Regional Skill Endowments, Employment Structure, and International Migration in the European Union, 1988-2005
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Abstract: This paper investigates international migrations patterns by skill and by region across the European Union during the period 1988-2005, which is characterised by substantial economic integration and further geographic enlargement. After presenting some facts about the regional distribution of skills of natives and foreigners, and their evolution over time, we develop a theoretical model where there is international trade and where both skilled and unskilled labour can move, and be employed in either a tradable or a non-tradable sector. The predicted skill distribution of natives and foreigners from both within and outside the European Union across regions is then tested using data from Eurostat's Labour Force Survey. The empirical results suggest that despite some tendency towards skill concentration, migrants actually reduce cross-regional variations in skill endowments across the EU, hence the persistence of regions with above-average skill endowments reduces over time. The results also show that the concentration of skills is directly related to the size of the non-tradable sector. Against the fear that closer economic ties among member states might lead to the creation of super-regions where all skilled workers converge, these findings support a more balanced view of the effects of migration in the presence of international trade, as per the Hecksher-Ohlin model, and the possible need for a regional, rather than European, migration policy.

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1   Introduction

More than twenty years have passed since 1986, when the then 12 member states of the European Community signed the Single Act, in which they agreed to establish, by January 1st 1992, "an area without frontiers in which the free movement of goods, persons, services and capital is ensured ..."[1] in order to "[...] promote [the Community's] overall harmonious development, [and strengthen its] economic and social cohesion"[2]. Since then, steady progress towards the formation of the "single market" has led to the reduction of many formal barriers to international factor movements, the adoption of a single currency in 2000, and the enlargement of the European Union (EU) to 15 new member states (while others are candidates).

The international freedom of movement was expected to help European workers to reallocate across member states given the significant cross-border differences in average income per capita and unemployment rate, as reported in the studies at that time (e.g. Flanagan, 1992). Prima facie, the data on the employment share of foreigners in the EU for the period 1988-2005 shown in Figure 1 suggest otherwise.

FIGURE 1   INTRA AND EXTRA-EU EMPLOYMENT SHARES IN THE EU, 1988-2005
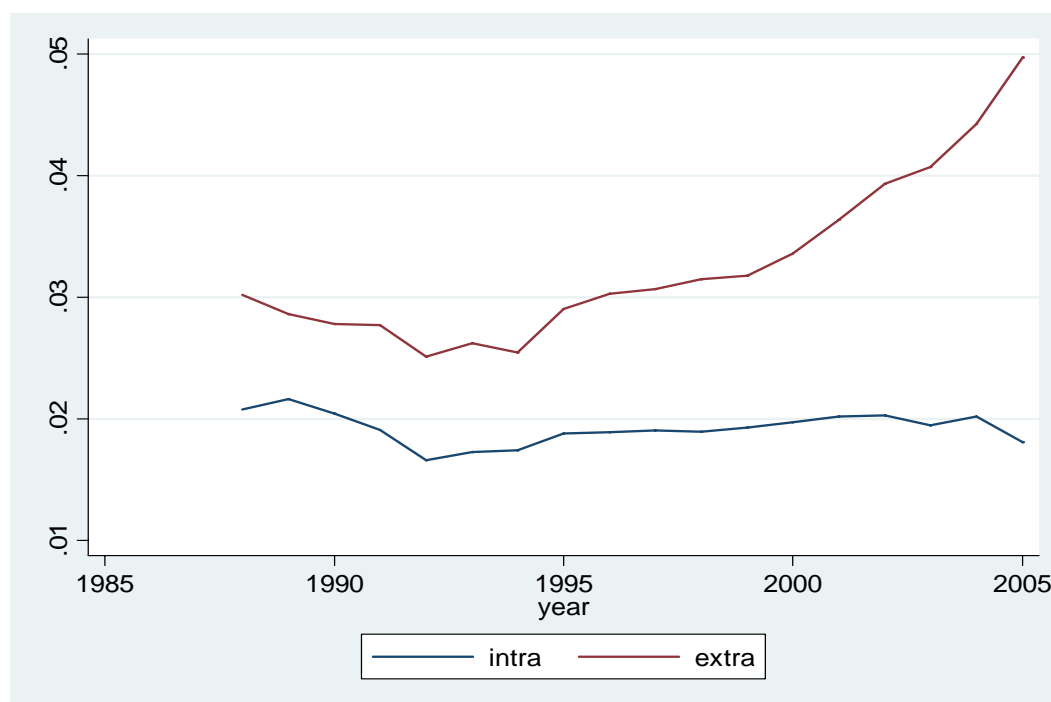
During the period 1988-2005 the employment shares of European citizens working in another member state from the one of birth or nationality ("intra-EU") as a percentage of total EU employment has remained fairly stable at around 2% of total employment. In contrast, the corresponding proportion of non-European citizens working in a member state ("extra-EU"), to whom the Single Act provisions did not apply, has almost doubled, from approximately 3% during 1988-1995 to about 5% in 2005.

However, when data are disaggregated by region (the administrative level immediately below that of a country), and by skill level, the employment shares and skill compositions of foreign workers reveal far more variation. As an example, Figure 2 depicts the shares of employment and skilled/unskilled ratios of intra-EU and extra-EU labour, respectively, in England's South East (the region of London) between 1988 and 2005.

FIGURE 2   INTRA- AND ETXRA-EU EMPLOYMENT SHARES IN ENGLAND'S SOUTH EAST, 1988-2005
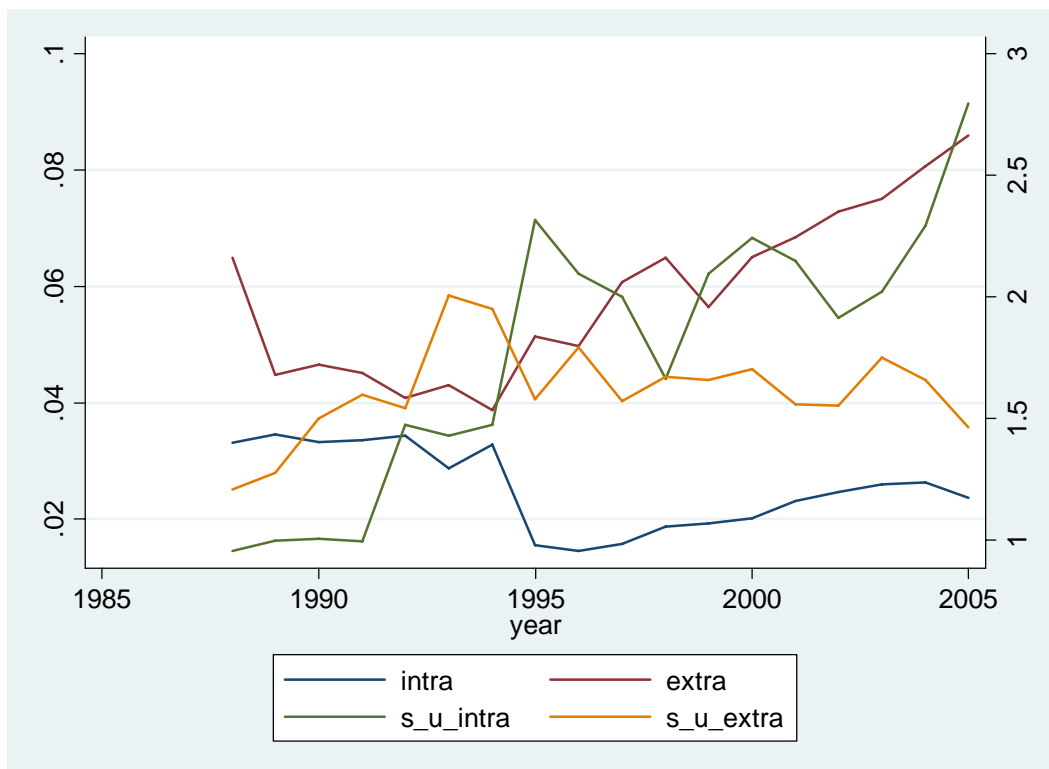
While the share of intra-EU workers has dropped from 3.7% of local employment in 1988 to about 2.6% in 2005 ("intra" in Figure 2), the corresponding ratio of skilled to unskilled labour ("s_u_intra"), calculated as the number of intra-EU workers in the top three categories of the occupational scale of the International Standard

Classification of Occupations (ISCO 1-3: managers, professionals and associate professionals) divided by the number of those in the bottom three ISCO categories (ISCO 7-9: foremen, operatives and labourers), has almost trebled from 1 to 2.8. Instead, the employment share of non-Europeans in the South East of England ("extra") has first dropped from just over 6% in 1988 to 4% in 1994 to then reach over 8% in 2005, though the skill composition of extra-EU workers has remained stable ("s_u_extra").

These employment shares of foreigners may not appear very high, especially when related to those of other destination countries, such as Australia where they are commonly above 25%. However, the share of foreigners within skill categories is more pronounced: in the South East of England, in 2005 it was 10.2% in ISCO categories 1-3 (2.8% intra-EU and 7.3% extra-EU, respectively). In categories ISCO 7-9, it was 11.2% (1.6% intra-EU and 9.6% extra-EU). By contrast, in the region of Paris, foreign workers account for less than 5% of those employed in ISCO categories 1-3 but for over 25% in ISCO categories 7-9. The shares of foreign employment in ISCO categories 1-3 in centres of EU headquarters such as Brussels and Luxembourg are commonly over 20% and 40%, respectively.

While the labour market effects of European economic integration have been studied in terms of the observed convergence in regional GDP and unemployment rates (e.g. Quah, 1995; Puga and Overman, 1998), and the channels through which European workers (should) respond to regional wage differentials or labour demand shocks (e.g. Decressin and Fatas, 1995, Fredriksson, 1998, Mauro and Spilimbergo, 1999, Tani, 2003, Nahius and Patel, 2005), the variability in the skill composition of foreign workers and its effect on regional skill endowments appears under-researched. In particular, little work seems to exist on whether Europe's economic integration (and the consequent redistribution of European funds from 'core' to 'peripheral' regions) has reduced or raised regional differences in skill endowments within and among member states. Yet, the stock of human capital is not only well-known source of comparative advantage and long-term economic growth for a locale (e.g. Romer, 1991, Dowrick, 2003), but also a resource that can be directly 'man-made' by policymaking, for example through investments in local schoolings. Have regions that have traditionally

been abundant of skilled labour maintained their advantage? Has economic integration strengthened initial differences in regional skill endowments across the EU?

This paper attempts to address these questions by documenting the impact of foreign workers on regional skill endowments during the period 1988-2005, and by developing a theoretical model, based on Blanchard and Katz (1992), to interpret their evolution. In particular, the skill composition of migrants is examined in relation to the spatial distribution of the stock of native skills and the degree of openness of a region's economy, as measured by the employment share of the tradable sector. The model can be summarised as follows: changes in labour demand due to economic integration and technological change are probably larger for firms in the tradable sector, as these have to face a global competition and hence are more sensitive to input costs. As a result, regions with a small tradable sector may enjoy a natural shelter from shocks to labour demand relative to regions with a large tradable sector. If native and foreign workers also differ in their elasticity of labour supply, it occurs that workers with higher elasticity (typically foreigners and the skilled) will be over-represented in local employment changes. The evolution of a region's endowment of skills will therefore depend on the share of the tradable sector and the proportion of foreigners in the region. This prediction is empirically tested using data extracted from Eurostat's Labour Force Survey (LFS).

Although the LFS assures a high degree of cross-national comparability, as it records the same set of characteristics in each member state using the same definitions, regional historical series on variables such as nationality, education, and occupational level are at times incomplete, especially in the period 1988-1991, and sometimes even during 1992-1994. Rather than trying to impute missing data from alternative sources, the empirical analysis is carried out on an unbalanced panel.

