NORTH-SOUTH IMBALANCES:
A SPATIAL GENERAL EQUILIBRIUM APPROACH

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1. Introduction

Ensuring cohesion – similar social and economic conditions – between different parts of the same political entity is a paramount policy objective in both the EU and single European states.

In Italy, convergence of laggard Southern areas towards the levels of development reached by Northern regions has been at the forefront of the policy agenda for decades (see Braunerhjelm *et al.*, 2000), but no visible results have been achieved (see Bank of Italy, 2008). In 2007, per capita GDP in the South was less than 60 per cent of that in the rest of Italy, actually lower than thirty years ago. The differences are particularly striking in the labour market where, in the early Nineties, the Southern unemployment rate reached levels as much as three times the Northern rate. Meanwhile, surveys of the quality of life in Italian cities consistently confirm the dramatic divide between the North and the South.

This paper frames several aspects of North-South dualism within a simple general equilibrium framework that considers local factors affecting productivity and attractiveness to business, as well as local amenities that can be enjoyed by residents.

Traditional theory on dual economies emphasized the speed at which agricultural labour was released for industrial work and the scarcity of industrial capital (see, e.g., Jorgenson, 1967 and Dixit, 1970). Other contributions singled out migration decisions, modelled as a function of rural and urban wage differentials (Harris and Todaro, 1970 and Mas-Colell and Razin, 1973). While this literature analyzed industrialization as a mechanism that would eventually eliminate dualism in developing economies, economic geography models like Roback (1982,1988) can explain why relevant differences across regions may remain as an equilibrium phenomenon even when firms and individuals can move about freely.

In what follows, we build on Roback's theory to analyze dualism in a spatial equilibrium model where both firms and workers are mobile across regions. When mobility costs are absent, regional wages and rents reflect local productivity and quality-of-life conditions. In particular, regions with more productive environments and better quality of life will have higher rents. By contrast, the effect on wages may be ambiguous, since residents could be willing to accept lower wages to live in a pleasant place. When workers face mobility costs, there will be some market segmentation affecting local prices. The model is extended to include different labour types (skilled and unskilled workers). Consistent with the Italian institutional setting, we assume that unskilled workers are paid a country-wide wage rate set by the unions. As in Faini (1999), this generates equilibrium unemployment. We also allow for the possibility that skilled individuals appreciate specific local characteristics, such as cultural or aesthetic amenities, that are ignored by the unskilled (see, e.g., Carlino and Saiz, 2008). Indeed, as is suggested by Dalmazzo and de Blasio (2008), there are some local characteristics that affect the utility of educated individuals and thus are important determinants of their location choices. In this setting, therefore, local prices,

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unemployment rates and population differences between regions are driven by both productivity and welfare-related local endowments, besides mobility costs.

This framework allows for some policy experiments. A number of policies can be introduced to reduce unemployment and income differentials, such as transfer payments, subsidies to firms, wage restrictions, etc. However, the implications for the relative population size of regions may differ. For instance, a reduction in transfers or the introduction of wage restraints tend to reduce unemployment differentials by increasing migration of workers (both skilled and unskilled) to the richer region. By contrast, subsidies to firms and public expenditure leading to higher local productivity tend to attract more firms and increase relative population in the disadvantaged region. Thus, subsidies and productivity-enhancing policies reduce both unemployment and population outflows. On the other side, policies that enhance local quality of life in the disadvantaged area may well worsen local labour market conditions (in terms of wages and unemployment) while attracting population at the same time.

The paper is organized as follows. Section II depicts some main facts characterizing dualism in the Italian economy, Section III presents and discusses the model, and Section IV concludes. Appendix B presents an empirical evaluation of the costs or gains of migration from South to North.

2. A Snapshot of Italy's territorial imbalances

Italy might be considered the textbook case of a dual economy: alongside a rich North – whose economic conditions are comparable with the richest areas of Europe – the economy of the *Mezzogiorno* is characterized by persistent underdevelopment in terms of GDP per capita, labour market performance, productivity and living conditions. In this section, we document this economic differential, focusing on the aspects that are most relevant for the theoretical model.

GDP per capita and unemployment – Despite enormous political and economic efforts[1], the per capita GDP of the southern regions has persistently been below than in the North since the Second World War and has shown little tendency to converge. In the early 1980s, per capita GDP in the South did not exceed 65 per cent of the North's, despite the large amount of public investment in the South in the previous years (see figure 1). This differential even widened later on: from 1989 the South-North ratio fell below 60 per cent and remained there despite some very marginal convergence in the late 1990s. In 2007, southern per capita GDP was still 57 per cent of the northern one. Unemployment rate differentials are large as well and actually show a clear trend toward divergence. In 1989, the southern rate was almost three times the northern one and this disparity has persisted in the two decades since. The clear reduction in the southern unemployment rate after the turn of the century is due to the reduction of the labour force due to the exit of long term discouraged unemployed workers rather than to an increase in employment.

Labour productivity – Using data from the Company Accounts Data Service (CADS) for 2006, Table 1 shows the North-South percentage gap between northern and southern firms: compared to column (1), which represents a simple difference in means, column (2) adds controls for industrial structure (NACE 2-digit dummies) and column (3) includes a control for the size of the firm (log of sales). The productivity differential for the entire sample was large and significant (–17.7 per cent) even after controlling for industrial structure and average size of firms. This North-South divide was particularly large for the service sector (–20.5 per cent) compared to manufacturing

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[1]   According to Magnani (1997) and Istat (1996) from 1970 to 1992, net public transfers to the South averaged 15-20 per cent of the Southern annual GDP. Cannari and Chiri (2006) report similar figures for the second half of the 1990s and the beginning of the 2000s.

Figure 1

Per capita GDP and unemployment rates
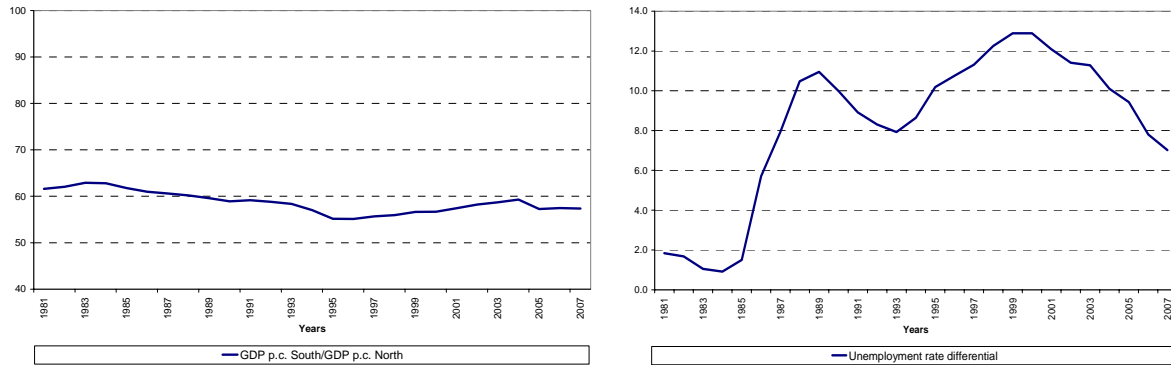
Source: Authors' calcuations on Prometeia and Istat dataset.

Source: Authors' calculations on Istat Regional Accounts.

Table 1

Labour productivity at firm level in 2006

	[1]	[2]	[3]
Dependent variable: log of labour productivity			
Dummy South	–0.215***	–0.202***	–0.177***
	(0.012)	(0.012)	(0.012)
Manufacturing	*–0.156***	*–0.186***	*–0.154***
	(0.017)	*(0.016)*	*(0.016)*
Service	*–0.289***	*–0.227***	*–0.205***
	(0.022)	*(0.021)*	*(0.021)*
No. Obs.	18,681	18,681	18,679
Manufacturing	*11,544*	*11,544*	*11,542*
Service	*7,253*	*7,253*	*7,253*
Sectoral dummies	NO	YES	YES
Size	NO	NO	YES

Source: Authors' calculations on CADS dataset. Sectoral dummies at NACE 2 digit level. Size controls for the log of sales. Standard errors in parentheses. * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent. All regressions exclude the 99th and the 1st percentile.

<div align="right">**Table 2**</div>

<div align="center">**Wages in 2006**</div>

	(1)	(2)	(3)
Dependent variable: log of net monthly wage			
Dummy south	–0.136***	–0.121***	–0.129***
	(0.011)	(0.011)	(0.012)
Unskilled workers	*–0.134****	*–0.119****	*–0.126****
	(0.012)	*(0.012)*	*(0.012)*
Skilled workers	*–0.134***	*–0.134***	*–0.143***
	(0.058)	*(0.055)*	*(0.055)*
Observations	3948	3922	3922
Unskilled workers	*3677*	*3655*	*3655*
Skilled workers	*271*	*267*	*267*

Source: Authors' calculations on SHIW data. Standard errors in parentheses. * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent. Specification (1) controls for education, experience, marital status, sex and part-time dummies. Specification (2) adds controls for sector of employment dummies. Specification (3) adds controls for the size of the municipalities dummies. All regressions exclude the 99th and the 1st percentile of the dependent variable.

(–15.4 per cent), which is more open to interregional and international competition.

