b) below, the elasticity sensitivity analysis affects key macroeconomic indicators rather marginally and with no changes in terms of the direction of impacts. More importantly, and as expected by conventional economic theory, an increase in the elasticity of substitution between factors of production has resulted in a reduction of the wage effects of labour, presumably because of greater substitutability towards the factors of capital and land following the imposed migration shock.

[INSERT TABLE 7(a) HERE]
[INSERT TABLE 7(b) HERE]

Allowing for mobility and accumulation of capital

The impact of migration on labour productivity in the long-run will also depend on the amount of capital that is available to the regions. When capital is variable, investment is likely to increase in the face of an increase in labour supply, due to the fact that the return to capital increases and firms expect a larger population to demand more goods and services (HOME OFFICE, 2007, p. 13). Past episodes of large immigration flows have indeed been associated with periods of rapid capital accumulation, so an attempt has been made here to capture this longer-term secondary effect on the economy by simulating the basic 10% shock in total labour supply along with a concurrent x% rise in capital supply (whilst allowing capital to be mobile across the various economic activities of production).[vii]

Figure 4 illustrates the response of real GDP in the three case study regions to the 10% labour supply shock for varying degrees of capital accumulation. It is clear from there that the magnitude of the GDP effect is larger by 1-5% depending on the degree to which capital grows. Another interesting finding from Table 7(b) is that as a result of the greater productive capacity and the mobility of capital, the negative wage effects of the migration shock are found to be smaller compared to the basic simulation.

[INSERT FIGURE 4 HERE]

Increased substitutability between skilled and unskilled labour

The findings above suggested that, of the three case study regions, the UK region of the East Highlands was most sensitive to the impact of unskilled workers in terms of wage impacts. Interviews with local policy makers and local managers in the region suggested that the productivity of migrants was higher than that of locals performing the same jobs. This is consistent with findings from a survey conducted by the Institute of Directors in December 2006 (cited in HOME OFFICE, 2007) which reported that migrant workers significantly outperform the existing workforce in terms of productivity, education and skills, reliability and the amount of sick leave.

In order to capture this, and also to test for the robustness of findings from the model, the elasticity of factor substitution between the two types of workers in the East Highlands model was increased to approximately one (as compared to 0.3 in the base model) and the simulation describing a 20% rise in

unskilled labour was replicated in the East Highland model. The results indicated a slight increase in GDP and its various components: Compared to an original GDP effect of 1.67%, if it is easier for employers to substitute skilled workers for unskilled migrants there is a positive GDP effect of 2%. A smaller decrease in the wages of unskilled workers is also found, as their wages no longer take the full brunt of the increase in labour supply.

CONCLUSIONS

The paper has used specially constructed regional SAMs and CGE models to analyse the effects of immigration on the economic activity of three remote EU case study regions within Scotland, Greece and Latvia. The CGE results indicate that the free movement of labour can have significant (short- and long-run) consequences for the GDP levels of some of the most remote European regions, yet the effects on living standards as reflected in per capita GDP are predicted to be more modest.

There is a large effect on the distribution of wages which is attributed to the inability of small regional economies to adjust their narrow economic base appropriately. In particular, the so-called 'skilled wage premium' is found to widen in response to an increased supply of unskilled workers. These results confirm those who have argued that immigration of low-skilled workers has been a significant contributor to the rising inequality of earnings experienced by most advanced OECD economies during the 1980s (BORJAS *et al*., 1997).

The results also give credence to those studies that have identified the 'brain-drain', namely the flow of skilled individuals outside their own country of origin, as a potentially serious barrier to economic growth and development (OZDEN and SCHIFF, 2005; ØSTBYE and WESTERLUND, 2007).

Although the models have been adapted so as to incorporate key characteristics of the regions under analysis, several limitations remain. Most obviously, the aggregation of local and central governments into a single entity in the model and the aggregation of transactions between each region and the rest of the country in which it is located with those of the ROW constrains the accuracy of the results. For instance, further disaggregation of these accounts would improve the ability of the models to analyse the fiscal impacts of migration. In order to provide an accurate evaluation of the effect of immigration to

public finances, the model would also require more accurate information on the number of dependents as well as on the differential consumption propensities of immigrant and local households. Furthermore, the incorporation of the possibility of remittances into the model would allow for a more comprehensive assessment of the overall impact of brain-drain on regional economies.