The rest of the paper is organised as follows: section 2 presents a brief summary of the reference literature, while Section 3 illustrates some facts about changes in regional skill endowments cross the EU. Section 4 develops the theoretical model. Section 5 presents the data while Section 6 discusses the empirical analysis. Section 7 draws some policy implications and final remarks.

2   Reference literature

The relationship between the skills of foreign and native workers is generally studied within microeconomic analyses of complementarity or substitutability between immigrants and natives, which tend to relate net immigration rates on the wage level of individual natives (e.g. Chiswick, 198??; Borjas, 1987). However, in the context of Europe's economic integration, the analysis of changes in regional skill endowments has to take into account that labour market integration is occurring along the (faster) removal of barriers to commodity trade and capital movements. Notwithstanding these characteristics, the paper studies the evolution of regional skill endowments using a partial equilibrium analysis, but trying to incorporate some of the insights of the international trade literature about predicted changes in factor endowments following integration. As a result, theoretical model developed features elements of comparative statistics and dynamic analysis.

From the international trade literature, and earlier studies on the spatial location of economic activity, the paper incorporates the idea that workers and firms may agglomerate in space because of some form of local economies of scale in production. Recent 'new geography trade' studies highlight that increasing returns, interacting with transport costs, may favour agglomeration of firms and workers against the classic prediction of diffusion arising from the Heckscher-Ohlin model in presence of factor movements (e.g. Mundell, 1957). It is the level of transport costs that determines whether increasing returns to scale (e.g. Krugman, 1991) or a high degree of vertical integration between upstream and downstream industries (e.g Venables, 1996) prevail over the competition for factors of production, or vice-versa. Starting from autarky, these models show that declining transport costs initially lead to agglomeration, but when transport is costless location does not matter. Regional skill endowments may therefore evolve following a U-shape: rising when regions initially 'merge' and subsequently fall as economic integration progresses (e.g. Puga, 1998 and 1999). Generally, when integration is 'intermediate', agglomeration forces dominate. As skilled workers move to skill-intensive regions, migration reinforces initial skill differences. Much of the empirical support to this literature comes from simulations rather than estimation, partly due to the technical construction of these models, and partly for a general lack of data on international trade across EU regions.

This paper aims at contributing to this literature by presenting regional data on the skill patterns of native and foreign workers.

Analytically, this paper is firmly located in the literature on the dynamic labour market analysis developed by Blanchard and Katz (1992), from which it borrows the overall theoretical framework. The advantage of such strategy is the ability of deriving analytical solutions that can be empirically tested. In particular, this paper extends the Blanchard and Katz model in two directions:

- horizontally, by introducing tradable and non-tradable firms in the labour demand, and by distinguishing between native and foreign workers in the labour supply. These elements determine how regional skill endowments react to a shock, such as an increased economic integration, from an equilibrium to another and during the transitional phase;

- vertically, by expanding the analysis across regions differently endowed with skills (rather than focusing on one only), to determine whether economic integration reduces or expand initial differences in skill endowments in the long-term.

Before presenting the model, some preliminary facts about regional skill endowments across the EU are discussed.

3 Preliminary facts about regional skill endowments in the EU

<u>T+5 Transition Matrices</u>

<u>Share pop natives</u>

```
Cell Partition:
 (0:-0.000) (1:0.002) (2:0.004) (3:0.006) (4:0.012)
 (5:0.055)
Stationary tr.pr.
         0        1        2        3        4        5
      0
 118:      0.96     0.04     0.00     0.00     0.00
      1
 107:      0.00     0.98     0.02     0.00     0.00
      2
 120:      0.00     0.11     0.88     0.01     0.00
      3
 118:      0.00     0.00     0.03     0.93     0.03
      4
 113:      0.00     0.00     0.00     0.02     0.98
      5
Ergodic distribution: 0.000, 0.771, 0.133, 0.033, 0.063
```

Share pop intra-EU

```
Cell Partition:
 (0:-0.000) (1:0.002) (2:0.004) (3:0.006) (4:0.011)
 (5:0.052)
Stationary tr.pr.
        0         1         2         3         4         5
    0
 118:    0.96      0.04      0.00      0.00      0.00
    1
 107:    0.00      0.98      0.02      0.00      0.00
    2
 120:    0.00      0.11      0.88      0.01      0.00
    3
 118:    0.00      0.00      0.03      0.93      0.03
    4
 113:    0.00      0.00      0.00      0.02      0.98
    5
Ergodic distribution: 0.000, 0.771, 0.133, 0.033, 0.063
```

Share pop extra-EU

```
Cell Partition:
 (0:-0.000) (1:0.002) (2:0.003) (3:0.006) (4:0.011)
 (5:0.050)
Stationary tr.pr.
        0         1         2         3         4         5
    0
 118:    0.96      0.04      0.00      0.00      0.00
    1
 108:    0.00      0.98      0.02      0.00      0.00
    2
 119:    0.00      0.09      0.90      0.01      0.00
    3
 118:    0.00      0.00      0.03      0.93      0.03
    4
 113:    0.00      0.00      0.00      0.02      0.98
    5
Ergodic distribution: 0.000, 0.743, 0.149, 0.037, 0.071
```

T+5

Employment share skilled natives

```
Cell Partition:
 (0:-0.001) (1:0.002) (2:0.004) (3:0.006) (4:0.011)
 (5:0.087)
Stationary tr.pr.
        0         1         2         3         4         5
     0
  105:      0.95      0.05      0.00      0.00      0.00
     1
  103:      0.06      0.90      0.04      0.00      0.00
     2
  112:      0.00      0.07      0.79      0.14      0.00
     3
  100:      0.00      0.00      0.04      0.89      0.07
     4
  104:      0.00      0.00      0.00      0.05      0.95
     5
Ergodic distribution: 0.162, 0.133, 0.072, 0.258, 0.375
```

Employment share unskilled natives

```
Cell Partition:
 (0:-0.000) (1:0.002) (2:0.005) (3:0.007) (4:0.011)
 (5:0.049)
Stationary tr.pr.
        0         1         2         3         4         5
     0
  107:      0.93      0.07      0.00      0.00      0.00
     1
  101:      0.02      0.87      0.11      0.00      0.00
     2
  106:      0.00      0.12      0.78      0.09      0.00
     3
   98:      0.00      0.00      0.12      0.86      0.02
     4
  112:      0.00      0.00      0.00      0.13      0.87
     5
Ergodic distribution: 0.102, 0.336, 0.298, 0.230, 0.035
```

Employment share skilled intra-EU
```
Cell Partition:
 (0:-0.001) (1:0.000) (2:0.002) (3:0.005) (4:0.011)
 (5:0.125)
Stationary tr.pr.
        0         1         2         3         4         5
     0
  109:      0.74      0.24      0.02      0.00      0.00
     1
  100:      0.20      0.54      0.26      0.00      0.00
     2
  107:      0.02      0.28      0.45      0.22      0.03
     3
  103:      0.00      0.01      0.24      0.65      0.10
     4
  105:      0.00      0.00      0.01      0.18      0.81
     5
Ergodic distribution: 0.202, 0.239, 0.213, 0.208, 0.138
```

9

Employment share unskilled intra-EU

```
Cell Partition:
 (0:-0.002) (1:0.000) (2:0.002) (3:0.004) (4:0.010)
 (5:0.174)
Stationary tr.pr.
         0         1         2         3         4         5
     0
 110:     0.74      0.23      0.04      0.00      0.00
     1
 112:     0.17      0.50      0.25      0.08      0.00
     2
 101:     0.02      0.13      0.57      0.28      0.00
     3
  91:     0.00      0.04      0.16      0.70      0.09
     4
 110:     0.00      0.00      0.00      0.18      0.82
     5
Ergodic distribution: 0.106, 0.138, 0.228, 0.356, 0.172
```

Employment share skilled extra-EU

```
Cell Partition:
 (0:-0.003) (1:0.000) (2:0.001) (3:0.003) (4:0.009)
 (5:0.273)
Stationary tr.pr.
         0         1         2         3         4         5
     0
 111:     0.61      0.35      0.02      0.02      0.00
     1
  94:     0.31      0.45      0.21      0.03      0.00
     2
 111:     0.03      0.29      0.46      0.20      0.03
     3
 106:     0.00      0.03      0.25      0.57      0.16
     4
 102:     0.00      0.00      0.00      0.14      0.86
     5
Ergodic distribution: 0.185, 0.217, 0.173, 0.180, 0.245
```

Employment share unskilled extra-EU

```
Cell Partition:
 (0:-0.001) (1:0.000) (2:0.002) (3:0.004) (4:0.010)
 (5:0.094)
Stationary tr.pr.
         0         1         2         3         4         5
     0
 124:     0.57      0.26      0.10      0.06      0.02
     1
 103:     0.16      0.50      0.22      0.07      0.05
     2
  90:     0.03      0.20      0.52      0.13      0.11
     3
 106:     0.00      0.01      0.38      0.53      0.08
     4
 101:     0.00      0.00      0.00      0.20      0.80
     5
Ergodic distribution: 0.075, 0.150, 0.263, 0.225, 0.287
```

TABLE 0   AVERAGE SKILLED/UNSKILLED RATIOS OF NATIVE AND FOREIGN WORKERS: 1995 AND 2005

	1995	2005
Q1		
S/U natives	.650	.674
S/U foreigners	.684	.391
Q2		
S/U natives	.932	.937
S/U foreigners	.670	.324
Q3		
S/U natives	1.119	1.153
S/U foreigners	.738	.644
Q4		
S/U natives	1.385	1.403
S/U foreigners	.612	.753
Q5		
S/U natives	2.033	2.184
S/U foreigners	.976	.973

The inflow of unskilled foreigners in the decade 1995-2005 has been significant in the least skill-endowed European regions.

4   Methodology

The model presented in this section builds on the work of Blanchard and Katz (1992), and the subsequent literature. In particular, it represents a two-sector region *i*, which produces two bundles of goods under a constant returns to scale technology. Of the two sectors, one produces tradable goods, while the other sector produces only non-tradable items. Employment growth in both sectors is negatively related to the regional wage level, but tradable firms are assumed to have a higher elasticity to labour demand under the assumption that competing on a global, as opposed to regional, scale makes them more sensitive to input costs. Labour is supplied by natives and foreigners. Foreigners are assumed to have higher labour supply elasticity, as in Tani (2003). Workers can further differ in their skill level (skilled or unskilled). To simplify the analysis, relative labour demand and supply are used.

As in Blanchard and Katz, workers and firms can move according to the 'attractiveness' exerted by each region, so that even with equal relative wages, net migration flows cn occur. A number of testable propositions can be derived from the model. These encompass both comparative statics and transitional dynamics.

Labour Demand

The relative labour demand for skilled labour in each region i at time t is:

$$w_{it} = \frac{w_{i,skilled,t} \, / \, w_{i,skilledEU,t}}{w_{i,unskilled,t} \, / \, w_{i,unskilledEU,t}} = -a(n_{it} - u_{it}) + z_{it} \qquad (1)$$

where w_{it} is the logarithm of region i's ratio of the skilled to the unskilled wage relative to the corresponding average ratio across the relevant geography (the EU). The parameter n_{it} is the logarithm of the regional relative labour force ($\frac{n_{i,skilled,t}}{n_{i,unskilled,t}}$) relative to the corresponding relative average labour force across the EU ($\frac{n_{eu,skilled,t}}{n_{eu,unskilled,t}}$).