Wages – Using the most recent Survey on Household Income and Wealth (SHIW) of the Bank of Italy (year 2006), Table 2 shows the percentage difference in the net monthly wage in the private sector between the North and the South. Specification (1) includes controls for individual characteristics: schooling, experience, sex, marital status and part-time dummies. Specification (2) adds controls for the sector of employment and Specification (3) includes dummies that control for the size of metropolitan areas (Glaeser and Maré, 2001). Table 2 also reports a sample split between skilled (college graduates) and unskilled workers. Net monthly wages were lower in the South in a statistically significant way ranging between 12.1 and 13.6 per cent in the 2006. The wage gap was slightly larger for skilled than unskilled workers, probably because centralized collective bargaining is more important at lower skill levels.

Quality of life – Besides classical economic data, southern underdevelopment might be measured by comparing the quality of life in North and South. The variables to be included in this kind of analysis are not straightforward; in this section we rely on a number of indicators published jointly by the Italian Statistical Office (Istat) and the Ministry of Economic Development on quality of life in the cities and on cultural resources for each area of the country. Quality of life indicators include: remoteness, pollution, crime, public transportation, public parks, parking areas, attractiveness of universities and hospitals, day care facilities, assistance to the elderly and healthcare expenditure. Cultural resources indexes include: number of visitors for museums (per inhabitant), public expenditure for cultural events, number of tickets sold for theaters and concerts, the share of household expenditure for cultural activities and the share of full-time equivalent workers in the recreation sector. Figures reported in Table 3 show, for both groups, the frequency by which an indicator has a higher score in the South compared to the North in the 2006. Results are quite clear: only 21.4 per cent of the quality of life indicators show a higher score in the South.

Table 3

Quality of life in 2006
(percentage of indicators showing a higher score in the South)

Quality of Life in the Cities indicators	21.4%
Cultural resources indicators	0.0%

Source: Authors' calculations on Istat data. For the list of indicators see Appendix.

Table 4

Housing rents

	(1)	(2)
Dependent variable: log of monthly rent		
Dummy south	−0.455***	−0.380***
	(0.031)	(0.025)
Observations	2232	2232

Source: Authors' calculations on SHIW data. Standard errors in parentheses. * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent. Specification (1) controls for area of the apartment, owner reported possible rent, heating and location dummies and the number of bathrooms. Specification (2) adds controls for the size of the city and kind of owner. All regressions exclude the 99th and the 1st percentile of the dependent variable.

The situation is even worse for cultural resources indicators: none reports a higher score in the South.

Housing costs and local prices – Location decisions of individuals should take into account the price levels across areas, especially in the non-tradable sector, which is likely to be larger in the core (Northern) region. By evaluating this component, we first consider the housing costs, which represents a large share of the non-tradable sector and can be easily measured using the SHIW data. The figures show that the gap is large. Table 4 reports the North-South differential in terms of rental rates of the housing sector. Specification (1) includes controls for the size of the apartment, the number of bathrooms, heating, location and owner-reported rent dummies. Specification (2) adds controls for the size of the city and the typology of the owner. The reported coefficients show that housing rents display a discount for the South averaging between 46 and 38 per cent in 2006.

Other components of the local prices show more limited differences. As Cannari and Iuzzolino (2009) point out, food and furnishing price differentials average around 10 per cent, the gap in the service sector is around 15 per cent and prices for clothing are 2 per cent lower in the South[2]. Overall, Cannari and Iuzzolino (2009) estimate that the cost of living is lower in the South by 16-25 per cent.

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[2] Figures for food, clothing and furniture refer to the regional capital cities only.

Interregional migration – As Mocetti and Porello (2008) point out, interregional migration was quite strong in the 1990s but slowed down after 2000, probably due to the rise in housing costs in the North. The authors also show that the education level of migrants rose dramatically, since a large fraction of those who changed their residence during the period 1991-2004 held a university degree.

3. The model

Building on Roback (1982,1988), we present a general equilibrium model where firms and workers are mobile across areas. The economy is composed of Area 1 and Area 2, which are endowed with different territorial characteristics, affecting both local productivity and residents' "quality of life". For our purposes, it is helpful to think of Area 2 as disadvantaged.

3.1 The basic framework

We start by introducing the basic model, where all firms produce a homogeneous good by using only *one type of labour* and "land". The good is traded competitively across the whole economy. Workers receive a competitive wage and consume both the produced good and "land". The supply of land in each area is fixed. Firms are assumed perfectly mobile between areas, so profits will be equalized across the economy. On the other hand, workers may face some mobility costs. In the presence of such costs, utility cannot be perfectly equalized between areas.

We start by describing workers' behaviour, and then we look at firms, so to characterize the equilibrium ratio between wages and rents (the price of land) in the two areas.

Workers – The utility of an individual worker who lives in area $c = \{1,2\}$ is given by:

$$U_c = A_U(X_c) \cdot L_c^{1-\mu} \cdot Y_c^{\mu} \tag{1}$$

and is maximized under the following budget constraint:

$$r_c \cdot L_c + p_c \cdot Y_c = w_c \tag{2}$$

where $\mu \in (0,1)$. $\{L_c, Y_c\}$ denote, respectively, the consumption of "land" and good by the individual. $\{r_c, w_c, p_c\}$ denote, respectively, the local price of land (rent), the local wage level and the price of the traded good. In what follows, we always assume that $p_1 = p_2 = 1$. The factor $A_U(X_c)$ in (1) denotes the impact on utility of a vector X_c of local characteristics (amenities, or disamenities) that affect residents' utility. We conventionally postulate that the elements of X_c, x_{ic}, are measured in a way such that $\partial A_U / \partial x_{ic} \geq 0$.

The solution to the utility maximization problem yields the following indirect utility function for a resident in area $c = \{1,2\}$:

$$v_c = \eta \cdot A_U(X_c) \cdot \frac{w_c}{r_c^{1-\mu}}, c = \{1,2\} \tag{3}$$

where $\eta \equiv (1-\mu)^{1-\mu} \mu^{\mu}$. If mobility costs between areas were absent, then it would be that $v_1 = v_2$. But when there is a cost $\kappa \geq 0$, proportional to utility, for moving from Area 2 to

Area 1, the following condition must hold in equilibrium:[3]

$$v_1 = (1 + \kappa) \cdot v_2 \tag{4}$$

By substituting the expressions from (3) into condition (4), we obtain the following equilibrium condition:

$$\left(\frac{w_1}{w_2}\right) = (1 + \kappa) \cdot \frac{A_U(X_2)}{A_U(X_1)} \cdot \left(\frac{r_1}{r_2}\right)^{1-\mu} \tag{5}$$

When expression (5) is satisfied, a worker is indifferent between Area 1 and Area 2.

Firms – The economy-wide market for the homogeneous consumption good is competitive. Producers located in $c = \{1, 2\}$ have a technology with constant returns to scale that uses a single type of labour, N_c, and "land" L_c:

$$Y_c = A_Y(Q_c) \cdot L_c^{1-\alpha} \cdot N_c^{\alpha} \tag{6}$$

where $\alpha \in (0,1)$ and $A_Y(Q_c)$ denotes the impact of the vector Q_c of local characteristics on firm's productivity. Again, we postulate that the elements of Q_c, q_{ic}, are measured in a way such that $\partial A_Y / \partial q_{ic} \geq 0$.[4] Profit maximization implies that price equals marginal cost, *i.e.*,

$$\xi \cdot \left[\frac{A_Y(Q_c)}{r_c^{1-\alpha} w_c^{\alpha}}\right] = 1 \tag{7}$$

where $\xi \equiv (1-\alpha)^{1-\alpha} \alpha^{\alpha}$. Since firms can move freely across locations 1 and 2, the following condition must hold:

$$\frac{A_Y(Q_1)}{r_1^{1-\alpha} w_1^{\alpha}} = \frac{A_Y(Q_2)}{r_2^{1-\alpha} w_2^{\alpha}} \tag{8}$$

Equation (8) can be rearranged into the following expression:

$$\left(\frac{w_1}{w_2}\right) = \left(\frac{A_Y(Q_1)}{A_Y(Q_2)}\right)^{\frac{1}{\alpha}} \cdot \left(\frac{r_2}{r_1}\right)^{\frac{1-\alpha}{\alpha}} \tag{9}$$

Equilibrium – Equations (5) and (9) characterize the equilibrium levels of the wage and rent ratios between Area 1 and Area 2, which are $\left(\frac{w_1}{w_2}, \frac{r_1}{r_2}\right)$. By taking logs and solving, we obtain the following:[5]

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[3] Note that condition (4) implies that $v_1 \geq v_2$ in equilibrium. Also, $\kappa > 0$ can be interpreted as a premium when moving from Area 1 to Area 2.

[4] The vector of local characteristics affecting firms' productivity, Q_c, must not to coincide with local characteristics affecting residents' utility (listed in vector X_c).

[5] We use the approximation $\log(1 + \kappa) \approx \kappa$.

$$\log\left(\frac{r_1}{r_2}\right) = \frac{1}{1-\mu\alpha}\left\{\log\frac{A_Y(Q_1)}{A_Y(Q_2)} + \alpha\cdot\log\frac{A_U(X_1)}{A_U(X_2)} - \alpha\cdot\kappa\right\} \tag{10}$$

and:

$$\log\left(\frac{w_1}{w_2}\right) = \frac{1}{1-\mu\alpha}\left\{(1-\mu)\cdot\log\frac{A_Y(Q_1)}{A_Y(Q_2)} - (1-\alpha)\cdot\log\frac{A_U(X_1)}{A_U(X_2)} + (1-\alpha)\cdot\kappa\right\} \tag{11}$$

Expression (10) shows that the greater the productivity and amenity advantage of Area 1, the higher the rent in Area 1 relative to Area 2. However, higher mobility costs will reduce the rent differential. When a resident in Area 2 suffers higher mobility costs, the opportunity cost of moving to Area 1 is greater, so it takes a relatively lower rent differential to discourage mobility from Area 2.