Finally, the bi-regional (rural-urban) nature of the constructed SAMs of the different case study areas allows for the examination of potential differences in the rural-urban effects that may arise in response to regional migration shocks. Due to space considerations such an analysis has not been pursued here, yet it constitutes an important agenda for future study.

Despite these limitations, it is believed that this paper contributes to a growing literature on the economic impacts of migration at the regional level and provides a useful basis for further research in this area.

Acknowledgments - The paper is based on research carried out as part of the EU 6th framework project "TERA" FP6-SSP-2005-006469. The authors are grateful to Euan Phimister and Daina Saktina for their invaluable contribution to the development of the model used in this paper. Useful comments by members of the EU project TERA and of participants at the IMAEF2008 meeting held at the University of Ioannina, Greece are also gratefully acknowledged. The usual disclaimer applies.

REFERENCES

BALáZ, V., WILLIAMS, A.M., and KOLLAR, D. (2004) Temporary versus Permanent Youth Brain Drain: Economic Implications, *International Migration*, **42(4)**, 3-34.

BLANCHFLOWER, D.G., SALEHEEN, J. AND SHADFORTH, C. (2007) The Impact of Recent Migration from Eastern Europe on the UK Economy, Research paper based on speech at the Cambridgeshire Chamber of Commerce, 4th January.

BORJAS, G.J. (2005) *Labor Economics*, 3rd ed., McGraw-Hill, New York.

BORJAS, G.J. AND KATZ, L. (2005) The Evolution of the Mexican-born workforce in the United States, NBER Working paper **No.11281**.

BORJAS, G.J., FREEMAN, R. AND KATZ, L. (1997) How much do immigration and trade affect labour market outcomes?, *Brookings Papers on Economic Activity*, **1**, 1-67.

BRUCKER, H. AND KOHLHAAS, M (2004) International Migration to Germany: A CGE-Analysis of Labour Market Impact, working paper presented at the 7th annual conference on global economic analysis, Washington.

CORTES, P. (2005) The Effect of Low-skilled Immigration on US Prices: Evidence from CPI Data, mimeo MIT.

DUSTMAN, C., FABBRI, F. AND PRESTON, I. (2005) The impact of immigration on the British labour market, *Economic Journal*, **115**, F324-F341.

ECONOMIST (2007) Poles in the Highlands: Glen Warsaw: Eastern Europeans are saving Scotland's economy, *The Economist Magazine*, December 13th.

ERNST and YOUNG, (2007) Migration and the UK economy, Ernst and Young ITEM Club, December.

GREEN, A.E., DE HOYOS, M., JONES, P. AND OWEN, D. (2008) Rural development and labour supply challenges in the UK: The Role of non-UK Migrants, *Regional Studies*, 1-13, iFirst article.

HIGHLAND COUNCIL (2006) Overseas Migrant Workers in Highland, *Policy and Briefing Note No. **15***, Planning and Development Service.

HIGHLAND COUNCIL (2007) Small Area Population Estimates 2005, *Policy and Briefing Note No. **19***, Planning and Development Service.

HOME OFFICE (2007) *The Economic and Fiscal Impact of Immigration*, A Cross-Departmental Submission to the House of Lords Select Committee on Economic Affairs, October.

HOUSE OF LORDS (2008) *The Economic Impact of Immigration*, Report of the Select Committee on Economic Affairs, 1st April, The Stationary Office Ltd: London.

JULIA-WISE, R; COOKE, SC; HOLLAND, D. (2002) A computable general equilibrium analysis of a property tax limitation initiative in Idaho, *Land Economics*, **78 (2)**, 207-227

LEAMER, E. AND LEVINSOHN, J. (1995) International Trade Theory: The Evidence, in *The Handbook of International Economics Vol. III*, edited by GROSSMAN, G. AND ROGOFF, K., Elsevier Science, 1339-1394.