The term u_{it} is region i's relative unemployment rate, which is defined as:

$$u_{i,t} \equiv ((\frac{U_{i,skilled,t}}{E_{i,skilled,t}}) / (\frac{U_{i,unskilled,t}}{E_{i,unskilled,t}})) / (\frac{U_{eu,skilled,t}}{E_{eu,skilled,t}}) / (\frac{U_{eu,unskilled,t}}{E_{eu,unskilled,t}}) \qquad (2)$$

where U_{it} and E_{it} represent region i's total number of unemployed and employed (i.e. native plus foreigners), respectively, at time t. This definition of unemployment implies that the difference $(n_{it} - u_{it})$ in (2) is approximately equal to the logarithm of relative employment[3]. It is assumed that $a > 0$.

The variable z_{it} denotes the number of firms in region i relative to the corresponding number across the EU, and is defined as:

$$\Delta z_{it} = z_{it+1} - z_{it} = \delta_{it} \Delta z_{it}^{tradable} + (1 - \delta_{it}) \Delta z_{it}^{non\text{-}tradable} \qquad (3)$$

where δ_{it} is the share of tradable firms in region i, i.e. $\delta_{it} = \frac{z_{it}^{tradable}}{z_{it}^{tradable} + z_{it}^{non-tradable}}$. The tradable sector demands labour according to:

$$\Delta z_{it}^{tradable} = -b_1 w_{it} + X_i^d + \varepsilon_{it+1|\Omega t}^d \qquad (4)$$

where $b_1 > 0$, X_i^d is the attractiveness of region i to tradable firms (for simplicity constant over time), and ε_{it+1}^d is a white noise stochastic process which represents unexpected changes in technology, the bundle of goods produced, and their relative

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[3] If U, E and N denote the numbers of unemployed, employed and those in the labour force, then u_s / u_u = (U/E)u_s / (U/E)$u_u \approx$ ln (1 + U/E)$_s$ / ln (1 + U/E)$_u$ = (ln(N) − ln(E))$_s$ / (ln(N) − ln(E))$_u$. Hence $(n_s/n_u -$ $u_s/u_u) \approx$ (ln(N) − ln(N) + ln(E))$_s$ / (ln(N) − ln(N) + ln(E))$_u$ = ln(E)$_s$ / ln(E)$_u$.

prices, including transportation costs. The superscript d of X^d_i and ε^d_{it+1} indicates 'demand', whilst Ω_t is the information set at time t.

The non-tradable sector demands labour according to:

$$\Delta z^{non\text{-}tradable}_{it} = -b_2\, w_{it} + \gamma\Delta n_{it} + X^d_i \tag{5}$$

where $b_1 > b_2 > 0$ to highlight that tradable firms have a higher elasticity of labour demand with respect to the wage than non-tradable firms. X^d_i is the relative attractiveness of region i to non-tradable firms (for simplicity assumed to be identical), and $1 > \gamma > 0$ is a measure of the skill-bias of the non-tradable sector: the higher the relative number of skilled workers in the region, the more non-tradable firms will be established. This assumption reflects the observation that non-tradable services generally cater for people with higher incomes (viewed as a proxy for skills). Unlike tradable firms, non-tradable firms are not modelled as being subject to labour demand shocks. This choice tries to represent that technological change and the international market are more likely to affect tradable vis-à-vis non-tradable firms (as an example, most business R&D expenditures occur in manufacturing, which is tradable - see. OECD ANBERD data).

Tradable and non-tradable firms do not distinguish between native and foreign labour. As long as regional relative wages are below their long-run equilibrium level, firms will move in, and vice-versa.

Labour Supply

The relative labour supply in region i includes both natives and foreigners:

$$\Delta n_{it} = (1 - \theta_{it})\, \Delta NL_{it} + \theta_{it}\Delta FL_{it} \tag{6}$$

where $\theta_{it} = \dfrac{FL_{it}}{NL_{it} + FL_{it}}$, while:

$$\Delta NL_{it} = c_1\, w_{it} + X^s_i - gu_{it} + \varepsilon^s_{1it+1|\Omega t} \tag{6a}$$

$$\Delta FL_{it} = c_2\, w_{it} + X^s_i - gu_{it} + \varepsilon^s_{2it+1|\Omega t} \tag{6b}$$

where ΔNL_{it} is the growth of the natives' relative labour force in region i at time t, and ΔFL_{it} is the corresponding growth in the relative foreign labour force; w_{it} and u_{it} are defined as in (1) and (2); c_1 is the relative labour supply elasticity with respect to

wages of natives, whilst c_2 is the corresponding measure for foreigners; X^s_i denotes relative attractiveness to workers (e.g. clean environment), which, for simplicity, is assumed to be identical for all, and time-invariant. For a given X^s_i, natives and foreigners in the region emigrate if the regional relative wage is below its long-run equilibrium level. The parameter g denotes the sensitivity of native and foreigners to the relative unemployment rate of the region, but for tractability it is not modelled further[4]. ε^s_{it+1} is a white noise stochastic component reflecting unexpected changes in the relative labour supply, such as a new migration law introducing a minimum educational requirement or specific occupational experience. The superscript s in X^s_i and in the error terms in (6a) and (6b) indicates 'supply'. By assumption $c_2 > c_1$, implying that skilled foreigners supply labour more elastically than skilled natives. It is also assumed that unskilled foreign workers supply labour more elastically than unskilled natives.

Finally, the relative wage is assumed to be related to relative unemployment through:

$$w_{it} = -\frac{u_{it}}{d} \tag{7}$$

where $d > 0$.

Equilibrium Paths and Steady States

The equilibrium paths of region i's relative wages, unemployment rates, and labour force growths are derived from the intersection of relative labour demand and supply curves [transform (1) into differences and substitute (2)-(7) into (1)]. Natives and foreigners face identical equilibrium paths with respect to the relative wage and the relative unemployment rate. These are respectively:

$$w^*_{it+1} = \frac{1 + ad - (a - \gamma(1 - \delta_{t+1}))R_{t+1} - Q_{t+1}}{1 + ad}w_{it} + \frac{\delta_{t+1}\varepsilon^d_{t+1} + X^d - aX^s}{1 + ad} - \frac{\varepsilon^s_{t+1}(a - \gamma(1 - \delta_{t+1}))}{1 + ad} \tag{8}$$

$$u^*_{it+1} = -dw^*_{it+1} \tag{9}$$

The term R_{t+1} is a shorthand for $((1 - \theta_{it})c_1 + \theta_{it}c_2 + gd)$, which increases with the proportions of foreigners in the local labour force, i.e. $\partial R_t / \partial \theta_{it} > 0$. The term Q_{t+1} is a

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[4] Doing so (e.g. different parameters for natives and foreigners) unnecessarily complicates the algebra,

shorthand for $(\delta_{it}b_1 + (1 - \delta_{it})b_2)$, which rises with the proportion of tradable firms in the region, i.e. $\partial Q_t / \partial \delta_{it} > 0$.

The equilibrium path for the regional employment growth is given by:

$$\Delta n_{it+1}^* = \frac{R_{t+1}(1 + ad - R_{t+1}(a - \gamma(1 - \delta_{t+1})) - Q_{t+1})}{R_t(1 + ad)}\Delta n_{it} + \frac{R_{t+1}(\delta_{t+1}\varepsilon_{t+1}^d + X_i^d - aX_i^s)}{1 + ad} + \varepsilon_{t+2}^s -$$

$$\varepsilon_{t+1}^s \frac{a - \gamma(1 + \delta_{t+1})}{1 + ad}R_{t+1} - \frac{R_{t+1}(1 + ad - R_{t+1}(a - \gamma(1 - \delta_{t+1})) - Q_{t+1})}{R_t(1 + ad)}\varepsilon_t^s \qquad (10)$$

The steady states are obtained by replacing the variables *w, u,* and *Δn* with their long-term values:

$$\overline{w}_i = \frac{X_i^d - aX_i^s}{(a - \gamma(1 - \delta_{t+1}))R_{t+1} + Q_{t-1}} \qquad (11)$$

$$\overline{u}_i = -d\overline{w}_i \qquad (12)$$

$$\overline{\Delta n}_i = R_{t+1}\frac{X_i^d - aX_i^s}{(a - \gamma(1 - \delta_{t+1}))R_{t+1} + Q_{t+1}} \qquad (13)$$

For a given level of attractiveness, relative skilled wages are higher in regions with fewer tradable firms, while the relationship between wages and foreign workers depends on the sign of the expression $(a - \gamma(1 - \delta_{t+1}))$. In these regions, relative skilled employment growth is also higher while relative skilled unemployment is lower, and vice-versa.

Because tradable and non-tradable firms face different labour demand elasticities, the sectoral composition of regional employment changes inversely with the level of the relative skilled wage: for a given degree of attractiveness, the number of tradable firms grows faster than the number of non-tradable firms when the relative skilled wage is low, and vice-versa. In other words, as $c_1 < c_2$ $\Delta z_t^T > \Delta z_t^{NT}$.

as it is not the focus of this paper.

In an analogous scenario, as natives and foreigners are characterised by different labour supply elasticities, the higher the regional relative skilled wage the higher the local employment growth of foreigners, for a given level of attractiveness.

As in Blanchard-Katz, the attractiveness of regions to workers and firms (i.e. X^d_i and X^s_i) are two underlying sources of regional employment growth. An increase in the attractiveness to workers reduces the regional relative wage and the growth rates of the local labour force and employment, whilst it increases the region's relative unemployment rate. An increase in attractiveness to firms increases the relative wage, the local labour force and employment, and decreases the relative unemployment rate. However, in the model presented here there are two more sources of employment growth: the share of foreigners in the local labour force and the proportion of tradable firms. An increase in the proportion of tradable firms lowers the steady state of wages and employment growth, raising at the same time the relative unemployment rate, and vice-versa. An increase in the proportion of foreigners in the region has instead an ambiguous effect, which depends on the sign of $(a - \gamma(1 - \delta_{t+1}))$. If positive, then the foreigners reduce the steady state levels of regional wages, native labour force and employment growth, whilst it raises the steady state of the unemployment rate, and vice-versa if $(a - \gamma(1 - \delta_{t+1})) < 0$.

Comparative statics

For an identical level of attractiveness, regions that are differently endowed with skills experience not only different growth paths, but also a different evolution in the composition of sectoral employment and the ratio of skills demanded. Consider the example of two regions differing only in their relative skill endowment and initially at their long run equilibrium levels of relative wages and employment, as in Figure 1. For simplicity assume that both regions have initially no foreign labour force. Assume momentarily that these regions are divided by barriers to commodity trade and migration. By virtue of equation (11) the steady states of Regions 1 and 2 are, respectively:

$$\overline{w}_1 = \frac{X^d - aX^s}{Q_1} > \overline{w}_2 = \frac{X^d - aX^s}{Q_2} \tag{14}$$

Equation (14) implies that $Q_1 < Q_2$, so that the proportion of non-tradable firms is higher in Region 2. Furthermore, as the labour demand can be written as:

$$w_{it+1} = \frac{-an_{it+1}}{1 + ac + Q_{t+1} - \gamma R_{it+1}} + \frac{\delta_{it+1}\varepsilon^d + (1 - \delta_{it+1})\gamma\varepsilon^s}{1 + ac + Q_{t+1} - \gamma R_{it+1}} \qquad (15)$$

Region 2 is also relatively better endowed with skilled labour and it has lower relative skilled wage, i.e. $n_{1t+1} < n_{2t+1}$. The thick double arrow along the horizontal axes in Figure 3 measures the extent of the initial difference in relative skill endowments among the two regions, while the dotted line parallel to the vertical axis shows their initial difference in relative wages.