Expression (11) shows that local characteristics have an ambiguous effect on wages. On the one hand, firms' mobility stops when the productivity advantage in Area 1 is offset by higher wages. On the other hand, if Area 1 has an "amenity" advantage over Area 2, workers may accept relatively lower wages to live there. An increase in mobility costs, however, raises the relative wage. When the opportunity costs of migration rise, workers are less prepared to accept wage discounts to live in an area with a better quality of life.

3.2 Developing the basic framework: different labour types and trade unions

We now extend the basic model to the case in which production requires two types of labour, skilled and unskilled. This extension has two main additional features. First, there are some local characteristics that affect productivity and quality of life of both skilled and unskilled individuals. However, we assume that there are some specific local features that may affect the utility of skilled individuals only. Moreover, while the labour market for the skilled is competitive as in the basic model presented above, we postulate that unskilled workers are fully unionized, and unions set the same wage rate across the areas of the economy: see Faini (1999)[6.] The monopolistic behaviour of unions generates some unemployment among members.

We start by characterizing the optimal behaviour of firms, skilled, and unskilled workers.

Firms – Firms in area $c = \{1,2\}$ produce an homogeneous good by using land and both skilled and unskilled labour, respectively $\{N_c^{\,s}, N_c^{\,u}\}$, with a Cobb-Douglas technology characterized by constant returns to scale:

$$Y_c = A_Y(Q_c)\cdot L_c^{1-\alpha-\beta}\cdot\left(N_c^s\right)^{\alpha}\cdot\left(N_c^u\right)^{\beta} \tag{12}$$

where $\alpha + \beta \in (0,1)$. The wage received by a skilled worker in area c is denoted by w_c^s, while the economy-wide wage set by unions for the unskilled is equal to $w_1^u = w_2^u = w^u$. A competitive firm located in c will equate price to marginal cost, which is, $\vartheta\cdot\left[\dfrac{A_Y(Q_c)}{r_c^{1-\alpha-\beta}\left(w_c^s\right)^{\alpha}\left(w^u\right)^{\beta}}\right] = 1$, where $\vartheta \equiv (1-\alpha-\beta)^{1-\alpha-\beta}\alpha^{\alpha}\beta^{\beta}$. Since firms are perfectly mobile across areas, it holds that:

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[6]   Faini (1999) assumes, however, that unskilled workers cannot migrate. In his paper, this extreme assumption helps define the magnitude of union membership, so as to make possible the explicit modeling of unions' behaviour.

$$\left(\frac{w_1{}^s}{w_2{}^s}\right) = \left(\frac{A_Y(Q_1)}{A_Y(Q_2)}\right)^{\frac{1}{\alpha}} \cdot \left(\frac{r_2}{r_1}\right)^{\frac{1-\alpha-\beta}{\alpha}} \tag{13}$$

which is the analog of equation (8) above.

Skilled workers – Skilled workers living in area c maximize the utility function:

$$U_c^s = A_U(X_c) \cdot B_U(Z_c) \cdot L_c^{1-\mu} \cdot Y_c^{\mu} \tag{14}$$

subject to the following budget constraint:

$$r_c \cdot L_c + Y_c = w_c{}^s \tag{15}$$

This skilled worker utility function (14) is very similar to utility (1), except for the additional "amenity" term $B_U(Z_c) \geq 1$, which is non-decreasing in Z_c. Here, the vector Z_c denotes some territorial characteristics that are valuable to skilled individuals but irrelevant for the welfare of the unskilled, which is still characterized by utility (1)[7].

The optimal choice of the consumption bundle involves an indirect utility that has a form similar to (3). When a skilled worker faces a mobility cost measured by $\kappa^s \geq 0$, he is indifferent whether to migrate or not whenever the condition $v_1{}^s = (1 + \kappa^s) \cdot v_2{}^s$ holds. Thus, it must hold that:

$$\left(\frac{w_1{}^s}{w_2{}^s}\right) = (1 + \kappa^s) \cdot \frac{A_U(X_2)}{A_U(X_1)} \cdot \frac{B_U(Z_2)}{B_U(Z_1)} \cdot \left(\frac{r_1}{r_2}\right)^{1-\mu} \tag{16}$$

which is the analog of equation (5). Notice that equations (13) and (16) by themselves are able to characterize the equilibrium values of skilled wage and rent ratios across areas, $\left(\frac{w_1{}^s}{w_2{}^s}, \frac{r_1}{r_2}\right)$.

Unskilled workers – When employed, an unskilled worker will receive a wage equal to w^u. Thus, the expected income for an unskilled worker in area c is $(1 - u_c) \cdot w^u$, where u_c denotes the unemployment rate in $c = \{1,2\}$[8]. We assume that the location decision is irreversible *ex post*. By maximizing utility (1) subject to $r_c \cdot L_c + Y_c = (1 - u_c) \cdot w^u$, one obtains the *ex ante* value of indirect utility for an unskilled individual:

$$v_c{}^u = \eta \cdot A_U(X_c) \cdot \frac{(1 - u_c) \cdot w^u}{r_c^{1-\mu}}, c = \{1,2\} \tag{17}$$

If $\kappa^u \geq 0$ denotes the mobility cost for an unskilled individual, it must hold that $v_1{}^u = (1 + \kappa^u) \cdot v_2{}^u$. This implies the following equilibrium condition:

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[7] This assumption is consistent with the findings of Carlino and Saiz (2008) and Dalmazzo and de Blasio (2008).

[8] For simplicity, we set unemployment benefits or gains from unemployment (such as leisure) to zero. Like Harris and Todaro (1970, p. 127), we assume that there is a random job selection process among job seekers.

$$\left(\frac{1-u_1}{1-u_2}\right) = (1+\kappa^u) \cdot \frac{A_U(X_2)}{A_U(X_1)} \cdot \left(\frac{r_1}{r_2}\right)^{1-\mu} \tag{18}$$

Expression (18) shows that the relative employment rate among the unskilled depends on the rent ratio between areas, as determined by (13) and (16). In particular, given (r_1 / r_2), this expression determines the relative employment rate such that an unskilled worker will be indifferent (*ex ante*) whether to migrate or not.

Equilibrium – The relative rent ratio, the relative wage ratio among skilled workers, and the relative unemployment ratio among the unskilled between areas are determined by (13), (16) and (18). Taking the logs of (13) and (16) and solving will yield:

$$\log\left(\frac{r_1}{r_2}\right) = \frac{1}{1-\beta-\mu\alpha} \left\{ \log\frac{A_Y(Q_1)}{A_Y(Q_2)} + \alpha \cdot \log\frac{A_U(X_1)}{A_U(X_2)} + \alpha \cdot \log\frac{B_U(Z_1)}{B_U(Z_2)} - \alpha \cdot \kappa^s \right\} \tag{19}$$

and:

$$\log\left(\frac{w_1^s}{w_2^s}\right) = \frac{1}{1-\beta-\mu\alpha} \left\{ (1-\mu) \cdot \log\frac{A_Y(Q_1)}{A_Y(Q_2)} - (1-\alpha-\beta) \cdot \left[\log\frac{A_U(X_1)}{A_U(X_2)} + \log\frac{B_U(Z_1)}{B_U(Z_2)} \right] + (1-\alpha-\beta) \cdot \kappa^s \right\} \tag{20}$$

Equations (19) and (20) can be interpreted along the same lines as (10)-(11) in the basic Roback model above. In particular, local characteristics such as externalities or amenities have a positive effect on the relative rents in Area 1 and 2, while their effect on relative wages is ambiguous. On the other side, the mobility cost for the skilled has a negative effect on the rent ratio and a positive effect on the wage ratio.

Taking logs of (18) yields, instead, the following expression for the relative rate of unemployment among the unskilled[9]:

$$u_2 - u_1 \cong$$

$$\frac{1}{1-\beta-\alpha\mu} \left\{ (1-\mu) \cdot \log\frac{A_Y(Q_1)}{A_Y(Q_2)} - (1-\alpha-\beta) \cdot \log\frac{A_U(X_1)}{A_U(X_2)} + \alpha(1-\mu) \cdot \log\frac{B_U(Z_1)}{B_U(Z_2)} \right\} + \left[\kappa^u - \left(\frac{\alpha(1-\mu)}{1-\beta-\alpha\mu}\right)\kappa^s \right] \tag{21}$$

When Area 1 is relatively more productive, it will exhibit lower unemployment. However, when Area 1 is relatively richer in amenities X_1 that are valued by both skill groups, the unemployment rate in that area will have to be sufficiently high, relative to Area 2, to discourage migration. By contrast, if Area 1 is relatively richer in amenities that are mostly appreciated by the skilled, Z_1, the unemployment rate in Area 2 tends to be relatively higher. This occurs because such amenities raise relative rents in Area 1, reducing the incentive of the unskilled to migrate.

Mobility costs from Area 2 to Area 1 have asymmetric effects. An increase in the mobility cost of the skilled will lower the relative unemployment rate in Area 2. By contrast, an increase in the mobility cost of the unskilled will make it more costly to reap the benefits of living in Area 1. In equilibrium, this permits the coexistence of relatively higher unemployment in Area 2 with the absence of incentives to move away. Finally notice that, when $\kappa^s = \kappa^u = \kappa$, an increase in the (common) mobility cost will increase segregation between areas and thus increase the unemployment rate differential.

