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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 examining 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 sub-national level. BLANCHFLOWER *et al.* (2007, p. 12) show that there is an important regional element in the decision of individuals to migrate. Immigrants are likely to have a higher propensity to settle in urban centres as higher wages, better employment opportunities combine with other factors such as greater anonymity, less traditional lifestyles etc (PHIMISTER,2005). However, 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.

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 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 of immigration, and of diverse skill-types of migrants on the GDP, welfare 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 be consistent with the size and nature of the economies being analysed and to include several specific characteristics of the regional economies under consideration.

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* explains how the SAMs were constructed and describes the nature and specific characteristics of the CGE modelling framework used in the analysis. *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. A mathematical representation of the underlying model used in the paper is included as an Appendix.

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 production 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; LEMOS and PORTES, 2008). For example, FRIEDBERG and HUNT (2005) have illustrated that a 10% rise in immigrants in the US and other advanced Western countries is associated with a fall in wages of at most 1%. BORJAS and KATZ (2005) have shown that an 11% increase in the US workforce between the years 1980-2000 resulted in an overall loss of about 3% of the real value of wages, 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. By contrast, LEMOS and PORTES (2008) have failed to unearth any convincing evidence of an effect of A8 immigration either on the average or at any point of the UK wage distribution.

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). BARRO and SALA-I-MARTIN (1992), for instance, have calculated that a 1% rise in US net immigration is association with a

0.1% growth of GDP. A study by ERNST and YOUNG (2007) has also estimated that UK GDP growth would have been 0.2% (0.4%) lower in 2006 (2007) had the wave of A8 immigration not occurred. Other evidence suggests that immigration only has a very small impact 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 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 at the national-level. Regional CGE models remain scarcer. The CGE model implemented for this paper draws on one of the standard frameworks made available by IFPRI (LOFGREN *et al.*, 2002). Starting with this basic structure, a number of modifications have been made, so that the model is adapted to reflect the small regional nature of the three study areas under analysis and their specific structural characteristics. This section first describes the regional SAMs that were constructed for the analysis before moving on to describe the characteristics of the model. The Appendix provides further elaboration of the model.

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 commodity accounts cover the whole study region. The differential spatial disaggregation of accounts derives from the way the economy is believed to operate. In particular, while the spatially distinct behavior of producers and households is accommodated in the model, commodity markets are not segmented on the basis that this would suggest a more complete isolation of markets than is the case at this spatial scale. Also important in terms of interpreting the figures in the SAM and associated CGE model, external transactions with both the rest of the national economy and other countries are captured in a combined account labeled the Rest of the World (ROW). Finally, flows to and from regional and national government are aggregated into a combined government account.

[INSERT FIGURE 1 HERE]

Based on the structure shown in Figure 1, SAMs were constructed for each case study region using a hybrid approach (LAHR, 1993). 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 the first step in all three cases was the regionalization of national tables. This is a mechanical process which involves several strong assumptions including that the productivity per employee, production mix and production technology in the region are identical to those at national level. It also relies on the assumption that income levels per household, as well as household and government consumption patterns at regional level match those observed at national level. So as to improve the validity of the regional SAMs, this initial step was followed by extensive primary data collection through surveys of households, businesses and key informants in each study region (the key informants including local government officials). The findings from these surveys were subsequently used to replace critical mechanically-derived entries in the regionalized tables – a process known as "superiorisation". Finally cross-entropy methods were used to balance the superiorised SAMs (ROBINSON *et al.*, 2001).

The disaggregation of activities and commodities in each SAM was based on the importance of sectors in employment and in gross value added levels within that particular economy. Table 1 provides summary information on the level of disaggreagation in each SAM. The factors of production in each SAM are labour, capital and land, with labour further split to distinguish between skilled and unskilled workers. Full details of the construction process and the regional SAMs are given in POULIAKAS *et al.* (2008).

[INSERT TABLE 1 HERE]

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 model also includes a set of constraints that have to be satisfied by the system as a whole, covering markets (for factors and commodities) and regional macroeconomic aggregates (balances for savings-investment, the government account, the current account and the external account). The abridged mathematical statement of the model can be found in the Appendix while the GAMS code and further details of the model are available from the authors upon request.

Production behaviour

Each production 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 (Eq. A6 in Appendix). At the bottom level each activity uses composite commodities as intermediate inputs, where intermediate demand is determined using fixed Input-Output (I-O) coefficients (Eq. A8). Value added is a CES function defined over factors of production which are spatially specific (Eq. A9). 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 (Eq. A13). 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 regional economies have segmented labour markets in terms of skilled and unskilled employment but both of these are integrated across space (as workers are 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 (Eq. A20). In contrast, the fixed regional supplies of the two non-labour factors of production (capital and land) are treated as immobile between activities. These assumptions were deemed to be realistic descriptions of the conditions that characterize the economies under study, and sensitivity analysis was conducted to test the extent to which they influence the magnitude and qualitative nature of the findings.[2]

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 (Eq. A12). 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 (Eq. A10).

[INSERT FIGURE 3 HERE]

An Armington function is used to prevent over-specialization. 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 (Eq. A11). The model assumes that export and import demands are infinitely elastic at given world prices (Eqs. A3 and A4). Flexible prices are also assumed to equilibrate demands and supplies of domestically marketed domestic output (Eqs. A1 and A21).