FIGURE 3 – COMPARATIVE STATICS: PREDICTIONS
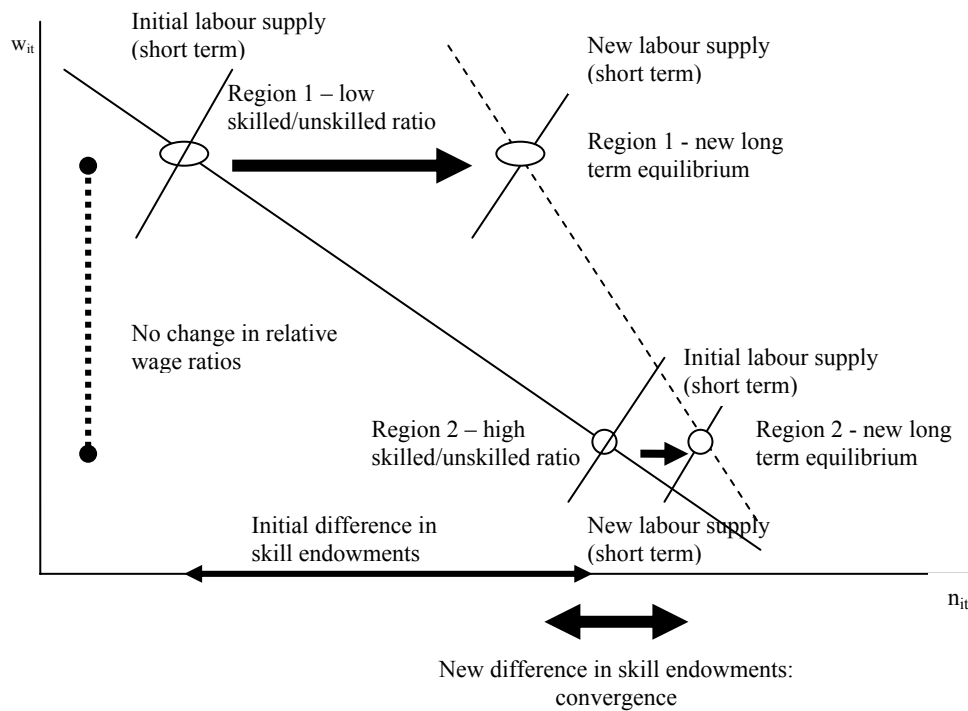
Consider now what occurs when both regions merge in a single country where there is no change in regional attractiveness but both trade and migration are allowed. As a result of the new 'single market', tradable firms in each region will face a higher demand for their products. They will hire more workers, shifting labour demand to the right (dotted line). The outward shift in labour demand will be larger for the region with the higher proportion of tradable firms, Region 1, which is also characterised by a lower relative skilled/unskilled ratio. By equation (13), if relative wages are higher in Region1 then:

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$$\overline{\Delta n}_1 = R_{1t+1} \frac{X_1^d - aX_1^s}{(a - \gamma(1 - \delta_{t+1}))R_{1t+1} + Q_{1t+1}} > \overline{\Delta n}_2 = R_{2t+1} \frac{X_2^d - aX_2^s}{(a - \gamma(1 - \delta_{t+1}))R_{2t+1} + Q_{2t+1}} \qquad (16)$$

(assuming for simplicity that $X_1^d = X_2^d$ and $X_1^s = X_2^s$).

The higher proportion of tradable firms in Region 1 implies a higher shock to its relative labour demand and hence a larger change in its relative skilled/unskilled ratio. In turn, the latter effect triggers a larger change in the number of non-tradable firms in Region 1 vis-à-vis the growth in non-tradable firms in Region 2.

The new long-term equilibrium is characterised by the relative wage in each region returning to its trend. In Figure 3 both regions are depicted as having their new long-term equilibrium points to the right of the original ones, implying that both regions can import and export labour and firms from and to third countries. If the world consisted only of the two regions, then the new equilibrium for Region 2 would be to the left of its original one, as its skilled people would have partially moved to Region 1, raising the latter's relative skilled/unskilled ratio. The opposite effect would occur in Region 2, as its skilled/unskilled ratio is reduced by native skilled labour leaving it. If unskilled labour moved too, these results would be reinforced. In the new equilibrium, the initial relative wage differentials have not disappeared. A researcher measuring the long-term effects of the 'single market' would not be able to report any. In contrast, the relative skilled/unskilled ratios in the two regions have become more similar to one another: the single market has indeed led to convergence, but only in relative skill endowments.

With reference to the nationality composition of the labour force, the model predicts that foreigners fill the new jobs created more than proportionally vis-à-vis their share in the destination region's labour force as they are assumed to have a higher elasticity to supply (though the final effect depends also on the responsiveness of the non-tradable sector to create jobs when workers move in). This can be seen by dividing equation (6a) by equation (6b) and noting that the ratio will be less than one as the foreign elasticity of labour supply, which appears in the denominator of the ratio, is by assumption larger than the corresponding elasticity among natives, which appears in the numerator. In terms of Figure 3, the increase in the relative skilled/unskilled ratio in Region 1 has occurred thanks to migrants characterised by a higher skilled/unskilled ratio than the native regional population. The higher skill

composition of migrants relative to Region 1's native labour is certainly predicted for immigrants from Region 2. With regards to the relative skill endowment of Region 2, it is depicted in Figure 3 as becoming slightly more skill-biased, but this effect is entirely driven by highly skilled immigrants from third countries: immigrants from Region 1 are instead predicted to have on average lower skill content than Region 2's native labour force.

Transition dynamics

The effect of a temporary shock in a region's relative labour demand is *transitory* with respect to the relative wage and the unemployment but it is *permanent* on the *level* of the relative native labour force. The labour force level series is assumed to contain a unit root, hence forcing the migration term to explain permanent changes in the employment level[5]. Although empirically based, the data used are generally too short to firm this assumption. In particular, the effect of a labour demand shock on the *growth* of a region's relative labour force is:

$$\partial \Delta n_{it+j+1}/\partial \varepsilon^{d}_{it|\Omega t} = \Sigma^{\infty}_{j=0} \lambda^{j} [\delta_{t+1} R_{t+1} /(1 + ad)] \tag{17}$$

where $\lambda = (1 + ad - (a - \gamma(1 - \delta_{t+1}))R_{t+1} - Q_{t+1})/(1 + ad)$. As $|\lambda| < 1$, $\Sigma^{\infty}_{j=0} \lambda^{j} \to 0$ as $j \to \infty$, implying that the effect is only temporary.

In contrast, the shock has a permanent effect on the *level* of the region's relative labour force, as:

$$\partial n_{it+j+1}/\partial \varepsilon^{d}_{it|\Omega t} = (1 - \lambda)^{-1} \Sigma^{\infty}_{j=0} \{1^{j}\} - \lambda(1 - \lambda)^{-1} \Sigma^{\infty}_{j=0} \{\lambda^{j}\} [\delta_{t+1} R_{t1}/((a - \gamma(1 - \delta_{t+1}))R_{t+1} + Q_{t+1})] \tag{18}$$

which tends to $\delta_{t+1} R_{t+1}/((a - \gamma(1 - \delta_{t+1}))R_{t+1} + Q_{t+1}) \neq 0$ as j tends to infinity. Since both Q_{it+1} and R_{it+1} appear in the numerator and the denominator of equation (18), the relationship between the permanent shock to employment and the share of tradable firms and foreigners, respectively, depends on the values of the parameters *a* and γ. If

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[5] This assumption is an important limitation of the Blanchard-Katz framework, as it may overestimate the role played by migration (changes in the working population). Based on the literature applying this theoretical framework, the reported Dickey-Fuller tests on unit roots are mixed. The prior of a unit root in employment growth is rejected by over half of the sample (e.g. Decressin and Fatas, 1995; Fredriksson, 1999; Tani, 2003), but the prior is maintained on the basis of the low power of the test due to the short time series. However, when the model is modified to accommodate a stationary relative employment (Obstfeld and Peri, 1998), imposing the long-run effects of labour demand shocks on

the derivative with respect to Q_{t+1} of $\delta_{t+1}R_{t+1}/((a - \gamma(1-\delta_{t+1}))R_{t+1} + Q_{t+1})$ is positive, then a higher share of tradable firms causes a lower permanent shock, and vice-versa In contrast, in the case of R_{it+1} the share foreigners in the local labour force is unquestionably reducing the effect of a permanent shock for lager values. Impediments to labour movements across regions only intensify the magnitude of a labour demand shocks, and vice-versa. As foreigners cushion shocks to local employment, reducing its variability during the phases of the economic cycle, it is in a region's interest to remove migration barriers.

The region's relative native labour force in fact responds to a labour demand shock according to:

$$\partial NL_{it+j+1}/\partial\varepsilon^d_{it|\Omega t} = (1 - \lambda)^{-1}\Sigma\ ^\infty_{j=0}\{1^j\}\ -\ \lambda(1 - \lambda)^{-1}\Sigma\ ^\infty_{j=0}\{\lambda^j\}\ [\delta_{t+1}(c_1 + dg)/((a - \gamma(1-\delta_{t+1}))R_{t+1} + Q_{t+1})] \qquad (19)$$

which tends to $\delta_{t+1}(c_1 + dg)/((a - \gamma(1-\delta_{t+1}))R_{t+1} + Q_{t+1}) \neq 0$ as j tends to infinity. Although R_{it+1} appears only in the denominator of equation (18), the long run effect of a shock on relative native labour force ultimately depends on the sign of $(a - \gamma(1-\delta_{t+1}))$. If this is positive, then the higher the proportion of foreigners, the lower will be the shock to native labour demand, and vice-versa.

It is clear however that the shock is higher for foreigners than natives as:

$$\partial FL_{it+j+1}/\partial\varepsilon^d_{it|\Omega t} \rightarrow \delta_{t+1}(c_2 + dg)/((a - \gamma(1-\delta_{t+1}))R_{t+1} + Q_{t+1}) > \partial NL_{it+j+1}/\partial\varepsilon^d_{it|\Omega t}.$$


Endogenous long-run wage determination[6] [preliminary only]

[remove long-term trends of BK model.] Suppose that the relative skilled labour supply function of Region 2 is more elastic than that of Region 1 – because the former has better education systems for producing skilled labour in response to increases in wages, it has better established skilled immigrant programmes, it has a greater pool of its own inactive skilled workforce who will enter the labour market with higher wages, and so on. Convergence in skill-sets and no convergence in relative wages may occur with a greater degree of endogeneity, as shown in Figure 3A.

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migration to be zero, "the first year effects and the response five years out are very close to those [of Blanchard and Katz]" (p.228).
[6] I am grateful to Kieren Sharpe for suggesting this extension.

FIGURE 3A – A VARIANT
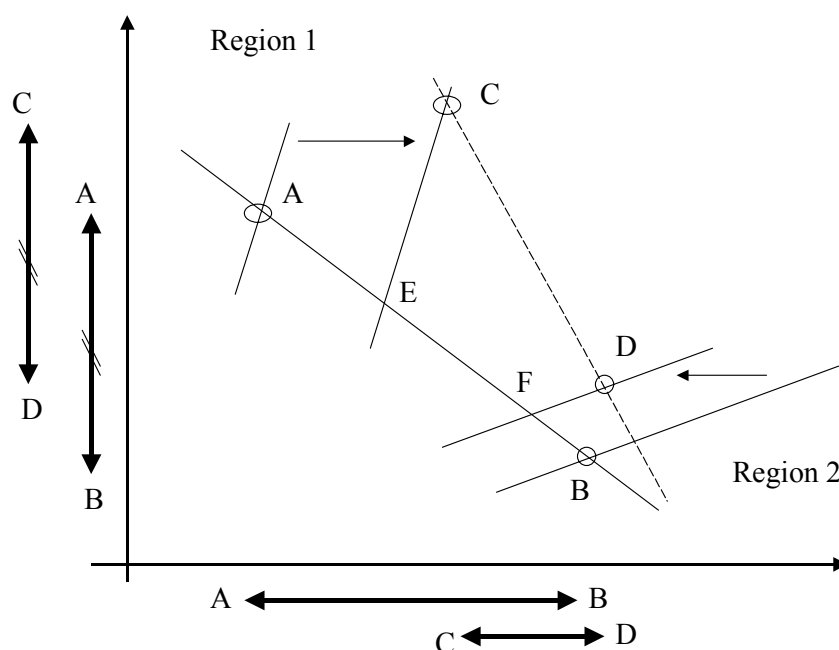
As can be seen in Figure 3A, the wage differentials between Regions 1 and 2 are not predetermines by each region's attractiveness to firms and workers, but they are fully endogenous. Region 2 has a more 'elastic' interaction with third countries than does Region 1, hence the different elasticities of labour supply response. Yet, the labour demand shock still produces convergence in skill endowments but not in wages.