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[9]   In (21), $u_2 - u_1$ approximates $\log[(1-u_1)/(1-u_2)]$.

Figure 1
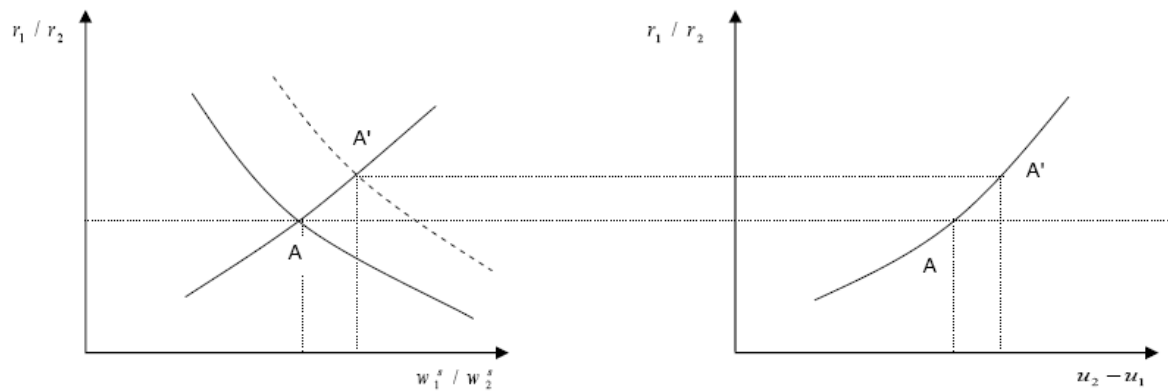
Migration costs can be partly related to demography. For instance, younger people generally have lower migration costs. Thus, from the model's standpoint, the effects of an ageing population can be represented by an increase in migration costs.

The impact of regional productivity, local amenities, and mobility costs on the equilibrium can be given a straightforward graphical representation. In particular, the firm's isocost curve (13) and the skilled worker's indifference curve (16) are, respectively, downward sloping and upward sloping curves in the diagram where relative rents and relative skilled wages appear on the axes: see the left-hand side graph in Figure 1. Once the equilibrium rent ratio is characterized (point A), the unskilled worker's indifference curve (18) will residually determine the unemployment rate differential (point A in the right hand-side graph).

Comparative statics exercises have straightforward representations. As shown in Figure 1, an increase in Area 1's relative productivity will shift the firm's isocost upward, increasing relative rents, skilled wages and employment in that region relative to Area 2 (refer to points A' in the graphs).

The effects of an increase in amenities that affect both skilled and unskilled utility are illustrated in Figure 2. A relative increase of such amenities in Area 1 will shift both skilled and unskilled indifference curves, raising rents but reducing wages and employment relative to Area 2 (see points B in the graphs).

Figure 3 illustrates the case in which Area 1 exhibits an increase in amenities that affect only skilled workers' utility. The skilled indifference curve shifts upward, while the position of the unskilled indifference curve is unaffected. As a consequence, Area 1 will experience an increase in the rent ratio and relative employment, while the skilled wage ratio will fall.

Similar figures can be used to represent changes in mobility costs. Increases in skilled workers' mobility costs will shift their indifference curve downward. Higher mobility costs for the unskilled will have a similar effect on their curve.

3.3 Transfer payments, territorial wage restraints and subsidies to firms

In what follows, we extend the model so to consider three specific policy instruments: transfer payments to residents, wage constraints across areas, and subsidies to local firms.
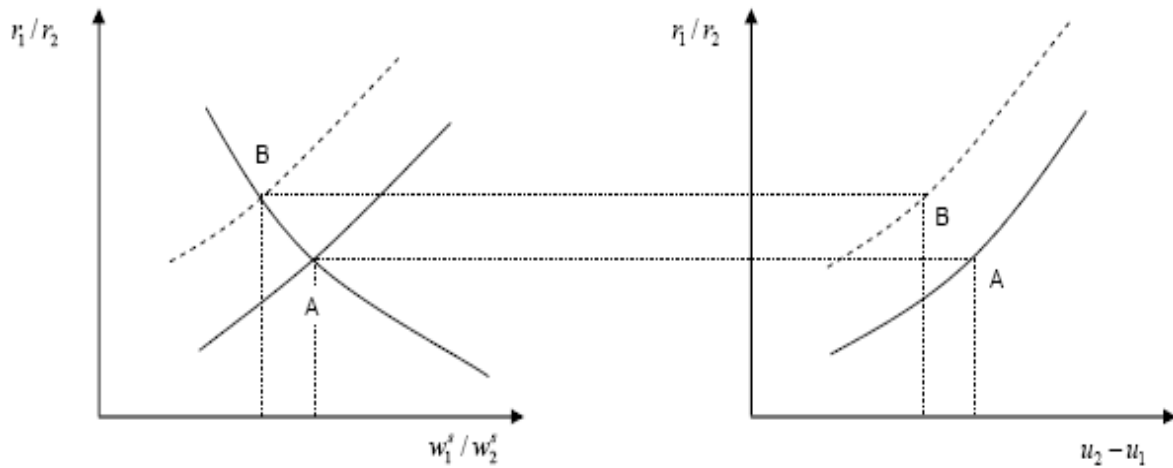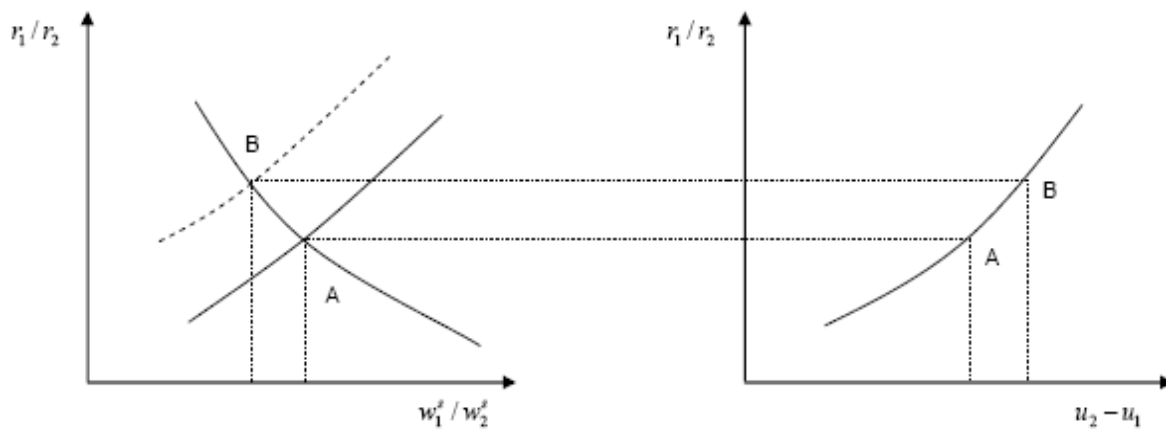
Figure 2

Figure 3

3.3.1 Transfer payments to individuals

We consider the case in which the central government distributes funds to individuals who live, say, in Area 2. We posit that both types of workers located in Area 2 are entitled to a transfer payment which, for simplicity, is taken to be proportional to their local wage. The budget constraint for a skilled worker in Area 2 becomes:

$$r_2 \cdot L_2 + Y_2 = (1 + \tau) \cdot w_2 \tag{22}$$

where $\tau \geq 0$ is the size of the transfer payment[10].

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[10]   When funds for transfer payments to Area 2 are raised by taxation on wage income in Area 1, the budget constraint for a skilled worker in Area 1 becomes: $r_1 \cdot L_1 + Y_1 = (1 - t) \cdot w_1$, where $t \geq 0$ denotes the tax-rate on wage income. With wage taxation in

(continues)

By solving the utility maximization problem for skilled residents in each region and imposing the mobility condition (4), we obtain that condition (16) will take the following form:

$$\left(\frac{w_1^s}{w_2^s}\right) = (1+\kappa^s)\cdot(1+\tau)\cdot\frac{A_U(X_2)}{A_U(X_1)}\cdot\frac{B_U(Z_2)}{B_U(Z_1)}\cdot\left(\frac{r_1}{r_2}\right)^{1-\mu} \tag{23}$$

Similarly, for the unskilled it must hold that:

$$\left(\frac{1-u_1}{1-u_2}\right) = (1+\kappa^u)\cdot(1+\tau)\cdot\frac{A_U(X_2)}{A_U(X_1)}\cdot\left(\frac{r_1}{r_2}\right)^{1-\mu} \tag{24}$$

Thus, the transfer measure τ has the *same comparative statics effects as the mobility cost*. In particular, an increase in transfer payments in favour of residents of Area 2 will increase the relative wage of the skilled in Area 1. Moreover, since transfer payments increase segmentation across areas, the unskilled unemployment rate differential between Area 2 and Area 1 will also rise.

3.3.2 Differentiation in unions' regional wage policy

In what follows, we ask what happens when unions agree to set differentiated wages across regions. The obvious intent of such a policy should be to increase the competitiveness of backward territories. The issue of local wage differentiation can be easily accommodated within our model.