LEE, W-S. (2007) Immigration and Wages: An Open Economy Model, Melbourne Institute Working Paper Series, No. 7/07.

LOFGREN, H, HARRIS, R.L., ROBINSON, S. (2002) *A Standard Computable General Equilibrium Model (CGE) in GAMS*, Microcomputers in Policy Research 5, IFPRI, Washington. http://www.ifpri.org/pubs/micocom/mico5.htm.

LONGHI, S., NIJKAMP, P. AND POOT, J. (2005) A meta-analytical assessment of the effect of immigration on wages, *Journal of Economic Surveys*, **19(3)**, 451-477.

NASKOTEEN, R.A. AND ZIMMER, M. (1980) Migration and income: the question of self-selection, *Southern Economic Journal*, **46**, 840-851.

OECD (2006), *Economic Outlook*, **80**, November, Paris.

ØSTBYE, S. AND WESTERLUND, O. (2007) Is migration important for regional convergence? Comparative evidence for Norwegian and Swedish Counties, *Regional Studies*, **41(7)**, 901-917.

OTTAVIANO, G. AND PERI, G. (2005) Rethinking the gains from immigration: theory and evidence from the US, NBER Working paper **No.11672**.

OZDEN, C. AND SCHIFF, M. (2005) *International Migration, Remittances and Brain Drain*, World Bank Report: Washington.

POULIAKAS, K., PHIMISTER, E., ROBERTS, D., THOMSON, K., BALAMOU, E., PSALTOPOULOS, D., HYYTIA, N., KOLA, J., GALASSI, F. (2008) *Review of the Structure of the TERA case-study SAMs and CGE models*, Report submitted to the EU Commission as part of the TERA project, Deliverable No. **8**, Workpackage No. 5.

ROBINSON, S., CATTANEO, A. AND EL-SAID , M. (2001) Updating and Estimating a Social Accounting Matrix Using Cross Entropy Methods, *Economic Systems Research*, **13 (1)**, 47-64.

RYBCZYNSKI, T. (1955) Factor endowments and relative commodity prices, *Econometrica*, XXII, 336-41.

STOCKDALE, A. (2006) Migration: Pre-requisite for rural economic regeneration?, *Journal of Rural Studies*, **22**, 354-366.

STOLPER, W.F. AND SAMUELSON, P.A. (1941) Protection and Real Wages, *Review of Economic Studies*, **9**: 58-73.

WATERS, EC, HOLLAND, DW AND WEBER, BA. (1997) Economic impacts of a property tax limitation: A computable general equilibrium analysis of Oregon's measure 5, *Land Economics*, **73**(1), 72-89.

ZORLU, A AND MULDER, C. (2007) Initial and subsequent location choices of immigrants to the Netherlands, *Regional Studies*, **42(2)**, 245-264.

Table 1 Summary statistics of the three study areas

	Greek study area Archanes-Heraklion	Scottish Study Area East Highlands	Latvian study area Latgale
Population	142,259	115,899	364 345
GDP (m Euros)	1,524.1	2,749.1	592.2
Rural Share (%)	4.28	40.5	41.3
Urban Share (%)	95.72	59.5	58.7
GDP Per Capita (Euros)	10,711	23,724	1625
Rural GDP per capita	14,345	15,599	1127

Source: Own calculations based on SAMs; base year values are 2005 for UK and LV; 2004 for GR.

Table 2 %Impact on Real GDP at factor cost

	GR		LV		UK	
	10%	**-10%**	**10%**	**-10%**	**10%**	**-10%**
Private Cons.	3.94	-4.1	4.59	-4.82	2.62	-3.05
Investment	13.93	-15.06	22.17	-26.48	24.89	-29.24
Reg exports	3.89	-4.06	7.87	-8.38	7.35	-8.79
Reg imports	6.04	-6.41	7.64	-8.51	7.98	-9.43
Foreign Savings	17.78	-19.10	0.29	-2.78	1.97	-2.29
Overall GDP	**4.6**	**-4.85**	**5.88**	**-6.38**	**5.64**	**-6.42**
GDP/capita	**0.41**	**-0.71**	**2.87**	**-3.55**	**0.79**	**-1.69**