Testable predictions

The model developed in this section generates a number of predictions, which can be easily tested. Given the paper's focus on the evolution of regional skill endowments across the European Union the following predictions can be easily tested:

1. differences in relative skill endowments across European regions reduce over time. The skilled/unskilled ratio of foreigners is higher than the corresponding ratio among natives in regions where skilled native labour is relatively scarce, and vice-versa. This prediction applies to foreigners at large and especially to those from within the European Union. From equation (16), when $n_1 < n_2$ then $\Delta n_1 > \Delta n_2$. Since $\partial FL_{it+j+1}/\partial \varepsilon^d_{it} > \partial NL_{it+j+1}/\partial \varepsilon^d_{it}$ then the relative skilled unskilled ratio among foreigners is not only higher than the corresponding

ratio among natives, but it is higher in Region 1 than in Region 2. This implies $FL_{1t} > NL_{1t} > NL_{2t} > FL_{2t}$ (if there are only two regions);

2. relative employment in the non-tradable sector grows over time, particularly in regions where the employment share of the tradable sector is small. Foreigners are more than proportionally represented in the tradable sector. Hence, from equations (16) and (5), in the long-run $\Delta \bar{n}_i = \gamma \Delta \bar{z}_i^{non-tradable}$, and when $n_1 < n_2$ then $\Delta n_1 > \Delta n_2$ and $\Delta \bar{z}_1^{non-tradable} > \Delta \bar{z}_2^{non-tradable}$.

3. the variability of native employment depends on the proportion of foreign workers (and the sign of $(a - \gamma(1-\delta_{t+1}))$) and the share of tradable industries in the region. This prediction can be tested using the equation describing native employment growth:

$$\Delta NL_{it+1}^* = \frac{(1+ad-R_{t+1}(a-\gamma(1-\delta_{t+1}))-Q_{t+1})}{(1+ad)} \Delta NL_{it} + \frac{(c_1+gc)(\delta_{t+1}\varepsilon_{t+1}^d + X_i^d - aX_i^s)}{1+ad} + \varepsilon_{t+2}^s -$$
$$\varepsilon_{t+1}^s \frac{a-\gamma(1+\delta_{t+1})}{1+ad}(c_1+gc) - \frac{(1+ad-R_{t+1}(a-\gamma(1-\delta_{t+1}))-Q_{t+1})}{(1+ad)} \varepsilon_t^s \qquad (20)$$

and testing the sign of the term $\dfrac{R_{t+1}(a-\gamma(1-\delta_{t+1}))+Q_{t+1}}{1+ad}$, after decomposing it

into $\dfrac{R_{t+1}(a-\gamma)}{1+ad}$, $\dfrac{R_{t+1}\gamma\delta_{t+1}}{1+ad}$, and $\dfrac{Q_{t+1}}{1+ad}$.

5 Data

The data used in the empirical analysis are extracted from the Labour Force Survey (LFS), a household survey organised by Eurostat. The data refer to the period 1988-2005 and are collected at regional level for all member states of the EU. The data identify groups of people with the same characteristics rather than individuals, and the weights reflect the actual stock of the population in each region by sex and age structure. There are 177 regions overall, across 15 member states for a total of 2,901 data points. The working sample is restricted with those aged 20-64.

Although regional boundaries have changed during the period, as well as the boundaries of the EU with the inclusion of Austria, Sweden and Finland in 1995, the geographic

consistency of the territorial unit of analysis and the EU averages used have been maintained, where necessary, through aggregations (e.g. in the case of Berlin, reunified after 1989). Analyses by nationality tend to cover only the period 1995-2005, as that variable is generally missing from previous years in the series obtained. Despite the reduction in the number of years covered, carrying out the analysis from 1995 enables one to consider the citizens of Austria, Sweden and Finland as 'intra-EU' rather than 'extra-EU', as they would have been for the prior years.

Table 1 presents a statistical summary of the variables used in the empirical analysis, separating those that are explicitly used as dependent or independent variables from those used as a control (*control - labour market* and *control - demographics*).

TABLE 1 SUMMARY STATISTICS OF VARIABLES USED

Variable	Observations	Mean	STD	10th Dec	90th Dec
Dependent/Independent					
Skilled/Unskilled ratio ("S/U"): natives	1637	1.270	0.607	.68	2.54
S/U ratio: foreigners	1625	0.771	1.073	.12	1.74
S/U ratio: intra-EU	1403	1.859	2.685	.25	3.97
S/U ratio: extra-EU	1607	0.602	1.033	.05	1.41
Control – Labour market					
% foreigners in employment	1637	.0499	.0515	.007	.113
Unemployment rate*	2901	.0894	.0522	.037	.167
Participation rate*	2901	.7139	.0601	.632	.785
% employment in agriculture	2313	.0686	.0705	.016	.143
% employment in manufacturing	2314	.1934	.0747	.095	.300
% employment in trade, hotels, util	2405	.3460	.0599	.285	.418
% employment in financial sectors	2412	.0936	.0430	.039	.146
% employment in gov, educ, health	2314	.2468	.0609	.164	.322
Population size (ln)*	2901	13.68	.9753	12.2	14.9
Control – Demographics					
% female in employment*	2901	.4159	.0422	.357	.467
Share of employed aged 20-39*	2901	.3715	.0479	.310	.435

* = 1988-2005

The first four rows of Table 1 summarise the skilled/unskilled ratio among native and foreign workers (then divided into intra-EU and extra-EU, respectively) across the EU. This ratio is constructed using the aggregation of occupations suggested by Keesing (1966): namely, by dividing the number of those in the top three categories of the ISCO occupational scale at 1-digit level (ISCO 1-3) by those in the bottom three categories (ISCO 7-9). Alternative indices (e.g. adding the top three categories

and half of those in the three intermediate skill groups ISCO 4-6, and dividing it by the bottom three categories plus the remaining 50% of ISCO 4-6) yield broadly similar ratios. There is significant variability across both time and regions: the period examined roughly covers two economic cycles, with regional unemployment rates in 1988, 1995 and 2005 broadly similar. The higher values of the variable generally refer to highly urbanised areas (e.g. Paris, Brussels, Hamburg, the Flanders) while the lowest values pertain to rural or tourist regions in Greece, Portugal, and Spain. Following Keesing in the rest of the paper '*skilled*' labour is used interchangeably to mean occupations ISCO 1-3 whilst '*unskilled*' is used to indicate occupations ISCO 7-9.

The statistics in the second block of rows of Table 1 report some of the labour market control variables used. The first of such rows shows that foreigners in the EU are a small percentage of the labour force compared with other OECD countries (e.g. OECD, 2000a,b): they are nil in several regions of the sample[7], though they are a non-negligible group in member states that have traditionally experienced positive net immigration rates (Germany, France, Benelux, and Denmark). There is significant regional variation in the value of this ratio, which is lowest in regions that have experienced net immigration rates only recently (Spain, Greece, Portugal, and Ireland). It is likely that measurement error is high in these regions.

6   Results

Differences in relative skill endowments

The relationship between the skill composition of foreign and native workers is tested using the following statistics model:

$$(\frac{S}{U})_{i,foreign,t} = \alpha + \beta(\frac{S}{U})_{i,native,t} + (or^*)\mu(Q_2..Q_5) + \lambda(controls)_{it} + \varepsilon_{it} \qquad (21)$$

where $Q_2..Q_5$ are dummy variables representing the second, third, fourth, and firth quintiles in which regions are ranked based on the skilled/unskilled ratio of native employment. Controls include some of the demographic (% young employed) and

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[7] This occurs as the LFS data capture mainly legal labour. Foreign immigrants are likely to be under-represented in the LFS as it is a household-based survey, which excludes many types of

labour market variables summarised in Table 1 (unemployment and participation rates, employment share of finance, population size).

The hypothesis of converging skill endowments implies that $\beta < 1$. The results are reported in Table 2, along with the results of the test for omitted variables (Reset), heteroskedasticity, and overall significance. The first column of Table 2 shows the results obtained using OLS on all regions pooled, while the second and third columns report the results of the interacting quintile dummy with the main independent variable with and without control variables, respectively. The last column to the right of Table 2 shows the results obtained by estimating equation (20) using fixed effects. The standard deviations of the estimates are reported in parentheses, while the coefficients that are statistically significantly different from zero at the 5% and 10% level are reported with a ** or *, respectively.

TABLE 2   THE RELATIONSHIP BETWEEN THE SKILLED/UNSKILLED RATIOS OF FOREIGN AND NATIVE WORKERS

	Pooled OLS	OLS	OLS	Panel FE
β	.291**	-1.513**	-2.288**	.325**
	(.031)	(0.256)	(.288)	(142)
Q2 (slope)		4.498**	4.956**	
		(0.760)	(.759)	
Q3 (slope)		1.420*	1.501**	
		(0.750)	(.729)	
Q4 (slope)		2.013**	2.579**	
		(1.005)	(1.023)	
Q5 (slope)		1.768**	2.116**	
		(.262)	(.263)	
Constant	.400**	1.540**	.357**	.357**
	(.042)	(0.189)	(.170)	(.170)
N	1,625	1,625	1,625	1,625
Controls	No	No	Yes	Yes
Adjusted R^2	.0267	.0494	.0757	.0521
Reset (p-value)	.0786	.4268	.0898	0.000
Hausman Chi^2				25.45
Heteroskedasticity	Yes (robust)	Yes (robust)	Yes (robust)	Yes (robust)
Overall significance (p-values)	0.000	0.000	0.000	0.000

The results indicate that the skill composition of foreign and native workers is positively related: the more skilled is native employment the more skilled is foreign

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accommodation where foreign immigrants are likely to live (e.g. hostels). See Hogarth, Salt, and

employment, while $\beta < 1$: on average the skilled/unskilled ratio of foreigners is only a third of the corresponding ratio of natives.

When regions are ranked by quintiles, it appears that those where the skilled/unskilled ratio among natives is low (Q_1) have a high skilled/unskilled ratio among foreigners. Indeed, the relation between the skill compositions of foreign and native workers in Q_1 is negative (second column in Table 2), though this result is likely to be driven by low numbers of foreigners in these regions and consequently affected by errors in the measurement of their skill composition.

The interaction of the main independent variable with the dummies yields positive coefficients for the quintiles Q_2-Q_5. In particular, the slope coefficients are less than 1 in the top two quintiles (($\beta + Q_4$) <1 and ($\beta + Q_5$) <1, respectively) supporting the hypothesis that in regions where skill endowments are above the European average, the skill composition of foreign labour works towards reducing relative skill abundance. In Q_3, the coefficient is not statistically different from zero, while in Q_2 the coefficient ($\beta + Q_2$) is greater than one, against the prediction.

The results obtained for intra-EU and extra-EU workers, respectively, (Table A1 in the Appendix) reveal similar patterns: the average skill content of foreign workers rises with the ones of natives, but less than proportionally. The only exception is the first quintile (Q_1) where the S/U ratio of both intra-EU and extra-EU workers is negatively related with the corresponding native S/U ratio. The coefficients obtained on the regression performed on intra-EU workers are generally much larger than those obtained on extra-EU workers, as the former are on average more skilled than the latter.