The appropriateness of the Armington specifications is much debated, for country as well as for regional-level CGE models (BURNIAUX AND WAELBROECK, 1992; PARTRIDGE AND RICKMAN, 1998). In particular, the assumption is criticized for implying that small open economies have greater market power than would otherwise be the case (LLOYD AND ZHANG, 2006). BROCKER (1995) is also critical of the over-reliance on Armington specifications in general equilibrium models arguing that at regional levels, where supply is much larger than demand, it is more appropriate to assume monopolistically competitive markets. Despite these concerns, the common CGE Armington specification was used in this analysis, justified in part on the basis that its implications are limited by the particular focus of the application (on factor markets), and in part by the desire to provide empirically realistic responses to the exogenous shocks.

Institutions

Institutions are represented by households, the government and a combined Rest of World (ROW) account. Each household type receives income from factors (in proportions fixed at the base year level), transfers from the government and the ROW (Eq. A15). 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 (Eq. A16). Household consumption is allocated across commodities according to linear expenditure system (LES) demand functions, derived from maximization of a Stone-Geary utility function (Eq. A17). 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 (Eq. A18). It then uses this income to purchase commodities for its consumption and for transfers to other institutions (Eq. A19). Government savings are the residual given by the difference between government income and spending (Eq. A23). Finally, from the ROW account one can deduce the current account deficit (Eq. A22). Because of the size of the regions and the combined nature of the government and ROW accounts in the model, the interpretation of the residual is more complex than in national CGE models where these values have a standard economic interpretation. This point is returned to in relation to the model closure rules below.

Closure rules

The regional CGE models needed to be "closed" with respect to three macroeconomic balances: the government balance, the external balance and the savings-investment balance. As regional economies are much more open than national economies, and because regions within a country share a common currency, a number of the standard closure rules used in country-level CGE models are unsuitable when a regional economy is being modeled (PARTRIDGE AND RICKMAN, 1998).

In relation to the government balance, in principle, a fixed regional government budget deficit could have been imposed in the models. However, in small regions it is less likely that government will adjust spending or taxes because of a regional surplus or deficit. Therefore, 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. In terms of the external balance, in country-level models closure can be obtained by endogenising the real exchange rate. Allowing a change in the general purchasing power parity between a region and the rest of the economy is also possible in regional models. However, in this case, the aggregation of the rest of the country with the ROW in the underlying SAM databases means that interpretation of this exchange rate variable would be difficult. In addition, as DOW (1986) discusses, the assumption that net savings from the external account may adjust at the regional level is reasonable. Therefore, the external balance was achieved through flexible foreign savings while the real exchange rate was assumed fixed. Finally, consistent with the approach used by other authors modeling open economies in the medium to long run (JULIA-WISE *et al.*, 2002; WATERS *et al.*, 1997), the savings-investment balance (Eq. A24) was achieved by assuming that the economies under analysis were savings-driven (the value of investment adjusts) with fixed marginal propensity to save for all non-government institutions.

Elasticities and calibration

The calibration process involved the utilization of the SAM information for the purpose of estimating certain parameters of the model, and subsequently, the endogenous variables. This process relies on the specification of a number of (exogenous) elasticity values relating to the production, trade and household consumption processes. As it is unlikely that economies with distinct economic structures are characterized by similar elasticities, a significant amount of attention was paid to the selection of appropriate figures for each study area. This process involved an extensive review of the existing literature. However, in order to represent case study area conditions better, some adjustments were made following discussions with local economy experts (e.g. the Development Agency of Heraklion). The set of elasticities used to calibrate the base year models of each region are described in Table 2, along with the sources from which they are drawn. Given that the empirical evidence base for elasticities at the regional level is limited, sensitivity analysis was conducted to test the robustness of the findings to the assumed elasticity values. This is discussed in detail below.

[INSERT TABLE 2 HERE]

THE CASE STUDY AREAS

This section provides a brief outline of some of the key features of the three case study economies, with Table 3 presenting some basic summary statistics as derived from the regional SAMs.

[INSERT TABLE 3 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.

Agriculture is very important in rural Archanes, especially in terms of employment, while the urban part of the region depends on both tourist-related and public sectors. Over the last 15 years the region has grown considerably mainly due to the growth of the service sector (especially tourism). The region has strong external links with 18.4% of household income originating from the ROW, 36.7% of total commodity value imported and 13.7% of output value is exported.

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. Over the last decade the regional economy has grown significantly, bolstered, amongst other things, by the attraction of several new sectors including the manufacture of pharmaceuticals and medical products. From the SAM, per capita GDP in the region was the highest of the three regions at 23,734 euros. The SAM also indicates that it is the most open of the three regions in terms of dependence on exports (and tourism) markets and flows of income to households from outside the region.

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. It is larger than the other case study regions, accounting for 15% of the total Latvian population and 6.5% of Latvia's total GDP in 2005.

The figures from the Latgale SAM show that per capita GDP in the region is far lower than in the Western European counterparts. The transport, storage and communication sector has a disproportionately important role in the region, compared to the country as a whole, due to its geographic location. At the same time, due to the size of the region, the SAM suggests a lower dependence on imports and non-local household income than in the other two regions.

With respect to migration patterns, while the population of both the rural and urban parts of the Greek region has grown, the increase in the population of the urban city of Heraklion has been more pronounced. Specifically, between 1991 and 2001 it increased by approximately 14.2%, compared to a 6.3% growth in the rural region, primarily due to in-migration of unskilled labour from the surrounding rural areas of the Prefecture. Immigrant labour is mostly employed in the secondary sector as well as in the provision of tourism-related services in the urban part of the region, and in the agriculture and tourism sectors in the rural 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 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) excluding 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). 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 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.