Table 3 %Impact on wage(rent) of labour

	+10%		-10%	
	Skilled	*Unskilled*	*Skilled*	*Unskilled*
GR	-4.47	-4.31	5.26	5.03
LV	-6.99	-9.58	8.36	12.11
UK	-15.79	-12.96	18.21	13.18

Table 4(a) %Changes in Producer Prices

	GR		LV		UK	
	+10%	**-10%**	**+10%**	**-10%**	**+10%**	**-10%**
Primary	1.76	-1.78	-1.82	2.12	3.51	-4.45
Secondary	1.53	-1.98	1.30	-1.93	-0.43	0.90
Tertiary	0.61	-0.65	-1.60	1.92	-3.11	3.43

Table 4(b) %Changes in Consumer Prices

	GR		LV		UK	
	+10%	**-10%**	**+10%**	**-10%**	**+10%**	**-10%**
Primary	1.64	-1.68	0.19	-0.19	0.53	-0.72
Secondary	0.79	-1.04	1.04	-1.41	0.19	-0.20
Tertiary	0.65	-0.70	-1.45	1.74	-2.58	2.75

Table 5 %Impact on Real GDP at factor cost

	GR		LV		UK	
	-20% skilled	**+20% unskilled**	**-20% skilled**	**+20% unskilled**	**-20% skilled**	**+20% unskilled**
Private Cons.	-4.27	3.79	-8.00	1.67	-4.95	1.25
Investment	-19.23	10.81	-52.05	2.50	-52.93	9.50
Reg exports	-4.14	3.77	-12.75	4.20	-16.09	2.27
Reg imports	-7.72	5.00	-14.97	2.30	-16.57	3.19
Foreign Savings	-25.49	12.95	-17.42	-11.48	-3.77	1.05
Overall GDP	**-5.40**	**4.16**	**-10.59**	**2.35**	**-11.76**	**1.67**
GDP/capita	**-1.88**	**-0.57**	**-5.96**	**1.40**	**-6.21**	**-1.98**

Table 6 %Impact on wage(rent) of labour

	-20% skilled		**+20 unskilled**	
	Skilled	*Unskilled*	*Skilled*	*Unskilled*
GR	17.64	-5.62	4.41	-12.23
LV	21.08	-2.55	1.64	-19.77
UK	50.18	-34.38	5.72	-41.65

Table 7(a) Elasticity Sensitivity Analysis
Impact on Real GDP (+10%)

	GR	**LV**	**UK**
Double elasticity of factor substitution			
Private Cons.	3.99	4.77	3.24
Investment	13.77	24.32	25.31
Reg exports	3.85	7.85	8.09
Reg imports	5.94	8.09	8.85
GDP at factor cost	4.62	6.02	5.59
Variable capital (+2%)			
Private Cons.	4.63	5.71	4.57
Investment	16.47	25.81	26.88
Reg exports	4.54	9.11	-12.31
Reg imports	6.92	9.15	-4.39
GDP at factor cost	5.45	6.82	7.02

Table 7(b) Elasticity Sensitivity Analysis – %Impact on wage(rent) of labour (+10%)

	Skilled	*Unskilled*
Double elasticity of factor substitution		
GR	-2.34	-2.13
LV	-3.55	-5.12
UK	-8.54	-6.58
Variable capital (+2%)		
GR	-2.08	-1.87
LV	-5.24	-7.85
UK	-8.53	-5.52