The contribution of foreigners towards convergence in regional skill endowments is illustrated by Figure 2A and 2B, which report the box plots of the distributions of the differences between the skilled/unskilled ratios of a region's employed (natives and foreigners) and that region's native employed relative to the EU average. A positive number indicates that foreigners raise that region's skilled/unskilled ratio relative to the average skilled/unskilled ratio in the EU. Each box contains the observations

Singleton (1994) for a comprehensive discussion of issues related to measuring immigration in the EU.

between the 25th and the 75th percentile of the distribution, while the lines above and below the box show the upper and lower adjacent values, which extend to 2/3 of the length of the box. The line inside the box represents the median. Points outside the box are outside values, and tend to refer to regions with a very small foreign workforce, where the measurement error of its skill composition is likely to be large.

FIGURE 2A DIFFERENCES BETWEEN THE SKILLED/UNSKILLED RATIOS FOR THE REGION AND THE NATIVES RELATIVE TO THE EU AVERAGE: 1995-2005 – SKILL-ABUNDANT REGIONS
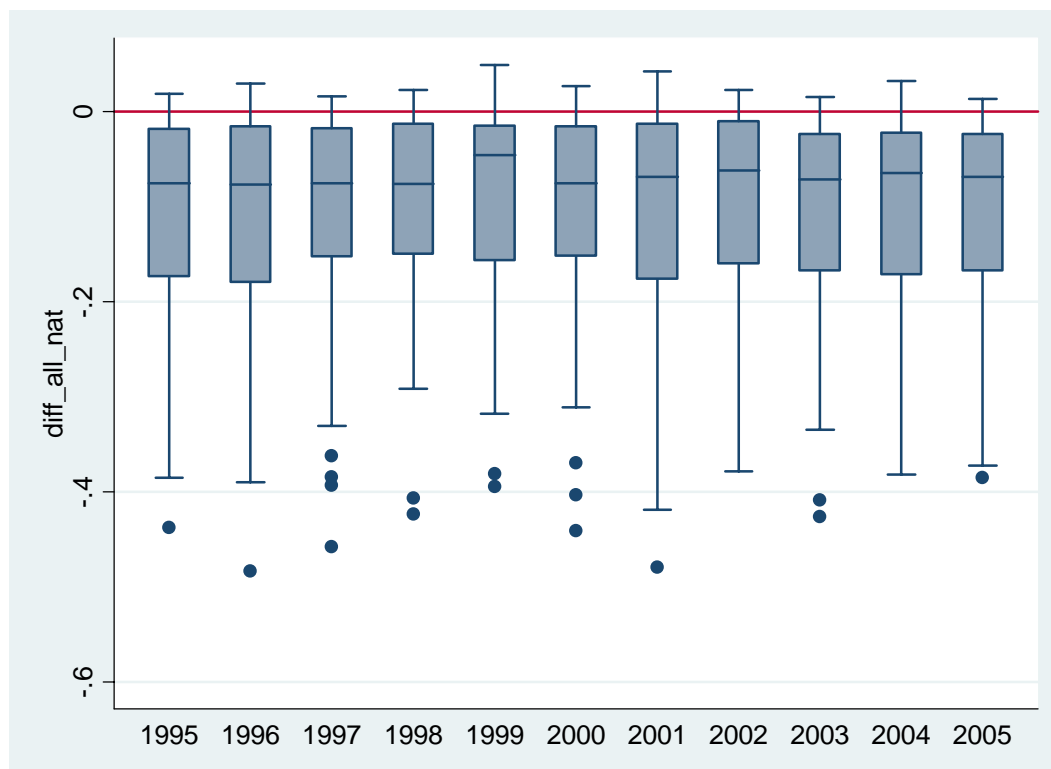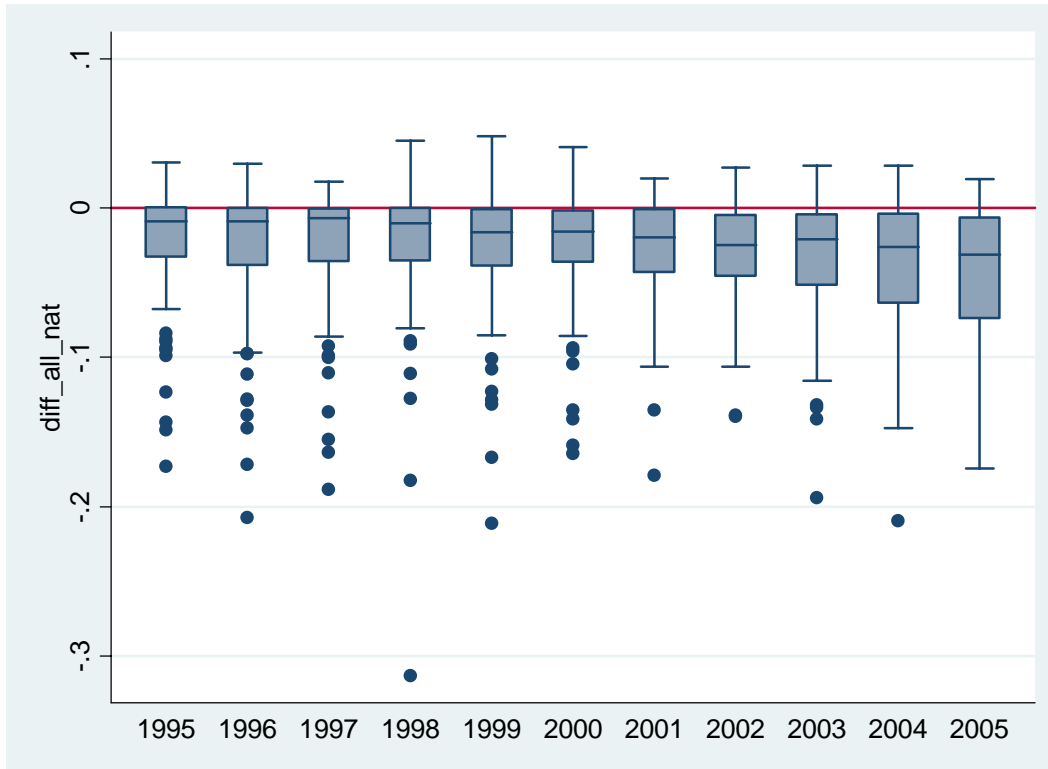
FIGURE 2B DIFFERENCES BETWEEN THE SKILLED/UNSKILLED RATIOS FOR THE REGION AND THE NATIVES RELATIVE TO THE EU AVERAGE: 1995-2005 – SKILL-SCARCE REGIONS

Figures 2A and 2B suggest that foreigners are generally less skilled than natives regardless of their region of residence. However, when the graphs are obtained separately for intra-EU and extra-EU workers, it is evident that intra-EU workers tend to raise S/U ratios in skill-scarce regions, while extra-EU workers tend to lower the S/U ratios in skill-abundant regions. As most foreign workers are extra-EU, the overall effect of foreign labour is a reduction of the S/U ratio. As this effect is predominant in skill-abundant regions, there is some degree of convergence between skill-rich and skill-poor regions.

To determine whether the convergence detected implies converge between countries, the statistical model (21) is re-estimated using country dummies as:

$$(\frac{S}{U})_{i,foreign,t} = \alpha + \beta(\frac{S}{U})_{i,native,t} + (or^*)\mu(country_2..country_{15}) + \lambda(controls)_{it} + \varepsilon_{it} \qquad (22)$$

The results are reported in Table 3. The first two columns show the OLS estimates of equation (22) obtained using the S/U of intra-EU and extra-EU, respectively, as

dependent variables. The third and fourth columns report the estimates obtained when equation (22) is regressed using foreign workers by OLS and by fixed effects.

TABLE 3   THE RELATIONSHIP BETWEEN THE SKILLED/UNSKILLED RATIOS OF FOREIGN AND NATIVE WORKERS

|	OLS Intra-EU	OLS Extra-EU	OLS Foreigners	Panel FE Pooled
β (Germany)	.584**	.182**	.264**	.385**
	(.100)	(.017)	(.030)	(.173)
East Germany	6.027	1.606**	2.374**	
	(5.05)	(.672)	(.871)	
France	-.628**	-.177**	-.262**	
	(.109)	(.031)	(.033)	
Italy	-	-	-	
Netherlands	.621	-.087	-.170**	
	(.458)	(.060)	(.087)	
Belgium	.044	.810**	.331**	
	(.133)	(.251)	(.092)	
Luxembourg	-.451**	.091	-.118	
	(.134)	(.073)	(084)	
United Kingdom	-.202	-.412	-.282	
	(.510)	(.255)	(.196)	
Ireland	.868**	-12.28**	-2.673**	
	(.180)	(3.13)	(.344)	
Denmark	4.057*	-.953**	-.838*	
	(2.32)	(.310)	(.445)	
Greece	4.476**	-.403**	-.459**	
	(1.15)	(.108)	(.111)	
Spain	4.644*	-.258**	-.699**	
	(2.579)	(.125)	(.207)	
Portugal	3.922**	-.929**	-.715*	
	(1.34)	(.481)	(.388)	
Austria	2.059*	-.083**	-.085**	
	(1.05)	(.027)	(.037)	
Sweden	-7.663	.746	.648	
	(9.93)	(.861)	(1.287)	
Finland	.047	-.156	-.242*	
	(.314)	(.099)	(.136)	
Constant	.051	.052**	.536	
	(.14)	(.025)	(.490)	
N	1,403	1,607	1,625	1,625
Controls	No	No	Yes	Yes
Adjusted R^2	.2261	.3132	.3018	.0142
Reset (p-value)	0.1471	0.007	.1926	
Hausman (chi-square)				30.59
Heteroskedasticity	Yes (robust)	Yes (robust)	Yes (robust)	Yes (robust)
Overall significance (p-values)	0.000	0.000	0.000	0.000

The results confirm the positive relationship between the skill composition of foreigners and natives. The also suggest that Greece, Spain, Portugal, and to an extent Ireland, attracted skilled workers from other EU member states and unskilled workers from outside the EU. These countries have traditionally experienced a S/U ratio well below the EU average and have recently turned from source into destination countries for migrants. While intra-EU workers contribute to the convergence of these countries towards the EU average, extra-EU workers contribute in the opposite direction.

The magnitude of the estimates on intra-EU workers in Greece, Spain, and Portugal is high compared with that obtained for other countries. While this may mask large measurement errors due to the small number of intra-EU working in these countries, it nevertheless shows that intra-EU workers contribute to convergence in skill endowments. One possible explanation of the high coefficients, which do not arise in the case of traditional immigration country, may be related to the liberalisation of movements of goods and capital introduced by the Single Act and the subsequent Maastricht Treaty, which brought an 'explosion' in intra-EU private foreign direct investments (FDI) to these countries during the late 1980s and early 1990s. During the period 1989-1993, FDI in Ireland grew at an annualised rate of 58%, the highest in the EU, followed by Portugal (25%), Greece (20%) and Spain (17%). The corresponding figure for the EU average was 15%. This frenzy is likely to have favoured the movement of skilled intra-EU labour. There seems to be a strong positive link between the direction of FDI and the migration patterns of skilled workers (e.g. Richardson, 1972). Regions at the 'periphery' of the EU were also the direct beneficiaries of the EU public funds, allocated by the Central Fund. Unfortunately the lack of data prevents exploring whether the high S/U ratios of intra-EU workers in Spain, Portugal and Greece are the direct consequence of higher private investments from other member states and/or public funding from the Central Fund.

Foreign workers and the tradable sector

The growth in the tradable sectors across regions during 1995-2005 has been steady, as highlighted by Figure 3, which reports the employment share of non-tradable industries in 1995 (vertical axis) and in 2005 (horizontal axis). The scatters show a visible skew towards the right.