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 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 (e.g. Balkan, African) countries as evidenced recently in the Scottish and Greek study areas.

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

As can be seen from Table 4, the CGE models predict that a ± 10% 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. The evidence presented here thus 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 4. 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 found in response to emigration.

[INSERT TABLE 4 HERE]

Table 4 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.[3] Investment also adjusts accordingly to match the rising (falling) level of savings that result from the increasing (decreasing) income levels associated with 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.

Table 5 presents the welfare effects associated with a 10% increase in labour. Welfare is measured by Equivalent Variation (EV), the monetary equivalent of how much better off (worse off) households are after the labour shock compared to their (unobserved) base welfare level. The measure provides a better basis for evaluation of impacts compared to just looking at changes in households income or wage changes independently. Although there are differences in the magnitude of impacts between household types and between study areas, the impact of immigration is shown to be unambiguously positive.

Analogous results in the case of the 10% reduction in labour supply are found, with negative welfare effects of the same order of magnitude detected.

[INSERT TABLE 5 HERE]

Table 6 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 , transport sector activity is dominant in the Latvian area, 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.

[INSERT TABLE 6 HERE]

This hypothesis is confirmed in Table 6, 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 (9-12%), 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 5-15%, 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, production technology, import dependence, and household consumption patterns will also have influenced the results.

Finally, Table 7 shows 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 both by commodity type and by region. However in all cases the price effects are small.

[INSERT TABLE 7 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 8 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% 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.[4]

[INSERT TABLE 8 HERE]

A key finding that emerges from the comparison of the two simulations in Table 8 is that the magnitude of the change in GDP that is associated with a shock to skilled labour is larger than the impact on the regional GDP levels when unskilled labour is altered. This asymmetric income effect is reflected in the GDP per capita and welfare measures. It is evident from Table 8 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 (although household welfare as reflected in EV increases in all three areas due to rising total incomes).

As far as the distribution of factor incomes is concerned, Table 9 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 9 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 9 HERE]

SENSITIVITY ANALYSIS

The sensitivity of the results was explored to different assumptions regarding the relative sizes of the selected elasticities, the mobility and accumulation of capital, and the degree of substitution between skilled and unskilled workers. In the first two cases, analysis focused on the first migration shock (10% growth in total labour supply), while the latter considered the case of unskilled migration into one of the study regions only.

Changing the relative size of elasticities

In order to explore the sensitivity of the baseline results to alternative parameterizations, we followed the sensitivity analysis approach of Li and Rose (1995), who, using the random number generator in GAMS, ran 100 simulations to verify that the means of the key aggregate variables from the experiment were close to those obtained with the point estimates. In a similar spirit, 100 randomized runs of the model of this study were undertaken, some of which were carried out by varying the individual elasticities by themselves, while others via simultaneous random configurations of all model elasticities.[5] The outcomes, illustrated in Figure 4, show that the findings are robust, with the mean differences from the base simulation results, particularly in GDP and welfare, small in all three regions. Only the wage effects in the Latvian study region were found to be slightly more sensitive to initial parameter values.

[INSERT FIGURE 4 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).[6]

Figure 5 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. Further analysis showed that, as a result of the greater productive capacity and mobility of capital, the negative wage effects of the migration shock are found to be smaller compared to the basic simulation. For instance, when the endowment of capital is increased in 2% in parallel with the 10% rise in labour, skilled wages fell by approximately 2% in the Greek and Latvian regions, and 4% in the UK study region, relative to the base results.

[INSERT FIGURE 5 HERE]

Increased substitutability between skilled and unskilled labour

The findings 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 provide another 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 0.4 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 1.78%, if it is easier for employers to substitute skilled workers for unskilled migrants there is a positive GDP effect of 2.03%. A smaller decrease in the wages of unskilled workers is also found (-14.8%), 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 and EV 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. 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 is restrictive. Further disaggregation of these accounts would improve the ability of the models to analyse the fiscal impacts of migration. However, 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. Another useful development of the analysis would be to incorporate the possibility of remittances into the model to allow for a more comprehensive assessment of the overall impact of brain-drain on regional economies.

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 intra-regional effects that may arise in response to migration shocks. Due to space considerations such an analysis has not been pursued here, yet it constitutes an important agenda for future study.

Overall, 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 highly topical area.

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APPENDIX
Abridged Mathematical Version of the TERA Model[7]