Figure 1: The basic TERA SAM structure

		Production sectors			Factors		Households						
		Urban	Rural	Commod-ities	Urban	Rural	Urban	Rural	Govern-ment	Capital	Tourists	Rest of World	Total
Production sectors	Urban			Marketed output			Home consumed goods						Urban gross output (basic prices)
	Rural			Marketed output				Home consumed goods					Rural gross output (basic prices)
	Commod-ities	Intermediate inputs	Intermediate inputs	Transaction costs			Consumption expenditure	Consumption expenditure	Government consump-tion	GFCF plus change in stocks	Tourist expend-iture	Exports	Demand (purchaser prices)
Factors	Urban	Value added			Factor income	Factor income							Urban factor income
	Rural		Value added		Factor income	Factor income							Rural factor income
House-holds	Urban						Inter-household transfers	Inter-household transfers	Transfers to urban households			Factor and transfer income from ROW	Urban household income
	Rural						Inter-household transfers	Inter-household transfers	Transfers to rural households			Factor and transfer income from ROW	Rural household income
	Govern-ment	Activity taxes		Sales taxes	Factor taxes	Factor taxes	Direct taxes	Direct taxes				Transfer to Governmen t from ROW	Government income
	Capital						Savings	Savings	Government savings			Foreign savings	Savings
	Tourists											Transfer to tourists	Income used by tourists
	Rest of World			Imports	Factor income to ROW	Factor income to ROW			Government transfers to ROW				Foreign exchange outflow
	Total	Urban gross input (Basic prices)	Rural gross input (Basic prices)	Supply (purchaser prices)	Urban factor expend-itures	Rural factor expend-itures	Urban household expenditures	Rural household expenditures	Government expenditures	Investment	Tourist expend-iture	Foreign exchange inflow	