FIGURE 3   **PERSISTENCE AND GROWTH OF THE NON-TRADABLE SECTOR ACROSS THE EU: 1995-2005.**
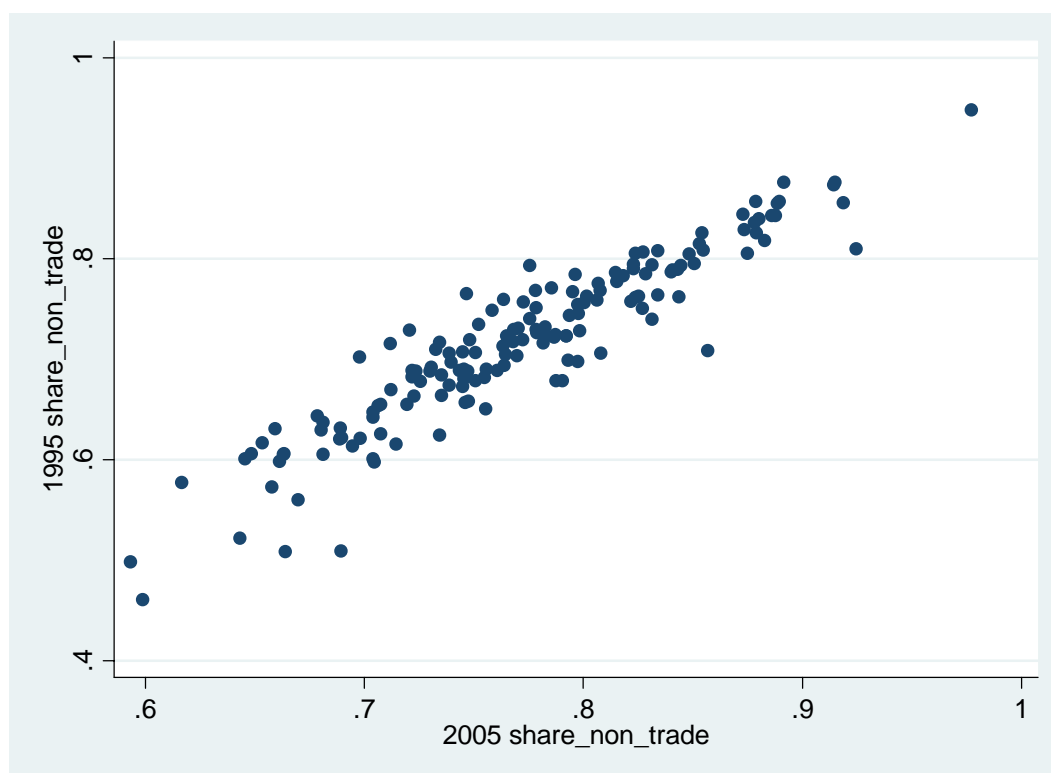
When the employment share of the non-tradable sector in 2005 is regressed on the corresponding share in 1995, the one-tailed test of the null hypothesis that the coefficient estimated is equal or less than unity is strongly rejected.

The hypothesis that foreigners are over-represented in the tradable sector is tested using the statistical model:

$$(\frac{Foreign}{Foreign + natives})^{tradable}_{i, foreign} = \beta(\frac{Foreign}{Foreign + natives})_{i,} + \varepsilon_{it} \qquad (23)$$

The tradable sector includes agriculture, fishing, mining, and manufacturing. The non-tradable sector includes utilities, constructions, hotel, retail and wholesale trade, finance, education, health, private services, and government. If foreign workers are over-represented in the traded sector then $\beta > 1$. All regressions are performed without the constant term. The results are reported in Table 4.

TABLE 4 EMPLOYMENT IN THE TRADABLE AND NON-TRADABLE SECTORS: FOREIGNERS AND NATIVES: 1995-1995

	OLS Foreigners	OLS Intra-EU	OLS Extra-EU	OLS Natives
β	1.113**	1.011**	1.212**	.991**
	(.0087)	(0084)	(.0103)	(.0006)
H_0: $\beta = 1$ (p-value)	.0000	.1921	.0000	.0000
N	1,637	1,574	1,628	1,637
Adjusted R^2	.9086	.9022	.8942	.9993

The results overwhelmingly suggest that foreigners are over-represented in the tradable sector while natives are not. The null hypothesis of $\beta = 1$ is rejected in the case of foreigners (as $\beta > 1$), and in the case of natives (as $\beta < 1$). When the regression is performed separately on intra-EU and extra-EU workers, it is evident that extra-EU workers are over-represented in the tradable industries. In contrast, the hypothesis that intra-EU workers are overrepresented in tradable industries cannot be rejected (p-value: .1921). As intra-EU workers appear to have on average a higher S/U ratio than natives and extra-EU workers, this result is consistent with employment in the non-tradable sector, where the skill content of the employed is approximately double the corresponding index for the tradable sector.

Native employment growth, the share of foreigners, and the tradable sector

The empirical analysis focuses on the signs of the coefficients $\dfrac{R_{t+1}(a-\gamma)}{1+ad}$, $\dfrac{R_{t+1}\gamma\delta_{t+1}}{1+ad}$,

and $\dfrac{Q_{t+1}}{1+ad}$ as they represent the permanent effect of foreigners and the tradable sector on native labour following a labour demand shock. Equation (20) can be represented by the statistical model:

$$\Delta NL^*_{it+1} = \beta\Delta NL_{it} + \eta\theta_{it}\Delta NL_{it} + \rho\theta_{it}\delta_{it}\Delta NL_{it} + \lambda\delta_{it}\Delta NL_{it} + \varphi X^d_i + \mu X^s_i + \chi\theta_{it} +$$
$$\psi\delta_{it} + \nu_{it} \tag{24}$$

where $\eta = \dfrac{(c_1 - c_2)(a - \gamma)}{1+ad}$, $\rho = \dfrac{\gamma(c_1 - c_2)}{1+ad}$, and $\lambda = \dfrac{(b_1 - b_2 + \gamma c_2)}{1+ad}$.

Under the assumption that $c_2 > c_1$, the sign of the coefficient η depends on whether $(a - \gamma) < 0$, in which case it is positive, or $(a - \gamma) > 0$, respectively. The sign of ρ is negative, as it depends on $c_2 > c_1$. Under the assumption that $b_2 > b_1$, the coefficient λ is positive.

When the sign of the combined term ($\eta + \rho + \lambda$) is negative, as depicted in Figure 3, the evolution of native employment is predicted to be smoother due to lower proportions of tradable industries and higher shares of foreign employment. An additional complication in the estimation of (24) is that the sign of ($\eta + \rho + \lambda$) is conditional on the terms χ and ψ not over-powering its sign and statistical significance. As a result, the empirical analysis is based on the estimation of the five coefficients η, λ, ρ, χ, ψ.

Equation (24) is estimated with panel data techniques to eliminate the likely presence of regional fixed unobserved variables. The regression performed is therefore based on the model:

$$\Delta NL^{*}_{it+1} = \beta \Delta NL_{it} + \eta \theta_{it} \Delta NL_{it} + \rho \theta_{it} \delta_{it} \Delta NL_{it} + \lambda \delta_{it} \Delta NL_{it} + controls + \nu_{it} \quad (25)$$

Since the lagged value of the dependent variable appears on the right hand side of (25), the explanatory variables are not all strictly exogenous. Hence, the estimation through fixed effects, random effects and first differencing will generally produce inconsistent estimates (e.g. Wooldridge, 1999). Inconsistency can be serious if the number of observational units is far larger than the fixed number of years for which data are available, as it is in this paper (Judson and Owen, 1999). Consistent estimates for equation (25) can however be obtained through a generalised method of moments procedure, where the explanatory variables are first transformed to eliminate unobservable regional fixed effects, and then estimated by instrumental variables. In particular this paper applies the dynamic panel data estimator developed by Arellano and Bond (1991), which instruments the endogenous variables with the lagged levels of dependent and predetermined variables and the differences of strictly exogenous variables. In the transformed equation, ΔNL_{it} is instrumented by its lagged values up to ΔNL_{it-2}. This methodology relies on the testable assumption that the first difference of the residuals does not follow a second-order autocorrelation process (Wooldridge, 1999; Stata, 2001).

To obtain a relative employment growth time series reflecting only labour demand shocks, the dependent variable in equation (25) is transformed using the method applied by Blanchard and Katz and the subsequent literature. This method assumes that any innovation in region i's relative employment growth is a local labour demand

shock. As a result, the dependent variable in equation (25) is 'purged' of EU disturbances by first estimating common movements across regions using:

$$\Delta\log(S/U)_{it} = \alpha_i + \beta_i \Delta\log(S/U)_{EUt} + \varphi_{it} \tag{26}$$

where $(S/U)_{it}$ is the S/U ratio of natives in employment of region i at time t, $(S/U)_{EUt}$ is the corresponding EU average, and φ_{it} is an error term. Then the dependent variable is transformed into its regional relative equivalent by removing the common movements estimated from (26), using:

$$(S/U)_{it} = \log(S/U)_{it} - \beta_i \log(S/U)_{EUt} \tag{27}$$

where $(S/U)_{it}$ and $(S/U)_{EUt}$ are defined as in (26) and β_i is the estimate obtained from (26).

Table 5 reports the regression results. The top half of the Table presents the estimates of the parameters of interest whilst the bottom half shows the result of post-estimation statistical tests. These include the overall significance of the regression coefficients (Wald statistic), model specification and validity of the over-identifying restrictions (Sargan test[8]) and structure of the error term. The signs ** and * highlight estimates that are statistically significantly different from zero as well as rejected outcomes of statistical tests at the 5% and 10% level, respectively. As shown in Table 5, all estimates are obtained from statistically significant regressions, and in most cases the error term does not follow an AR(2) process. The estimates reported are obtained from robust estimation to control for cross-regional heteroskedasticity.

Following the recommendation of Arellano and Bond (1991), inference on the coefficients is based on the one-step dynamic panel data estimator, whilst inference on model specification uses the two-step estimator (see Stata, 2001). As a result, Table 5 reports the one-step coefficient estimates and standard errors but the two-step outcome of the Sargan test.

A number of alternative specifications are currently being investigated to address the potential endogeneity between the share of foreigners in the workforce, immigration

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[8] The null hypothesis of the Sargan test postulates that the over-identifying restrictions are valid (i.e. the instruments of the endogenous variables are not correlated with the error term), hence the model is properly specified.

policy and regional labour demand, as immigrants locate in regions where jobs are available and regions experiencing labour shortages may adopt more favourable policies towards immigrants. Alternative specifications include substituting the current value of the share of foreigners with its first as well as earlier lags.

TABLE 5 **REGRESSION RESULTS, 1995-2005 [PRELIMINARY ONLY]**

Coefficient	OLS	Dynamic panel (Arellano-Bond)	
β	-.050**	-.061**	-.062**
	(.015)	(.019)	(.018)
η	6.208**	5.825**	5.852**
	(.717)	(.631)	(.667)
ρ	-22.216**	-21.378**	-21.290**
	(3.849)	(3.936)	(3.993)
λ	3.499**	3.541**	3.530**
	(.155)	(.204)	(.203)
χ	-.013	.096	-.087
	(.045)	(.137)	(.089)
ψ	-.038	-.065	.185
	(.107)	(.089)	(.177)
Constant	.013	-.0014**	-.0008
	(.012)	(.0006)	(.0009)
Nr Observations	1,337	1,037	1,037
Control variables			
Year Dummies	No	No	Yes
Regional labour market	Yes	No	Yes
Regional demographics	No	No	Yes
Tests			
Adjusted R^2	.9362		
Wald test of overall significance		3,427.96**	3,978.96**
Serial AR(2) in the error term		p = .0894	p = .1129
Sargan test (based on the two-step estimator)		p = .0960	p = .4062

These preliminary estimates obtained suggest that η, ρ, and λ are statistically significant and conform to the predicted sign. More importantly they support that the sign of the combined term $(\eta + \rho + \lambda)$ is negative. The effect of the terms χ and ψ

appears insignificant in both statistical significance and magnitude of the coefficient, hence will not be further discussed.