Suppose that the unskilled wage set by unions in Area 2, w_2^u, is lower that the corresponding wage bargained in Area 1, w_1^u, and such that:

$$w_1^u = (1+\delta)\cdot w_2^u, \quad \text{with } \delta \geq 0 \tag{25}$$

Thus, unskilled labour will be cheaper in Area 2. Then, using (25), free mobility of firms across areas will imply that $\left[\dfrac{A_Y(Q_1)}{r_1^{1-\alpha-\beta}\left(w_1^s\right)^\alpha\left((1+\delta)w_2^u\right)^\beta}\right] = \left[\dfrac{A_Y(Q_2)}{r_2^{1-\alpha-\beta}\left(w_2^s\right)^\alpha\left(w_2^u\right)^\beta}\right]$, and condition (13) will take the following form[11]:

$$\left(\frac{w_1^s}{w_2^s}\right) = \left(\frac{1}{1+\delta}\right)^{\frac{\beta}{\alpha}}\cdot\left(\frac{A_Y(Q_1)}{A_Y(Q_2)}\right)^{\frac{1}{\alpha}}\cdot\left(\frac{r_2}{r_1}\right)^{\frac{1-\alpha-\beta}{\alpha}}. \tag{26}$$

In equilibrium, relative rents and skilled wages between areas become, respectively, equal to:

$$\log\left(\frac{r_1}{r_2}\right) = R.H.S.\,of\,(19) - \left(\frac{\beta}{1-\beta-\alpha\mu}\right)\cdot\delta \tag{27}$$

and:

$$\log\left(\frac{w_1^s}{w_2^s}\right) = R.H.S.\,of\,(20) - \left(\frac{\beta(1-\mu)}{1-\beta-\alpha\mu}\right)\cdot\delta \tag{28}$$

Area 1, the term $(1+\tau)$ in (23) and (24) will be replaced by $\left(\frac{1+\tau}{1-t}\right)$. Thus, the impact on wage and unemployment differentials of an increase in trasfer payments (higher τ) is greater when it also involves higher taxation (higher *t*).

[11] Notice that condition (16) for skilled workers' mobility remains unaffected by such a wage policy.

since $\log(1+\delta) \approx \delta$. The wedge δ artificially makes unskilled labour more expensive in Area 1 and reduces relative rents, because firms will be discouraged from locating in Area 1. Moreover, the higher cost of unskilled labour in Area 1 will reduce demand for this factor and, consequently, will also lower the marginal productivity and wages of *skilled* workers.

With territorial differences in union wage policies, the *ex ante* value of indirect utility for an unskilled resident in Area 2 will be equal to:

$$v_2{}^u = \eta \cdot A_U(X_2) \cdot \frac{(1-u_2) \cdot (1+\delta)^{-1} \cdot w_1{}^u}{r_2{}^{1-\mu}} \tag{29}$$

Since $v_1{}^u = (1+\kappa^u) \cdot v_2{}^u$, the equilibrium condition now takes the following form:

$$\left(\frac{1-u_1}{1-u_2}\right) = \frac{(1+\kappa^u)}{(1+\delta)} \cdot \frac{A_U(X_2)}{A_U(X_1)} \cdot \left(\frac{r_1}{r_2}\right)^{1-\mu} \tag{30}$$

Together with (27), equation (30) implies that, in equilibrium, the unemployment gap is equal to:

$$u_2 - u_1 \cong R.H.S. \, of \,(21) - \left(\frac{1-\mu(\alpha+\beta)}{1-\beta-\alpha\mu}\right) \cdot \delta \tag{31}$$

Thus, wage policies that artificially increase the competitiveness of firms in Area 2 tend to narrow the unemployment gap. This result is driven by two forces. First, firms find it more profitable to locate in the disadvantaged area to enjoy lower unskilled labour costs. And second, the lower wages of the unskilled in Area 2 makes migration to Area 1 more attractive. Although both these forces tend to reduce unemployment in Area 2 relative to Area 1, their impact on the population size is ambiguous, as will be argued below.

3.3.3 Territorial subsidies to firms

Suppose that the government wants to subsidize firms locating in a certain area, say Area 2[12]. It can do so both by paying a subsidy $s \geq 0$ per unit of output or by giving a subsidy of $\sigma \cdot w \geq 0$ per worker, reducing actual per capita labour costs to $(1-\sigma) \cdot w$ [13]. Under such schemes, the profit for firms locating in Area 2 is equal to $(1+s)Y_2 - (1-\sigma)\left[w_2^s N_2^s + w^u N_2^u\right] - r_2 L_2$ and, in equilibrium, the analog of equation (13) will hold:

$$\left(\frac{w_1{}^s}{w_2{}^s}\right) = \left(\frac{A_Y(Q_1) \cdot (1-\sigma)^{\alpha+\beta}}{A_Y(Q_2) \cdot (1+s)}\right)^{\frac{1}{\alpha}} \cdot \left(\frac{r_2}{r_1}\right)^{\frac{1-\alpha-\beta}{\alpha}} \tag{32}$$

As is apparent from (32), an increase in subsidies to firms (s,σ) that choose to locate in Area 2 has the same qualitative effect as an increase in total factor productivity, $A_Y(Q_2)$, in the same area. Thus, subsidies to firms are, at least in principle[14], able to produce an artificial increase

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[12]   Subsidies may be financed taxing wages. If the tax rate on wages is the same across regions, it will not affect workers' mobility decisions.

[13]   The subsidy σ has the same qualitative effect as a tax discount for local firms that reduces their labour costs.

[14]   This conclusion obviously abstracts from problems related to enforcing and monitoring such schemes to prevent fraud.

in competitiveness for firms operating in disadvantaged areas[15].

We can summarize the effects of transfer payments, institutional wage restraints and subsidies to firms as follows. An increase in transfer payments will have the same effect as higher mobility costs, thus increasing territorial segmentation. Contrary to mobility costs, restraints that artificially reduce unskilled wages in a certain area will also lower the relative unemployment rate in that area. Since the comparative statics effects of transfer payments and wage restraints can be represented, respectively, as increases and decreases in mobility costs, in what follows there is no need to explicitly model transfer payments or wage legislation. Finally, local subsidies to firms attract businesses in a way similar to environments characterized by high productivity. For this reason, the comparative statics effects of subsidies to local firms can be mimicked as the impact of higher total-factor productivity in the area.

3.4 Relative population sizes across areas

The equilibrium derived above characterizes the relative prices (rents, wages) and unemployment rates across areas. In what follows, we shall characterize the relative equilibrium sizes of skilled and unskilled populations in the two areas.

Similarly to Roback (1988), the procedure to determine the equilibrium populations builds on a market-clearing condition in the market for land and in the market for skilled labour in area *c*. Here there is also a condition that requires that the number of unskilled workers demanded in area c be equal to the number actually employed. We leave the details of the derivation of the results to Appendix A.

In equilibrium, the proportion of skilled workers across areas is given by:

$$\log\left(\frac{n_1^s}{n_2^s}\right)=\log\left(\frac{\bar{\ell}_1}{\bar{\ell}_2}\right)+(1-\beta-\alpha\mu)^{-1}\left\{\mu\log\left(\frac{A_Y(Q_1)}{A_Y(Q_2)}\right)+(1-\beta)\left[\log\left(\frac{A_U(X_1)}{A_U(X_2)}\right)+\log\left(\frac{B_U(Z_1)}{B_U(Z_2)}\right)-\kappa^s\right]\right\}\quad(33)$$

Expression (33) shows that skilled workers will tend to locate in Area 1 when productivity and both types of amenities (X_1, Z_1) in Area 1 are high relative to Area 2. Thus, local characteristics that enhance productivity and welfare are central factors in attracting skilled workers. By contrast, mobility costs towards Area 1 (as well as transfer payments in favour of skilled residents in Area 2) will reduce the proportion of the skilled workers in Area 1.

Similar calculations show that the proportion of unskilled workers across areas is equal to:

$$\log\left(\frac{n_1^u}{n_2^u}\right)=\log\left(\frac{\bar{\ell}_1}{\bar{\ell}_2}\right)+(1-\beta-\alpha\mu)^{-1}\left\{\mu\log\left(\frac{A_Y(Q_1)}{A_Y(Q_2)}\right)+(1-\beta)\log\left(\frac{A_U(X_1)}{A_U(X_2)}\right)+\alpha\mu\cdot\log\left(\frac{B_U(Z_1)}{B_U(Z_2)}\right)\right\}-$$

$$-\left[\kappa^u+\tfrac{\alpha\mu}{1-\beta-\alpha\mu}\kappa^s\right]$$

(34)

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[15]   The government might also introduce subsidies that discriminate between skilled and unskilled labour. If the subsidy is such as to generate a discount σ' for skilled labour and σ'' for unskilled labour respectively, the term $(1-\sigma)^{\frac{\alpha+\beta}{\alpha}}$ in expression (32) will be replaced by $(1-\sigma')(1-\sigma'')^{\frac{\beta}{\alpha}}$. Setting, by assumption, the total income share that goes to labour, $\alpha+\beta$, equal to 2/3, and assuming that skilled labour receives a share of $\alpha+\beta$ itself that ranges between 1/2 and 2/3 (see Mankiw *et al.*, 1992), then α will range between 1/3 and 4/9 and, consequently, β will range between 2/9 and 1/3. Thus, for reasonable parameter values, the ratio β/α ranges between 1/2 and 1, so a subsidy that reduces skilled labour costs will generally have a stronger impact than a subsidy on unskilled labour cost.