Figure 2 Production Technology

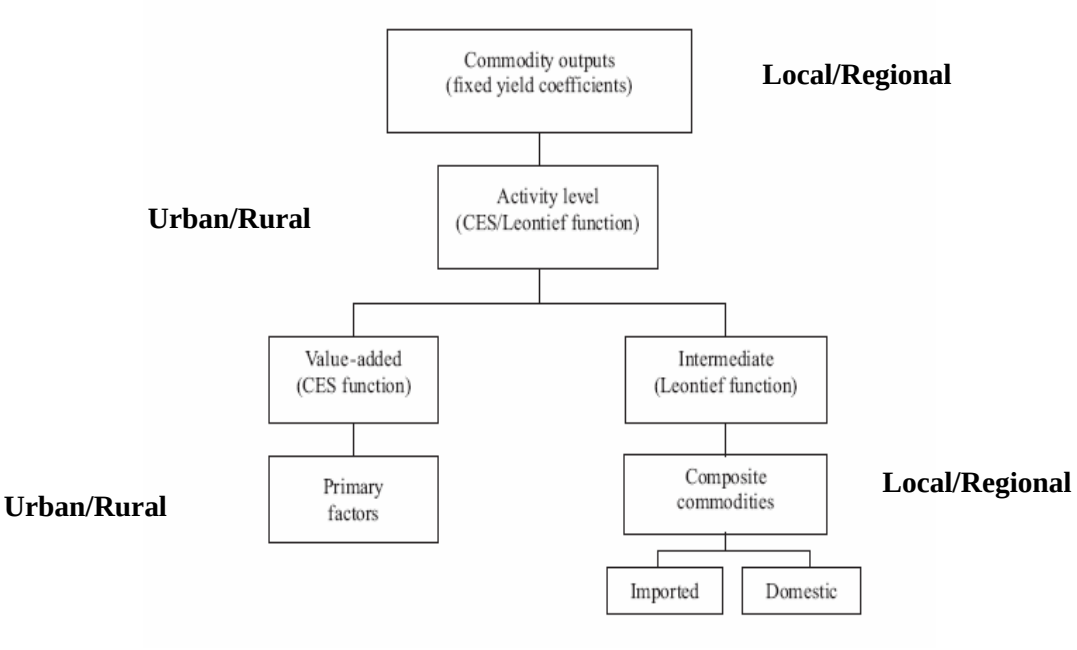


Figure 3 Commodity flows

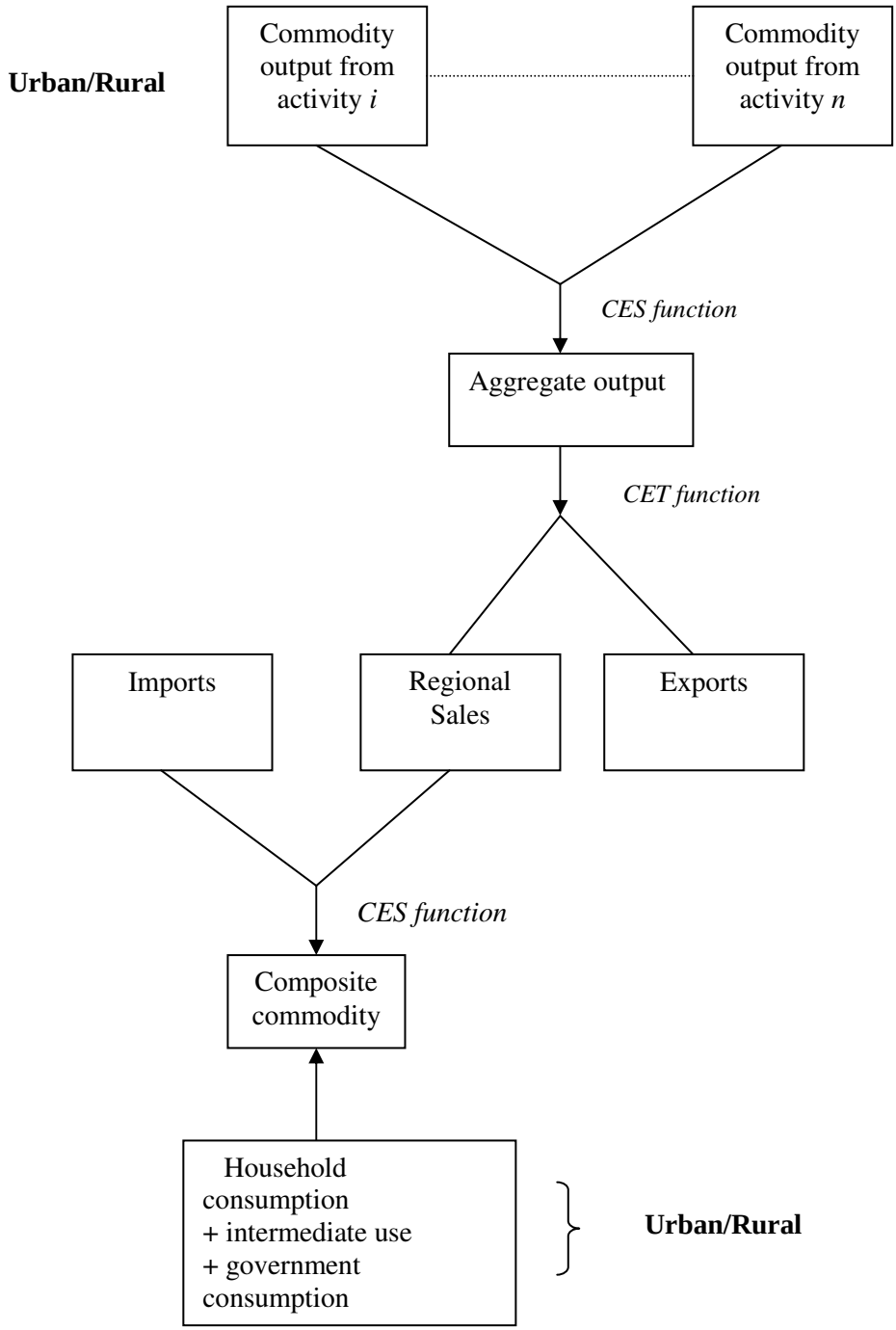
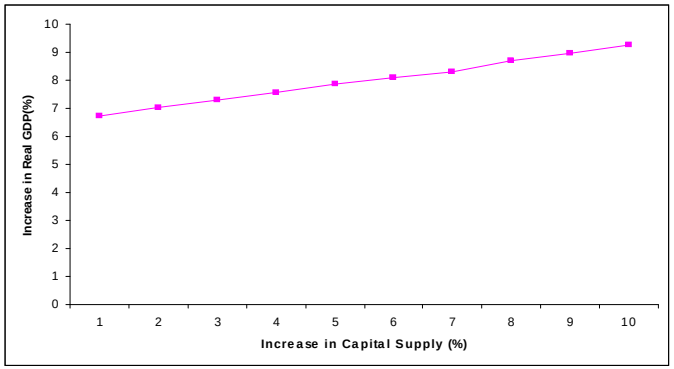
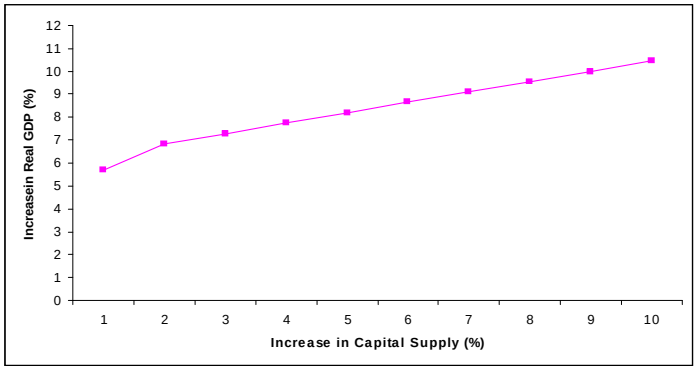