Prices		
Absorption:	$PQ_c(1-tq_c)QQ_c = PDD_cQD_c + PM_cQM_c$	(A1)
Marketed output value:	$PX_cQX_c = PDS_cQD_c + PE_cQE_c$	(A2)
Import price	$PM_C = pwm_c(1+tm_c)EXR$	(A3)
Export price	$PE_c = pwe_c(1-te_c)EXR$	(A4)
Activity revenue/costs	$PA_a(1-ta_a)QA_a = PVA_aQVA_a + PINTA_aQINTA_a$	(A5)
Production and Trade		
CES Technology: Activity Production Function:	$QA_a = \alpha_a^a(\delta_a^aQVA_a^{-\rho_a^a} + (1-\delta_a^a)QINTA_a^{-\rho_a^a})^{-\frac{1}{\rho_a^a}}$	(A6)
Leontief technology: Demand for aggregate value-added:	$QV_a = iva_aQA_a$	(A7)
Leontief technology - Demand for aggregate intermediate input:	$QINTA_a = \text{int}\,a_aQA_a$	(A8)
Value added and factor demands:	$QVA_a = a_a^{va}(\sum_{f\in F}\delta_{fa}^{va}QF_{fa}^{-\rho_a^{va}})^{-\frac{1}{\rho_a^{va}}}$	(A9)
Output transformation (CET function):	$QX_c = \alpha_c^t(\delta_c^tQE_c^{\rho_c^t} + (1-\delta_c^t)QD_c^{\rho_c^t})^{\frac{1}{\rho_c^t}}$	(A10)
Composite supply (Armington function):	$QQ_c = \alpha_c^q(\delta_c^qQM_c^{-\rho_c^q} + (1-\delta_c^q)QD_c^{-\rho_c^q})^{-\frac{1}{\rho_c^q}}$	(A11)
Output aggregation function:	$QX_c = \alpha_c^{ac}(\sum_{\alpha\in A}\delta_{ac}^{ac}QXAC_{ac}^{-\rho_c^{ac}})^{\frac{1}{\rho_c^{ac}-1}}$	(A12)
Institution Block		
Factor income:	$YF_f = \sum_{a\in A}WF_f\overline{WFDIST}_{fa}QF_{fa}$	(A13)
Institutional factor incomes:	$YIF_{if} = shif_{if}[(1-tf_f)YF_f - trnsfr_{ROWf}EXR]$	(A14)
Income of domestic non-government institutions	$YI_i = \sum_{f\in F}YIF_f + \sum_{i\in INSDNG}TRII_{ii'} + trnsf_{igov} + trnsfi_{ROW}EXR$	(A15)
Household consumption expenditure	$EH_h = (1-\sum_{i\in INSDNG}shii_{ih})(1-MPS_h)(1-TINS_h)YI_h$	(A16)
Household consumption demand for marketed commodities (similar for home commodities):	$PQ_cQH_{ch} = PQ_c\gamma_{ch}^m + \beta_{ch}^m(EH_h - \sum_{c\in C}PQ_c\gamma_{ch}^m - \sum_{a\in A}\sum_{c\in C}PXAC_{ac}\gamma_{ach}^h)$	(A17)
Government revenue:	$YG = \sum_{i\in INSDNG}TINS_iYI_i + \sum_{f\in F}tf_fYF_f + \sum_{a\in A}tva_aPVA_aQVA_a + \sum_{a\in A}ta_aPA_aQA_a +$	(A18)

	$$+\sum_{c\in CM} tm_c\, pwm_c QM_c EXR + \sum_{c\in CE} te_c\, pwe_c QE_c EXR +$$ $$+\sum_{c\in C} tq_c PQ_c QQ_c + \sum_{f\in F} YIF_{govf} + trnsf_{govROW} EXR$$	
Government expenditure	$$EG = \sum_{c\in C} PQ_c QG_c + \sum_{i\in INSDNG} transf_{igov}$$	(A19)
System Constraint Block		
Factor Market:	$$\sum_{a\in A} QF_{fa} = \overline{QFS}_f$$	(A20)
Composite commodity markets:	$$QQ_c = \sum_{a\in A} QINT_{ca} + \sum_{h\in H} QH_{ch} + QG_c + QINV_c + qdst_c$$	(A21)
Current account balance:	$$\sum_{c\in CM} pwm_c QM_c + \sum_{f\in F} trnsfr_{ROWf} = \sum_{c\in CE} pwe_c QE_c + \sum_{i\in INSD} trnsfr_{iROW} + \overline{FSAV}$$	(A22)
Government balance:	$$YG = EG + GSAV$$	(A23)
Saving-Investment Balance:	$$\sum_{i\in INSDNG} MPS_i (1 - TINS_i) YI_i + GSAV + EXR\overline{FSAV} = \sum_{c\in C} PQ_c QINV_c + \sum_{c\in C} PQ_c qdst_c$$	(A24)
Total absorption:	$$TABS = \sum_{h\in H}\sum_{c\in C} PQ_c QH_{ch} + \sum_{a\in A}\sum_{c\in C}\sum_{h\in H} PXAC_{ac} QHA_{ach} +$$ $$+\sum_{c\in C} PQ_c QG_c + \sum_{c\in C} PQ_c QINV_c + \sum_{c\in C} PQ_c qdst_c$$	(A25)

DEFINITIONS OF MODEL PARAMETERS/VARIABLES

Sets

$a \in A$	activities (disaggregated according to rural-urban status)
$c \in C$	commodities
$c \in CM$	imported commodities
$c \in CE$	exported commodities
$f \in F$	factors (disaggregated according to rural-urban status)
$i \in ISNDNG$	domestic non-government institutions
$h \in H$	households (disaggregated according to rural-urban status)

Parameters

α_a^a	efficiency parameter in the CES activity function
α_a^{va}	efficiency parameter in the CES value added function
α_c^t	CET function shift parameter
α_c^q	Armington function shift parameter
α_c^{ac}	shift parameter for domestic commodity aggregation function
β_{ch}^m	marginal share of consumption spending on marketed commodity *c* for household *h*
δ_a^a	CES activity function share parameter
δ_{fa}^{va}	CES value-added share parameter for factor *f* in activity *a*
δ_c^t	CET function share parameter
δ_c^q	Armington function share parameter
δ_c^{ac}	share parameter for domestic commodity aggregation function
γ_{ch}^m	subsistence consumption of marketed commodity *c* for household *h*
γ_{ach}^h	subsistence consumption of home commodity *c* from activity *a* for household *h*
ρ_a^a	CES production function exponent
ρ_a^{va}	CES value-added function exponent
ρ_c^t	CET function exponent
ρ_c^{ac}	domestic commodity aggregation function exponent
iva_a	quantity of value-added per activity unit
$\text{int}\ a_a$	quantity of aggregate intermediate input per activity unit
tq_c	rate of sales tax
tf_f	direct tax rate for factor f
tva_a	rate of value-added tax for activity *a*
tm_c	import tariff rate
te_c	export tax rate
$shif_{if}$	share for domestic institution *i* in income of factor *f*
$trnsfr_{if}$	transfer from factor *f* to institution *i*
pwm_c	import price (foreign currency)
pwe_c	export price (foreign currency)