Here, again, higher local productivity (due to Q_1) and general amenities (due to X_1) in Area 1 will bias the location of unskilled workers towards that area. What is more surprising is that abundance of local amenities that are specific to the utility of skilled individuals (Z_1) will also tend to increase the location of unskilled workers in Area 1[16]. Mobility costs (as well as transfer payments in favour of Area 2) will reduce the proportion of unskilled workers located in Area 1.

When we consider the possibility that unions will agree to set differentiated territorial wages for the unskilled (that is, when $\delta > 0$, as analyzed in Sect. 3.2), the right-hand side of expression (33) will be *reduced* by $\left(\frac{\beta\mu}{1-\beta-\alpha\mu} \right) \cdot \delta$. Thus, regional wage policies that artificially increase the competitiveness of firms located in Area 2 will also encourage skilled workers to locate in that area. Since employment of the unskilled expands in the disadvantaged area, the marginal productivity (and wages) of the skilled will increase as well.

However, the same policy will *augment* the right-hand side of expression (34) by $\left(\frac{1-\beta-\mu(\alpha+\beta)}{1-\beta-\alpha\mu} \right) \cdot \delta$, but the sign of this factor is in principle *ambiguous*. The reason is that such wage policies attract firms and reduce unemployment among the unskilled but at the same time stimulate unskilled workers to migrate to areas that pay higher wages.

Finally, since $\log\left(\frac{n_1^s}{n_2^s} \right) - \log\left(\frac{n_1^u}{n_2^u} \right) = \log\left(\frac{n_1^s}{n_1^u} \right) - \log\left(\frac{n_2^s}{n_2^u} \right)$, equations (33) and (34) can also be used to characterize the skill mix across areas. The difference in skill mix across areas is given by the following expression:

$$\log\left(\frac{n_1^s}{n_1^u} \right) - \log\left(\frac{n_2^s}{n_2^u} \right) = \log\left(\frac{B_U(Z_1)}{B_U(Z_2)} \right) + \left(\kappa^u - \kappa^s \right) \tag{35}$$

Expression (35) shows that, in this model, the local proportion between skilled and unskilled workers depends on: (i) the presence of amenities that are specific to the tastes of the skilled[17], like those included in vector Z_c and (ii) the difference between unskilled and skilled mobility costs. That is, if skilled and unskilled individuals face the same mobility costs, the skill mix will be unaffected, but if the unskilled face higher costs, or receive more transfer payments than the skilled when living in Area 2, or do not face institutional wage restraints in Area 2, Area 1 will exhibit a larger proportion of skilled workers[18].

3.5 Some policy implications

Governments usually care about social and economic inequality between regions. Public policies are often designed to reduce income differences, unemployment gaps, and even disparities in the "quality of life". For these purposes, policymakers can use various instruments, such as transfer payments, subsidies, public expenditure to enhance local productivity and residents' welfare, or even legal restrictions in the labour market. As emphasized below, however, even if such policies may have a common objective, for example the reduction in the regional unemployment gap, they may have very different implications for population flows.

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[16]   When more skilled workers tend to locate in Area 1, the local productivity of unskilled workers will increase, and their employment opportunities in Area 1 improve.

[17]   Local general amenities (X_c) and productivity advantages (Q_c) affect skilled and unskilled individuals in the same way.

[18]   When unions set different wages across regions, the right-hand side of (35) will be reduced by δ.

Consider first policies to *reduce unemployment* in the disadvantaged region, Area 2. As implied by (21) and the discussion in Section 3, the unemployment gap will narrow as a consequence of: (i) a reduction in transfer payments to Area 2 (lower *τ*), (ii) policies setting lower wages for the unskilled in Area 2 (*i.e.* *δ*>0), (iii) subsidies to firms that locate in Area 2 (higher *s* and *σ*), and (iv) the use of public funds to raise productivity in Area 2 (through, say, better infrastructure, bureaucracy, etc., so to raise Q_2). Moreover, notice from (20) that the same policies also tend to reduce the wage gap for skilled workers between Area 1 and Area 2.

Significantly, however, in this model these policies have very different implications for relative population sizes across regions, as shown by equations (33) and (34). The reduction of transfer payments in Area 2 tends to *decrease* population in the disadvantaged region, relative to the rest of the country[19]. In other words, lower unemployment (and a narrower wage gap) in Area 2 is associated with migration of workers (both skilled and unskilled) to Area 1. By contrast, subsidies to firms and public expenditure leading to higher productivity in Area 2 tend to attract more firms and *increase* relative population in the disadvantaged region. Thus, subsidies and productivity-enhancing policies reduce unemployment and outward migration at the same time.

The impact of local policies that improve residents' welfare is more ambiguous. In the model, these amenity effects are captured by changes in X_2 and, for the skilled only, by Z_2.

Consider first an increase in the quality of services that benefit *both* skilled and unskilled residents, such as health services or public transport (higher X_2). In this case equation (21) suggests that unskilled workers will be ready to accept higher unemployment in order to remain in Area 2, and skilled workers will accept lower relative wages to stay there. At the same time, however, equations (30) and (31) suggest that an increase in the quality of life in the disadvantaged region will increase its population relative to the rest of the country. Thus, better amenities attract people to Area 2 even when local labour market conditions worsen.

A policymaker can also decide to fund local cultural activities, or aesthetic attractions, even though such amenities are largely restricted to the utility of skilled residents (higher Z_2). In this case, while the relative wage of skilled workers is reduced in Area 2 (see equation (20)), the relative unemployment rate is *reduced* in the disadvantaged region. At the same time, such specific kinds of amenities will raise the relative size of *both* skilled *and* unskilled populations. In other words, public policies that focus on amenities that are particularly valuable to educated individuals have positive spillovers on the unskilled. The inflow of skilled workers makes the unskilled more productive, and reduces their rate of unemployment[20].

3.6 Two extensions: foreign immigration and biased technical change

The following two sections extend the model to consider the effects of foreign immigrants and a representation of technical change that is biased towards skills.

3.6.1 Immigration

Suppose that there are *m* unskilled foreign immigrants who compete on the labour market

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[19] Recall that this measure has comparative statics effects similar to reductions in mobility costs, κ^s and κ^u. Regional differences in the collectively bargained wage of unskilled workers attract skilled workers to the disadvantaged area but have ambiguous effects on the unskilled.

[20] Also, as shown by (35), an increase in Z_2 will also increase the skilled-unskilled ratio in Area 2, relative to Area 1.

with unskilled native workers. When native workers face a strictly positive mobility cost ($\kappa^u > 0$), equilibrium implies that $v_1^u > v_2^u$, *i.e.* welfare in Area 1 is greater than in Area 2. Then, if foreign immigrants face the same wage and employment opportunities as unskilled natives, but if their mobility costs within the host country are zero[21], they will *all choose to locate in Area 1*, the better region.

Provided that the number of immigrants is sufficiently small, equilibrium will still be characterized by equation (18), where unemployment rates now refer to the pool of unskilled natives and immigrants. As shown in Appendix A, however, the flow of foreign migration into Area 1 will reduce the relative number of unskilled natives in that region. So in this model the inflow of foreign workers replaces unskilled natives in the advantaged area.

3.6.2 Biased technical change

Technological change is most often represented as a shift in Total Factor Productivity, the term denoted by $A_Y(Q_c)$ in our model. In recent decades, however, the demand for skilled workers has grown faster than the pool of educated workers. This observation has motivated a large body of literature, especially in labour economics, on so-called "skilled-biased technical change". In terms of production theory, technical change is skill-biased if it increases the marginal productivity of skilled workers relative to that of other factors: see Acemoglu (2002, p.785). In general, representations of skill-biased technical change rely on CES production functions, as for example in Acemoglu (2002) and Krusell *et al*. (2000). In fact, under a Cobb-Douglas production function such as $y = L^{1-\varphi} \cdot N^{\varphi}$, the technological parameter φ – assumed constant over time – makes factor shares themselves constant[22].

Some recent literature, however, has asked what happens when technological change is represented as a shift in the Cobb-Douglas share parameters. In particular, Seater (2005), Peretto and Seater (2008), and Zuleta (2008), motivated by observations like the historical fall in the share of raw labour in the US, together with the stability of the share going to labour income, have explored several implications of the "share-altering" technological change hypothesis with Cobb-Douglas production functions. Such a representation of technological change is very convenient in our framework, since we can explore the consequences for the spatial equilibrium of an increase in the skilled workers' share that is matched by an equal decrease in that of the unskilled, leaving the overall income share of labour unchanged. A relevant implication of this approach is that skill-biased share-altering technological change, in order to be profitable, requires an abundance of skilled workers.

In what follows, we consider the effect of biased technical change on the equilibrium across areas and assess the implications for relative regional prices, unemployment rates, and populations. We leave the formal derivations of all the results presented in this section to Appendix A.

Referring to the Cobb-Douglas technology (12), common to both areas $c = \{1,2\}$, we posit a *share-altering technical change*. We suppose that a new technology becomes available such that the share of skilled labour α increases by $\Delta \geq 0$, while the share of unskilled labour β is reduced in the same measure. Thus, the *total* labour share, $\alpha + \beta$, remains constant. When such a technical innovation is made in Area 1 but is unprofitable in Area 2, then Area 1 will exhibit: (i) an increase

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[21]   This is a reasonable assumption, since the mobility cost for a foreign migrant concerned his original decision whether to leave his country of origin, and is already "sunk" from the perspective of our analysis.