Figure 4 GDP responses to 10% rise in labour supply with variable capital

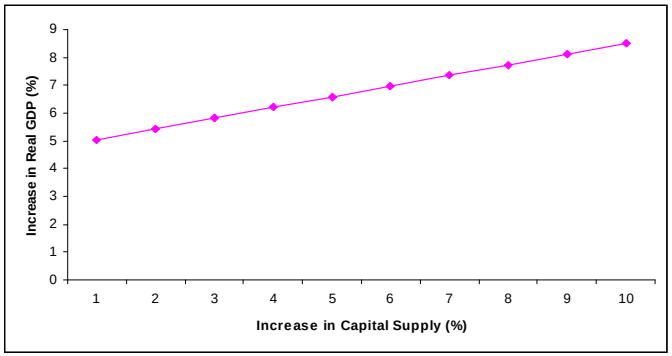
(a) United Kingdom



(b) Latvia



(c) Greece



NOTES

[1] For example, it is believed that around half a million workers had moved into the UK by late 2006 (BLANCHFLOWER *et al*., 2007, p. 1). In a similar spirit, the large net migration from (mainly) Balkan countries in the 1990s rapidly transformed Greece from one of the most homogenous populations of Europe into a country that now has one of the largest foreign-born/native population ratios in the EU (at around 10%; OECD, 2006).

[ii] Although it has been necessary to assume that labour is mobile across sectors in order to execute the migration scenarios within the IFPRI model framework, this potentially constitutes a weakness of the analysis. A more comprehensive analysis would require consideration of the exact wage-setting process (e.g. BRUCKER AND KOHLAAS, 2004).

[iii] The analysis was undertaken firstly by assuming that the average factor price is an endogenous variable while the activity-specific "wage distortion" term is exogenous. We then also allowed for fixed factor demands using extraneous activity-specific employment data disaggregated by skill level. In this case the activity specific wage-distortion variables vary in order to assure that the fixed activity-specific employment level is consistent with profit maximisation (see LOFGREN *et al*., 2002, p. 35-36). No significant changes in the effects of the main simulations were found.

[iv] Given the size of the regions under analysis, cross hauling is a potential problem, identified in the model as the situation where a higher value for a commodity is exported from the region than is produced within the region. This was only identified in the Scottish case study area and was dealt with (as suggested by LOFGREN *et al*., 2002) by creating a re-export activity and commodity category.

[v] Because of the size of the regions and the combined nature of the government and ROW accounts in the model, the interpretation of the residuals is more complex than in national CGE models where these values have a standard economic interpretation.

[vi] The model assumes that immigrants have identical purchasing patterns to local households. However "it is likely that immigrants spend a lower fraction of their income when compared to domestic workers, perhaps because they send remittances back home or spend less on durable goods while temporarily resident in the country" (BLANCHFLOWER *et al*., 2007, p. 24). In this case the total GDP effects reported in Table 2 are expected to be lower, ceteris paribus.

[vii] It is acknowledged that the sunk costs and adjustment costs associated with investment can imply a lag between inward migration and increased investment. However, such dynamic links between immigration and capital accumulation cannot be captured by the static CGE model used in this paper.