$qdst_c$	quantity of stock change

Exogenous Variables

$\overline{QFS}_f$	quantity of factor supplied
$\overline{WFDIST}_{fa}$	wage distortion factor for factor *f* in activity *a*
$\overline{FSAV}$	foreign saving (foreign currency unit)
MPS_i	marginal propensity to save for domestic non-government institution

Endogenous Variables

PQ_c	composite commodity price
PDD_c	demand price for commodity produced and sold domestically
PE_c	export price (domestic currency)
PM_c	import price (domestic currency)
PX_c	aggregate producer price for commodity
$PXAC_{ac}$	producer price of commodity *c* for activity *a*
PDS_c	supply price for commodity produced and sold domestically
PVA_a	value-added price (factor income per unit of activity)
QA_a	quantity (level) of activity
QQ_c	quantity of goods supplied to domestic market (composite supply)
QD_c	quantity sold domestically of domestic output
QE_c	quantity of exports of commodity
QM_c	quantity of imports of commodity
$QXAC_{ac}$	quantity of marketed output of commodity *c* from activity *a*
QX_c	aggregate marketed quantity of domestic output of commodity
QVA_a	quantity of (aggregate) value-added
$QINTA_a$	quantity of aggregate intermediate input
$QINT_{ca}$	quantity of commodity *c* as intermediate input to activity *a*
QF_{fa}	quantity demanded of factor *f* from activity *a*
QH_{ch}	quantity consumed of commodity *c* by household *h*
QHA_{ach}	quantity of household home consumption of commodity *c* from activity *a* for household *h*
$QINV_c$	quantity of investment demand for commodity
QG_c	government consumption demand for commodity
YF_f	income of factor *f*
WF_f	average price of factor *f*
YIF_{if}	income to domestic institution *i* from factor *f*
YI_i	income of domestic nongovernment institution
EH_h	consumption spending for household
EXR	exchange rate (local currency unit per foreign currency unit)
$TINS_i$	direct tax rate for institution *i*
YG	government revenue
EG	government expenditures
$GSAV$	government savings
$TABS$	total nominal absorption

Table 1 Level of Disaggregation of TERA model			
	GR	**LV**	**UK**
Activities/Industries	18	33	38
Of which Rural	9	17	19
Commodities	20	15	19
Factors of Productions	10	10	10
Of which Rural	5	3	6
Households	13	8	8
Of which Rural	6	4	4
Notes: 1 ROW, 1 Government sector for all case study areas			

Table 2 Selected Elasticities of CGE models			
	Archanes-Heraklion model (GR study region)	**Latgale model (LV study region)**	**East Highlands model (UK study region)**
Production Block			
Top: Substitution between VA and intermediate inputs	Activity-specific (range: 0.5-1.5)	0.6	0.6
Bottom: Substitution between factors of production	Activity-specific (range: 0.5-1.5)	0.8	0.4
Output aggregation	6	6	6
Trade Block			
Armington	Commodity-specific (range: 0.1-1.2)	0.8	2
CET	Commodity-specific (range: 0.2-2.4)	1.6	1.6
HH Consumption			
Frisch	-1	-1	-1
Home	1	1	1
Market	Commodity-specific (range: 0.4-1.0)	Commodity-specific (range: 0.6-1.5)	Commodity-specific (range: 0.3-1.3)
Sources: **UK**: LISENKOVA *et al*., 2007; BARNES *et al*., 2008; HUNT AND MANNING, 1989; HARRIS, 1989; GIBSON, 1990; **GR**: ZOGRAFAKIS, 1997; SARRIS AND ZOGRAFAKIS, 2003; **LV**: Due to lack of relevant literature, mainly default IFPRI model values used.			

Table 3 Summary information on the three study areas from the Regional SAMs			
	Greek study area Archanes-Heraklion	**Latvian study area Latgale**	**Scottish Study area East Highlands**
Region population	142,259	364,345	115,899
Regional GDP (m Euros)	1524.1	592.2	2,749.1
Rural Share (%)	4.28	41.3	40.5
Urban Share (%)	95.72	58.7	59.5
GDP Per Capita (Euros)	10,711	1625	23,724
Top sector in terms of value-added (m Euros; % of subregional total):			
Rural area:	Agriculture (28.5; 35.1%)	Transport, storage & communication (42.6; 17.5%)	Business services (201.5; 18.1%)
Urban area:	Hotels and restaurants (345.6; 24.5%)	Wholesale and retail (65.8; 18.9%)	Health (292.48; 17.9%)
Top sector in terms of employment: (FTEs; % of subregional total):			
Rural area:	Agriculture (855; 43.7%)	Education (8236; 19.4%)	Hotels and catering (3395; 15.6%)
Urban area:	Public Services (15632; 27.2%)	Education (9973; 17.9%)	Wholesale and retail (7365; 21.6%)
Total household income	1557.787	556.8	2685.9
% total household income from outside region	18.4	10.2	20.1
Total value of exports	439.465	343.5	2717.4
% of total output exported	13.7	19.0	20.8
Total value of imports	677.3	368.3	4205.7
% of total commodities accounted by imports	36.7	19.7	35.8
Source: Own calculations based on SAMs; base year values are 2005 for UK and LV; 2004 for GR.			