[22]   On this point, see Acemoglu (2003, p. 3).

in its relative skilled wage, (ii) an increase in relative rents, (iii) a decrease in its relative unemployment rate, and (iv) an increase in both skilled and unskilled populations, relative to Area 2. Moreover, this kind of biased technical change will shift the skill mix in favour of Area 1. In other words, the ratio between skilled and unskilled workers will increase in the region that was ready to adopt the new technology.

In short, our model predicts that the regional skill mix will be driven mainly by two factors: skill-biased local amenities (*i.e.*, amenities that mostly affect the utility of educated workers; see equation (35)), and skill-biased technologies.

4. Conclusions

In our model, inter-regional differences in wages, unemployment, rents and population all depend on local factors affecting both firms' productivity and residents' welfare.

The evidence we have reported shows the very wide gap in productivity – at least labour productivity – between the North and the South of Italy. Thus Northern firms have a strong competitive advantage over those located in the South. In the model, this productivity divide implies that southern regions should have both lower wages and higher unemployment than the North.

Empirical observation largely corroborates the theoretical implications. First, the unemployment rate in the South is much higher than in the North. Second, southern wages are lower on the average. Further, the wage gap is slightly wider for *skilled* workers, consistent with the fact that unskilled wages are largely determined by national agreements. In the model, nationwide wage agreements reduce the wage gap among unskilled workers at the cost of generating unemployment in the disadvantaged region.

At the same time, inter-regional productivity differences do not appear to be fully reflected in wage differences. And the regional divide also emerges in local "quality of life" measures. Residents in northern areas enjoy better local amenities than those in the South. Both these observations are consistent with the model's implication that individuals are ready to accept a wage "discount", and pay higher rents, in order to live in areas where local public services are better, cultural life is richer, and so on. Also, consistently with theoretical predictions, data on rents show a very large gap in favour of dwellings located in the North.

Further, both the productivity and the quality-of-life advantages of the North are consistent with substantial migration from the South. However, migration to the North may have been slowed by transfer payment policies in favour of southern areas. Such policies may have made higher unemployment tolerable to southerners.

Our model offers a variety of theoretical suggestions on policy measures to reduce the North-South gap. Some policies, such as subsidies to southern firms, abstract from problems of enforcement (in a more realistic setting, with heterogeneous firms, it is difficult for the policymaker to determine which firms will put the subsidies to good use; see De Blasio and Lotti, 2008). Moreover, fraud can actually be pervasive in areas where crime plays a prominent role. Other policies, such as collective bargaining that accepts the differentiation of the regional wage structure or a reduction in transfer payments to households, might be easier to implement. Also, the model predicts reductions in inter-regional transfer payments to households would reduce the disparity in labour market performance by encouraging migration out of the South.

On the other hand, a distinctive merit of Roback's theory is its attention to the welfare of residents. In principle, public policy can affect local quality of life very significantly. For example, a central government may spend more funds on schools in disadvantaged regions, or on more

effective law enforcement in selected areas. Further, local administrations and politicians might enhance the provision of services like health assistance, public transport or even cultural activities and aestethic attractions. The model implies that such policies attract people. Competent administrations may concentrate on services intended to appeal to educated workers in particular.

Appendix A

A.1 Derivation of relative population sizes in equilibrium

Profit maximization for firms located in area c implies that the demand for skilled labour N_c^s, unskilled labour N_c^u, and land L_c are given, respectively, by:

$$N_c^s = \frac{\alpha \cdot Y_c}{w_c^s}, \quad N_c^u = \frac{\beta \cdot Y_c}{w^u}, \quad L_c = \frac{(1 - \alpha - \beta) \cdot Y_c}{r_c} \tag{A.1}$$

In equilibrium, skilled labour demand N_c^s must be equal to its local supply n_c^s. Also, unskilled labour demand N_c^u must be equal to actual unskilled employment, which is, $(1 - u_c) \cdot n_c^s$. Finally, the local supply of land, $\bar{\ell}_c$, must be equal to the total demand for land, which is given by the sum of land demanded by firms (as from A.1), plus the land demanded by the skilled workers, equal to $n_c^s \cdot (1 - \mu) \cdot \dfrac{w_c^s}{r_c}$, plus the land demanded by the unskilled workers,

$(1 - u_c) \cdot n_c^u \cdot (1 - \mu) \cdot \dfrac{w^u}{r_c}$.

Thus, the following three equations constitute a system in $\{Y_c, n_c^s, (1 - u_c) \cdot n_c^u\}$, for any given price vector $\{r_c, w_c^s, w^u\}$:

$$n_c^s = \frac{\alpha \cdot Y_c}{w_c^s} \tag{A.2}$$

$$(1 - u_c) \cdot n_c^u = \frac{\beta \cdot Y_c}{w^u} \tag{A.3}$$

$$\bar{\ell}_c = \frac{1}{r_c} \left\{ (1 - \alpha - \beta) \cdot Y_c + (1 - \mu) \cdot n_c^s \cdot w_c^s + (1 - \mu) \cdot (1 - u_c) \cdot n_c^u \cdot w^u \right\} \tag{A.4}$$

Using (A.2) and (A.3) to substitute $\{n_c^s, (1 - u_c) \cdot n_c^u\}$ away in (A.4), one obtains:

$$Y_c = \frac{\bar{\ell}_c \cdot r_c}{1 - \mu(\alpha + \beta)} \tag{A.5}$$

which can be substituted back into (A.2) and (A.3) to obtain:

$$n_c^s = \frac{\alpha}{w_c^s} \left[\frac{\bar{\ell}_c \cdot r_c}{1 - \mu(\alpha + \beta)} \right], \quad c = 1, 2 \tag{A.6}$$

$$(1 - u_c) \cdot n_c^u = \frac{\beta}{w^u} \left[\frac{\bar{\ell}_c \cdot r_c}{1 - \mu(\alpha + \beta)} \right], \quad c = 1, 2 \tag{A.7}$$

Thus, using (A.6), the relative population size of skilled individuals across areas will be given by:

$$\frac{n_1^s}{n_2^s} = \frac{\overline{\ell}_1}{\overline{\ell}_2} \cdot \frac{r_1}{r_2} \cdot \frac{w_2^s}{w_1^s} \tag{A.8}$$

Taking logs of (A.8) and using (19) and (20), one obtains equation (33) in the text.

Similarly, using (A.7), the relative population size of the unskilled individuals across areas is given by:

$$\frac{n_1^u}{n_2^u} = \frac{\overline{\ell}_1}{\overline{\ell}_2} \cdot \frac{r_1}{r_2} \cdot \frac{(1-u_2)}{(1-u_1)} \tag{A.9}$$

Again, taking logs of (A.9) and using (19) and (21), one obtains equation (34) in the text.

A.2 Derivation of the impact of foreign immigration

As is argued in the text, when native unskilled workers face strictly positive mobility costs, the welfare of residents in Area 1 will be greater than welfare in Area 2. For this reason, if there is no discrimination between foreigners and natives in the labour market, all m foreign workers will choose to locate in Area 1. Equation (A.7), evaluated for $c=1$, will take the following form:

$$(1-u_1) \cdot \left[n_1^u + m\right] = \frac{\beta}{w^u} \left[\frac{\overline{\ell}_1 \cdot r_1}{1 - \mu(\alpha + \beta)}\right], \tag{A.10}$$

while the corresponding equation for Area 2 remains unchanged. Thus, the ratio between unskilled *native* populations will now be equal to:

$$\frac{n_1^u}{n_2^u} = \frac{\overline{\ell}_1}{\overline{\ell}_2} \cdot \frac{r_1}{r_2} \cdot \frac{(1-u_2)}{(1-u_1)} - \left(\frac{m}{n_2^u}\right) \tag{A.11}$$

Expression (A.11) shows that migration ($m>0$) reduces the relative presence of unskilled native workers in the advantaged region.

A.3 Share-altering technical change: derivation of the results

Share-altering technical change that leaves TFP unaffected generates the following production function:[23]

$$Y_c = A_Y(Q_c) \cdot L_c^{1-\alpha-\beta} \cdot \left(N_c^s\right)^{\alpha+\Delta} \cdot \left(N_c^u\right)^{\beta-\Delta} \tag{A.12}$$

Individual firms will find it profitable to adopt technology (A.12) when the following condition holds:

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[23] Notice that the production function (A.12) implies that the ratio of the marginal productivity of skilled labour to the marginal productivity of other factors (unskilled labour, land) is increasing in Δ. Thus, this form of technical change is consistent with Acemoglu's (2002) definition of skill-biased technical change.

$$\frac{\partial Y_c}{\partial \Delta} = Y_c \cdot \log\left(\frac{N_c^s}{N_c^u}\right) > 0 \qquad (A.13)$$

Condition (A.13) is satisfied whenever $\frac{N_c^s}{N_c^u} = \frac{n_c^s}{(1-u_c) \cdot n_c^u} > 1$, that is, when production in

Area c is relatively skilled-labour intensive. This conclusion has potentially significant implications. Suppose that Area 1 has ratio between skilled and unskilled individuals of more than 1, and Area 2 of less than 1. Then, firms that locate in Area 1 will find it profitable to implement the new technology (A.12), with $\Delta > 0$, while firms locating in Area 2 will stick to the original technology (12).