These preliminary results suggest that annual changes in a region's native employment are inversely related to the proportion of foreign workers and the employment share of the tradable sector. In particular, following a labour demand shock, the lower is the share of the tradable industries and the higher is the share of foreign labour, the more native workers are cushioned by the year-after effects caused by the shock. Over time the shield provided by the non-tradable sector and by foreign labour makes native employment levels less variable, as predicted by the theoretical model presented in Section 4.

7   Policy implications and final remarks [preliminary only]

During a period of increased economic integration, with the introduction of the euro in 2000, and arrival of new member states, the skill patterns of migrants appear to have worked towards reducing regional differences in skill endowments. Skill endowments across European regions are typically more similar one another when the skills of foreign workers are included in the calculation. This occurs as foreign labour in the EU is predominantly composed of unskilled workers, while traditional immigration regions tend to have a relatively skilled workforce. In particular, convergence between regional skill endowments is provided by skilled intra-EU workers residing in traditionally skill-scarce regions, and unskilled extra-EU workers living in skill-rich regions. This result is analogous to the predictions of the Heckscher-Ohlin model in presence of mobile factors, and contextualises some of the conclusions of recent 'new geography models' about the possible agglomeration of skills at times of declining, but not nil, transportation costs across countries. Although the persistence of skill-rich regions to remain so over time is high, migration acts as a natural 'redistributor' of human capital across the EU, especially with regards to intra-EU movements.

The preliminary results of the empirical analysis suggest that foreign workers and the non-tradable sector reduce the variability of native employment due to shocks in labour demand.

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TABLE A1 **THE RELATIONSHIP BETWEEN THE SKILLED/UNSKILLED RATIOS OF INTRA-EU AND EXTRA-EU AND NATIVE WORKERS**

	OLS Intra-EU	OLS Extra-EU
β	-5.987**	-1.200**
	(1.331)	(0.347)
Q2 (slope)	8.786**	3.607**
	(2.982)	(0.813)
Q3 (slope)	2.612	1.332*
	(2.777)	(0.841)
Q4 (slope)	3.867**	1.298
	(2.028)	(0.873)
Q5 (slope)	4.712**	1.562**
	(1.318)	(0.368)
Constant	3.069**	1.208**
	(0.873)	(0.236)
N	1,403	1,607
Controls	No	No
Year dummy	No	No
Adjusted R^2	0.0960	0.0398
Reset (p-value)	0.1706	0.6341
Heteroskedasticity	Yes (robust)	Yes (robust)
Overall significance (p-values)	0.000	0.000

FIGURE A1 DIFFERENCES BETWEEN THE SKILLED/UNSKILLED RATIOS FOR THE INTRA-EU AND THE NATIVES RELATIVE TO THE EU AVERAGE: 1995-2005 – SKILL-ABUNDANT REGIONS
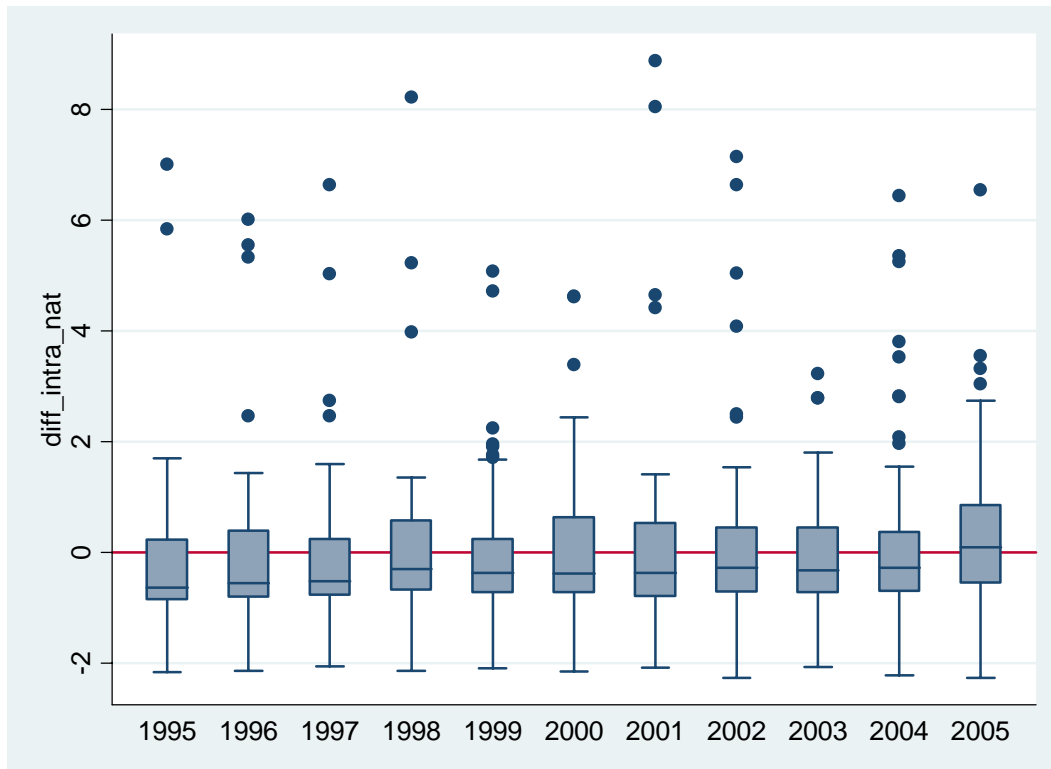

FIGURE A2 DIFFERENCES BETWEEN THE SKILLED/UNSKILLED RATIOS FOR THE INTRA-EU AND THE NATIVES RELATIVE TO THE EU AVERAGE: 1995-2005 – SKILL-SCARCE REGIONS
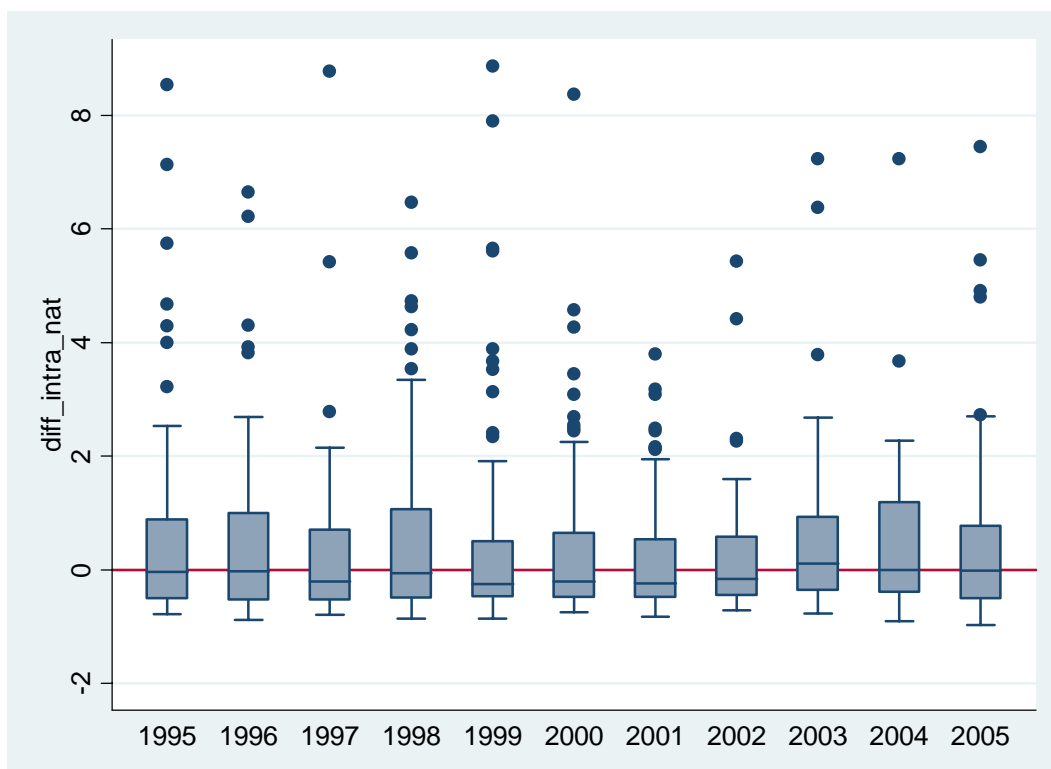
FIGURE A3 DIFFERENCES BETWEEN THE SKILLED/UNSKILLED RATIOS FOR THE EXTRA-EU AND THE NATIVES RELATIVE TO THE EU AVERAGE: 1995-2005 – SKILL-ABUNDANT REGIONS
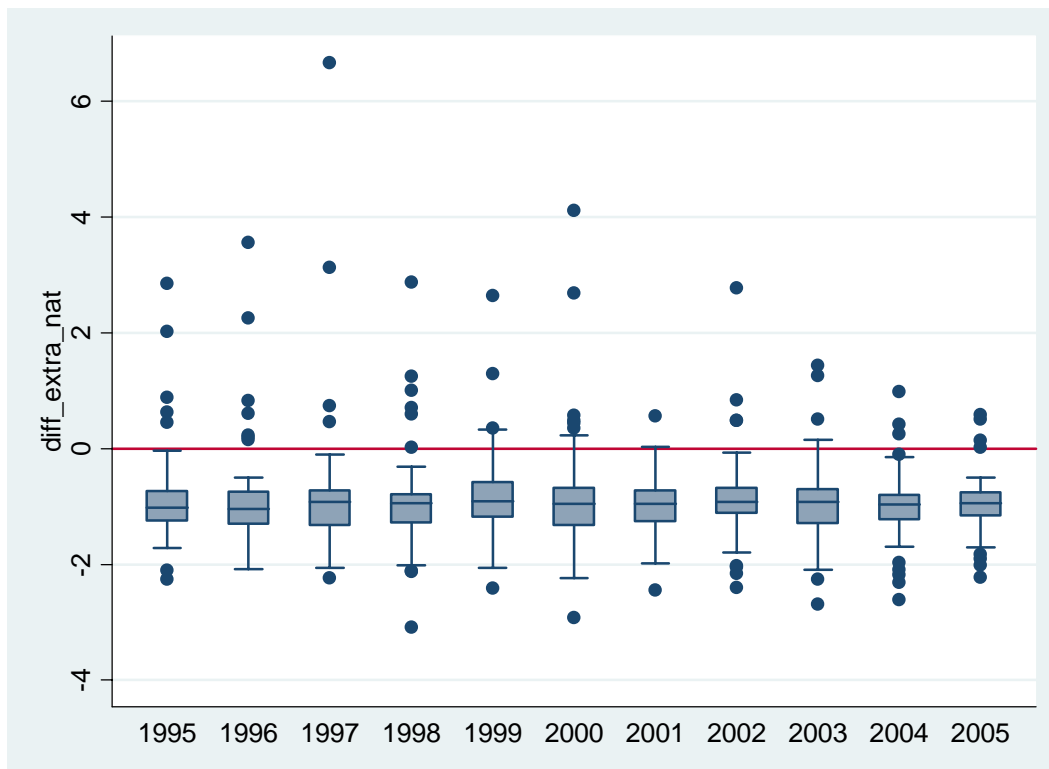

FIGURE A4 DIFFERENCES BETWEEN THE SKILLED/UNSKILLED RATIOS FOR THE EXTRA-EU AND THE NATIVES RELATIVE TO THE EU AVERAGE: 1995-2005 – SKILL-SCARCE REGIONS