Table 4 %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	2.92	-3.20
Investment	13.93	-15.06	22.17	-26.48	25.11	-28.66
Reg exports	3.89	-4.06	7.87	-8.38	7.74	-8.66
Reg imports	6.04	-6.41	7.64	-8.51	8.42	-9.45
Foreign Savings	17.78	-19.10	0.29	-2.78	2.08	-2.35
Overall GDP	**4.6**	**-4.85**	**5.88**	**-6.38**	**5.62**	**-6.23**
GDP/capita	**0.41**	**-0.71**	**2.87**	**-3.55**	**0.77**	**-1.49**
Welfare (EV)*	**5.14**	**-5.36**	**1.42**	**-1.50**	**1.17**	**-1.32**
*Note: The units for EV are, by country, million €, million Lats and million £.						

Table 5 Impact on Welfare by Household Type (Equivalent Variation) from 10% increase in labour			
Household Type	**GR (€m)**	**LV (Lats m)**	**UK (£m)**
Urban Commuters	0.01	0.07	0.36
Urban Local	2.91	0.74	-0.12
Urban Other	0.42	0.03	1.30
Rural Commuters	0.01	0.07	1.17
Rural Local	0.02	0.14	0.67
Rural Other	0.00	0.03	0.87
Agricultural Households	1.90	0.29	0.24
Tourists	-0.12	0.04	0.00
Total	**5.14**	**1.42**	**4.49**

Table 6 %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	-12.29	-9.76	14.42	10.42

Table 7 %Changes in Producer and Consumer Prices						
	GR		**LV**		**UK**	
	+10%	**-10%**	**+10%**	**-10%**	**+10%**	**-10%**
Producer Prices						
Primary	1.76	-1.78	-1.82	2.12	3.42	-3.99
Secondary	1.53	-1.98	1.30	-1.93	-0.40	0.60
Tertiary	0.61	-0.65	-1.60	1.92	-2.40	2.75
Consumer Prices						
Primary	1.64	-1.68	0.19	-0.19	0.55	-0.69
Secondary	0.79	-1.04	1.04	-1.41	0.22	-0.26
Tertiary	0.65	-0.70	-1.45	1.74	-2.06	2.49

Table 8 %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	-5.09	1.34
Investment	-19.23	10.81	-52.05	2.50	-50.52	9.88
Reg exports	-4.14	3.77	-12.75	4.20	-15.25	2.53
Reg imports	-7.72	5.00	-14.97	2.30	-16.11	3.40
Foreign Savings	-25.49	12.95	-17.42	-11.48	-3.82	1.08
Overall GDP	**-5.40**	**4.16**	**-10.59**	**2.35**	**-11.11**	**1.78**
GDP/capita	**-1.88**	**-0.57**	**-5.96**	**1.40**	**-5.53**	**-1.87**
Welfare (EV)*	**-5.88**	**5.19**	**-2.49**	**0.52**	**-7.89**	**2.06**
*Note: The units for EV are, by country, million €, million Lats and million £.						

Table 9 %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	39.54	-25.40	4.44	-33.11

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											Urban factor income
	Rural		Value added										Rural factor income
House -holds	Urban				Factor income	Factor income	Inter- household transfers	Inter- household transfers	Transfers to urban households			Factor and transfer income from ROW	Urban household income
	Rural				Factor income	Factor income	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

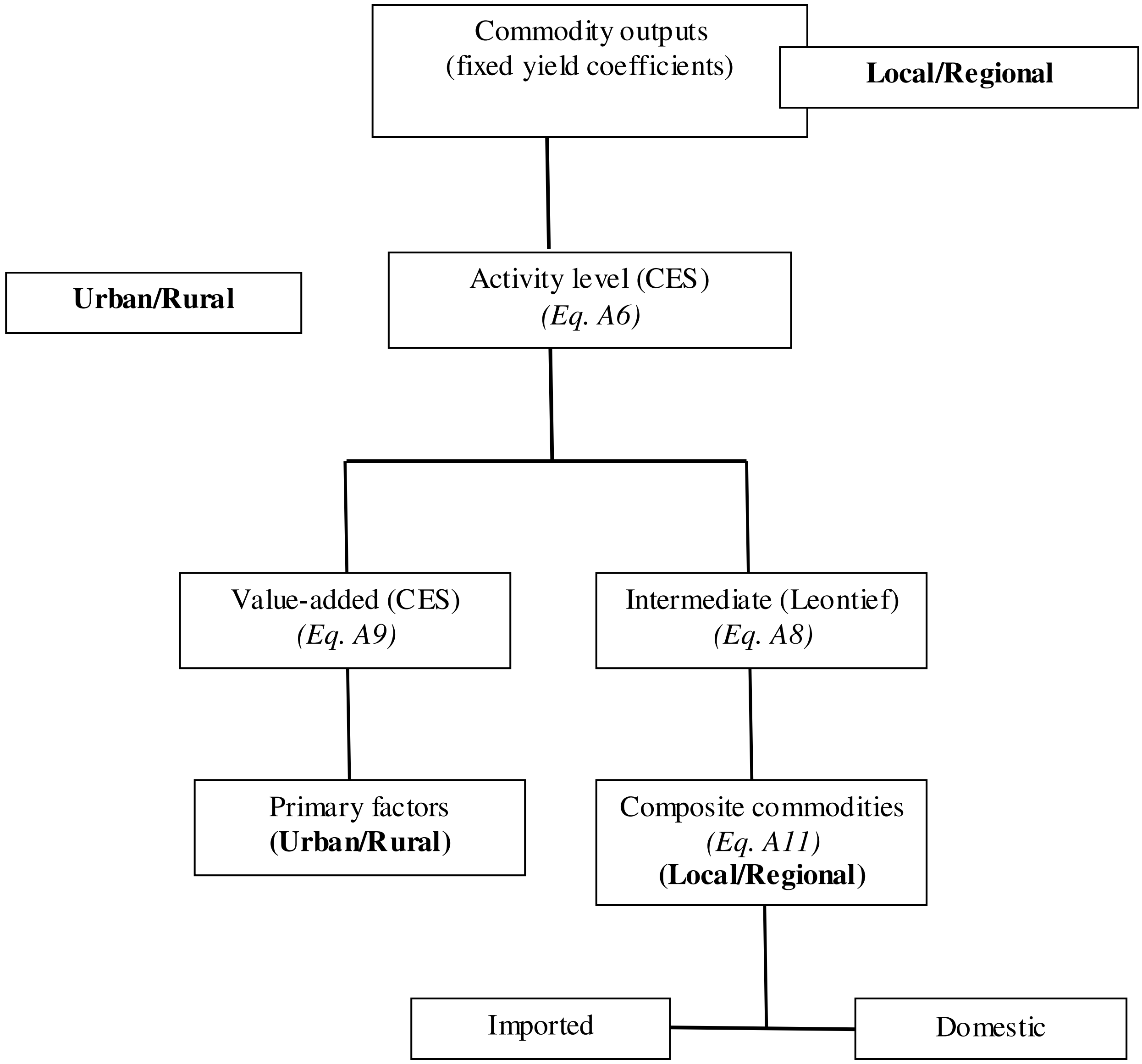


Figure 3 Commodity flows

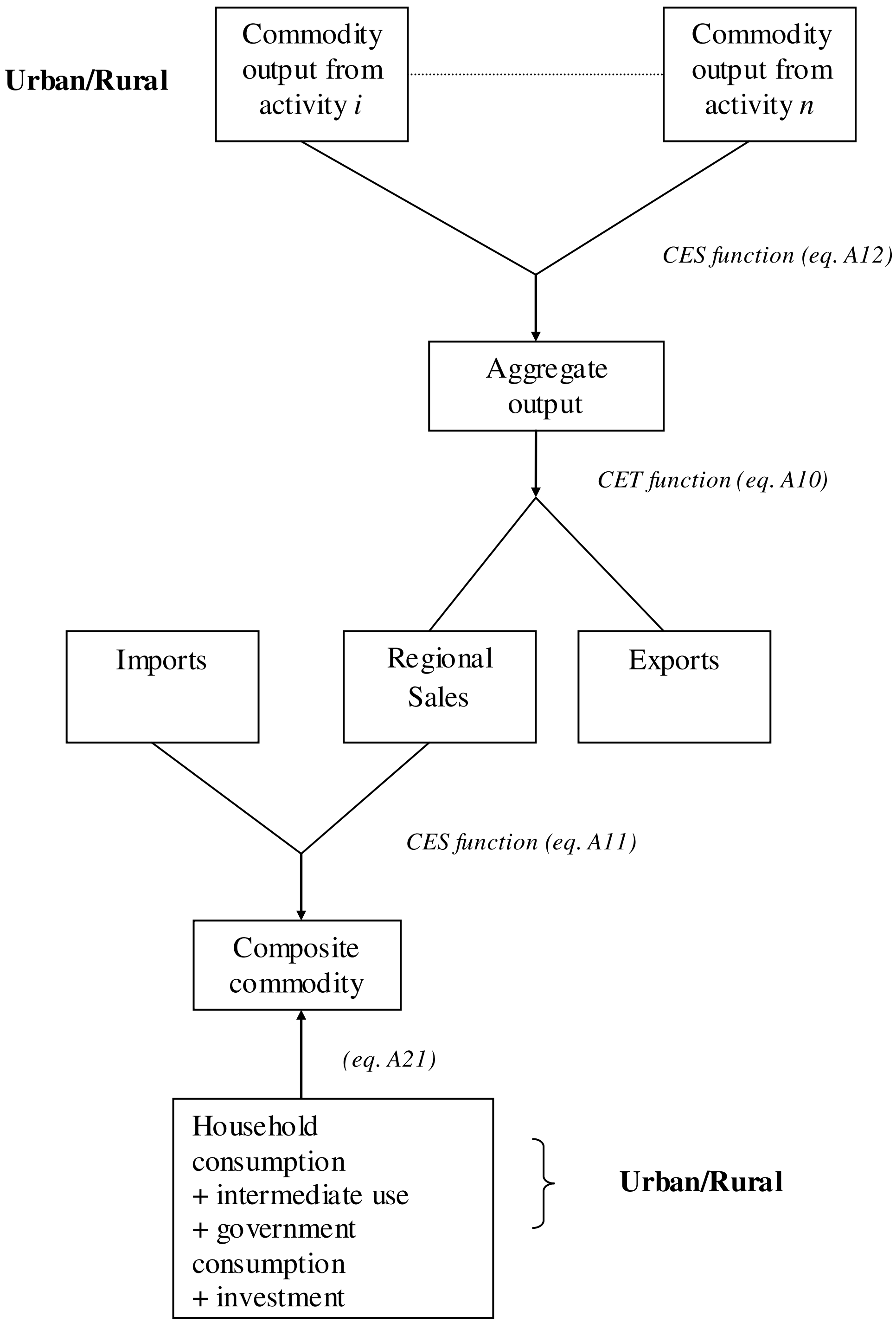


Figure 4 Sensitivity Analysis to 10% rise in labour supply

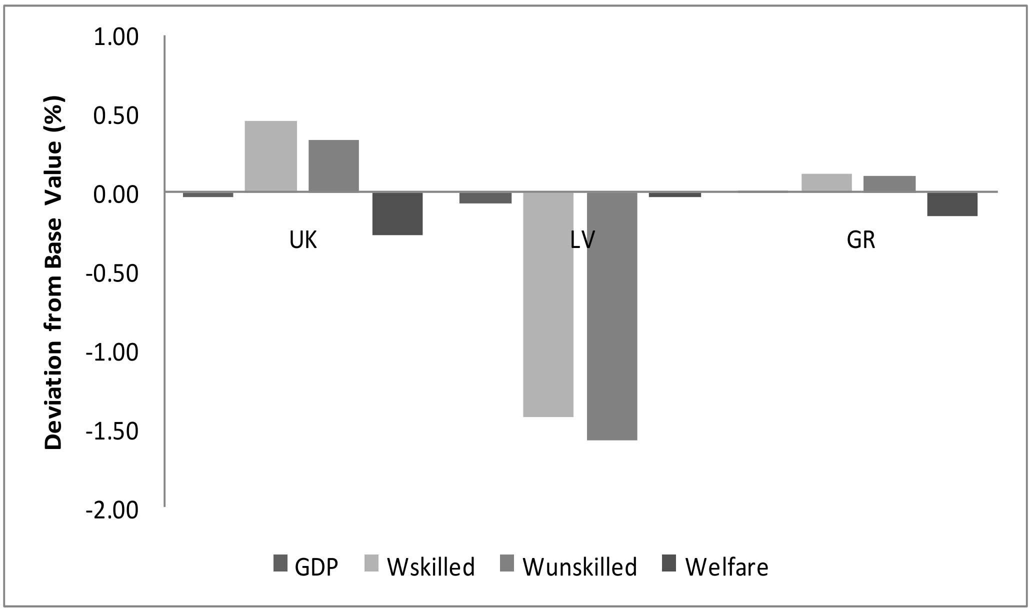
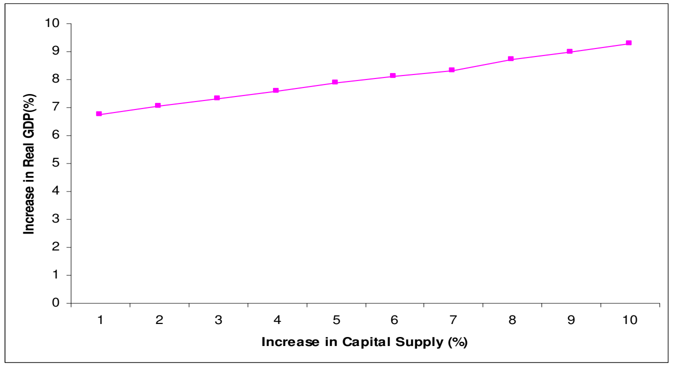
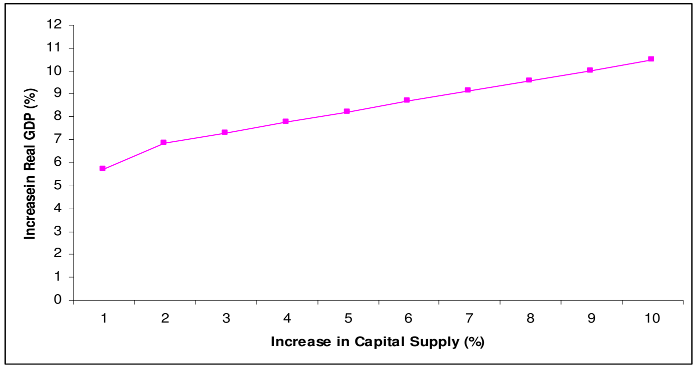


Figure 5 GDP responses to 10% rise in labour supply with variable capital

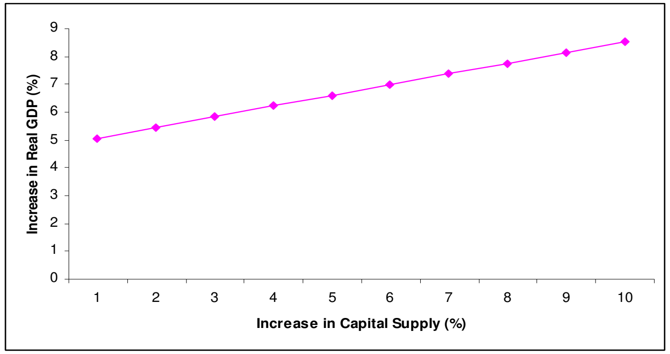
(a) United Kingdom



(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).
[2] 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.
[3] 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 4 are expected to be lower, ceteris paribus.
4 Data limitations have not allowed the explicit integration of this channel into the CGE analysis of this paper.
[5] In all cases the elasticities are assumed to be randomly drawn from a uniform distribution, with lower and upper boundaries that correspond to -50% and +50%, respectively, of the assumed baseline elasticity values.
6 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.
[7] Due to space limitations, the following types of equations have been omitted from the mathematical statement of the model: (*i*) identities; (*ii*) aggregation equations; (*iii*) indices; (*iv*) optimizations conditions.