In what follows, we first consider the impact of this share-altering technological change on wage, rent and unemployment differentials. In doing this, we work out the comparative statics results for $\Delta \approx 0$, that is, starting with the same production function in both areas. Moreover, when exploring the effect of a change in the share of skilled workers in Area 1, we will evaluate the results for an initially given N_1^s / N_1^u ratio, which is equal to the constant Σ_0. The constant Σ_0 must be greater than 1, so as to satisfy the condition (A.13) for the adoption of the new technology.

Suppose that condition (A.13) is satisfied for Area 1 (so the share-altering technology is adopted), but not for Area 2, which thus continues to use the old technology. Under perfect competition in tradable goods production, price (the *numeraire*) equals marginal cost, implying that firms locating in Area 1 will respect the following condition:

$$\vartheta' \left[\frac{A_Y(Q_1)}{r_1^{1-\alpha-\beta} \cdot \left(w_1^s\right)^{\alpha+\Delta} \cdot \left(w^u\right)^{\beta-\Delta}} \right] = 1, \qquad (A.14)$$

where $\vartheta' \equiv (1-\alpha-\beta)^{1-\alpha-\beta}(\alpha+\Delta)^{\alpha+\Delta}(\beta-\Delta)^{\beta-\Delta}$. For competitive firms locating in Area 2, the condition:

$$\vartheta \cdot \left[\frac{A_Y(Q_2)}{r_2^{1-\alpha-\beta} \cdot \left(w_2^s\right)^{\alpha} \cdot \left(w^u\right)^{\beta}} \right] = 1 \qquad (A.15)$$

will continue to hold. Free mobility implies that, in equilibrium, firms must make zero profit no matter where they choose to locate. Thus, by combining (A.14) and (A.15), one obtains:

$$\frac{r_1}{r_2} = \left[\left(\frac{(\alpha+\Delta)^{\alpha+\Delta}(\beta-\Delta)^{\beta-\Delta}}{\alpha^\alpha \beta^\beta} \right) \cdot \left(\frac{A_Y(Q_1)}{A_Y(Q_2)} \right) \cdot \left(\frac{w_2^s}{w_1^s} \right)^\alpha \cdot \left(\frac{w^u}{w_1^s} \right)^\Delta \right]^{\frac{1}{1-\alpha-\beta}} \qquad (A.16)$$

Equations (A.16) and (16), the free-mobility condition for skilled workers, deliver the equilibrium skilled wage ratio between Area 1 and Area 2:

$$\log\left(\frac{w_1^s}{w_2^s}\right) = \frac{1-\mu}{1-\beta-\alpha\mu} \left\{ \begin{array}{l} \left[(\alpha+\Delta)\log(\alpha+\Delta)+(\beta-\Delta)\log(\beta-\Delta)-\log(\alpha^\alpha\beta^\beta)\right]+\Delta\cdot\log\left(\frac{w^u}{w_1^s}\right)+ \\ +\log\left(\frac{A_Y(Q_1)}{A_Y(Q_2)}\right)+\frac{1-\alpha-\beta}{1-\mu}\left[\log\left(\frac{A_U(X_2)}{A_U(X_1)}\right)+\log\frac{B_U(Z_2)}{B_U(Z_1)}+\kappa^s\right]+ \end{array} \right\} \qquad (A.17)$$

where it holds that $\left(\dfrac{w^u}{w_1^s}\right) = \dfrac{\beta}{\alpha}\dfrac{N_1^s}{N_1^u}$. Differentiating (A.17) with respect to Δ, and evaluating

the result for $\Delta \approx 0$ and $\dfrac{N_1^s}{N_1^u} = \Sigma_0 > 1$, one obtains:

$$\frac{d\log\left(\dfrac{w_1^s}{w_2^s}\right)}{d\Delta} = \left(\frac{1-\mu}{1-\beta-\alpha\mu}\right)\cdot\log\Sigma_0 \qquad (A.18)$$

Since $\Sigma_0 > 1$, the sign of expression (A.18) is positive. Thus, localized skill-biased technical change will increase relative skilled wages in Area 1.

Consider now the impact of the shift in the share of the skilled on the rent ratio. Taking the logs of (A.16) and exploiting (A.17), one obtains the following expression for the rent ratio:

$$\log\left(\frac{r_1}{r_2}\right) = \left[1-\beta-\alpha\mu\right]^{-1}\left\{\begin{array}{l}\left[(\alpha+\Delta)\log(\alpha+\Delta)+(\beta-\Delta)\log(\beta-\Delta)-\log\left(\alpha^\alpha\beta^\beta\right)\right]+\Delta\cdot\log\left(\dfrac{w^u}{w_1^s}\right)+\\[2mm]+\log\left(\dfrac{A_Y(Q_1)}{A_Y(Q_2)}\right)-\alpha\cdot\left[\log\left(\dfrac{A_U(X_2)}{A_U(X_1)}\right)+\log\left(\dfrac{B_U(Z_2)}{B_U(Z_1)}\right)+\kappa^s\right]\end{array}\right\} \qquad (A.19)$$

By differentiating (A.19) with respect to Δ, and evaluating the result for $\Delta \approx 0$ and $\dfrac{N_1^s}{N_1^u} = \Sigma_0 > 1$, one obtains:

$$\frac{d\log\left(\dfrac{r_1}{r_2}\right)}{d\Delta} = \left(\frac{1}{1-\beta-\alpha\mu}\right)\cdot\log\Sigma_0 > 0 \qquad (A.20)$$

Thus, an increase in the skilled share ($\Delta > 0$) increases both relative rents and skilled wages in the area where the share-altering technology is implemented.

The impact of this kind of technological change on unemployment differentials is immediate. The increase in the skilled share widens the unemployment gap. Indeed, exploiting (18), one obtains:

$$\frac{d[u_2-u_1]}{d\Delta} = (1-\mu)\cdot\frac{d\log\left(\dfrac{r_1}{r_2}\right)}{d\Delta} > 0 \qquad (A.21)$$

The analysis of share-altering technological change can be extended to consider equilibrium populations in the different areas. First, we analyze the impact of skill-biased share-altering technological change on the relative size of the skilled population. In Area 1, skilled population is now given by:

$$n_1^s = \frac{\alpha+\Delta}{w_1^s}\left[\frac{\bar{\ell}_1\cdot r_1}{1-\mu(\alpha+\beta)}\right] \qquad (A.22)$$

while for Area 2 equation (A.6) still holds. Hence, with share-altering technical change, the skilled-population ratio is given by:

$$\frac{n_1^s}{n_2^s} = \frac{\alpha + \Delta}{\alpha} \cdot \frac{\overline{\ell}_1}{\overline{\ell}_2} \cdot \frac{r_1}{r_2} \cdot \frac{w_2^s}{w_1^s} \tag{A.23}$$

Taking the logs of (A.23), differentiating with respect to Δ, and calculating the resulting expression for $\Delta \approx 0$, one obtains:

$$\frac{d \log\left(\frac{n_1^s}{n_2^s}\right)}{d\Delta} = \left(\frac{1}{\alpha}\right) + \frac{d \log\left(\frac{r_1}{r_2}\right)}{d\Delta} - \frac{d \log\left(\frac{w_1^s}{w_2^s}\right)}{d\Delta} = \frac{1}{\alpha} + \frac{\mu}{1 - \beta - \alpha\mu} \cdot \log \Sigma_0 > 0 \tag{A.24}$$

Thus, a local skill-biased technological change will generate a relative increase in the skilled population of that area. As we show in what follows, for the unskilled the opposite generally holds.

In Area 1, unskilled population is given by

$$n_1^u = \frac{\beta - \Delta}{(1 - u_1) \cdot w^u} \left[\frac{\overline{\ell}_1 \cdot r_1}{1 - \mu(\alpha + \beta)} \right] \tag{A.25}$$

while for Area 2 equation (A.7) still holds. Hence, the unskilled-population ratio is equal to:

$$\frac{n_1^u}{n_2^u} = \frac{\beta - \Delta}{\beta} \cdot \frac{\overline{\ell}_1}{\overline{\ell}_2} \cdot \frac{r_1}{r_2} \cdot \frac{(1 - u_2)}{(1 - u_1)} \tag{A.26}$$

Differentiating the log of (A.26) with respect to Δ and calculating the result for $\Delta \approx 0$, one obtains:

$$\frac{d \log\left(\frac{n_1^u}{n_2^u}\right)}{d\Delta} = \frac{-1}{\beta} + \frac{d \log(r_1 / r_2)}{d\Delta} - \frac{d(u_2 - u_1)}{d\Delta} = \frac{-1}{\beta} + \frac{\mu}{1 - \beta - \alpha\mu} \cdot \log \Sigma_0 \tag{A.27}$$

The sign of expression (A.27) is ambiguous, in principle. In practice, though, plausible values of parameters generally imply that such a type of technological change will reduce the relative size of the unskilled population in Area 1[24].

Expressions (A.24) and (A.27) can be exploited to find the effect of the skilled-biased share change on the relative *skill mix* of the two areas.[25] Thus:

$$\frac{d\left[\log\left(\frac{n_1^s}{n_1^u}\right) - \log\left(\frac{n_2^s}{n_2^u}\right) \right]}{d\Delta} = \frac{1}{\alpha} + \frac{1}{\beta} > 0 \tag{A.28}$$

As is claimed in the text, expression (A.28) shows that a localized skilled-biased share-altering technical change will lead to an increase in the skilled-unskilled ratio within the

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[24] With $\mu=2/3$ and $\alpha=\beta=1/3$, expression (A.27) is negative when $\log \Sigma_0 < 2$; when instead $\alpha=4/9$ and $\beta=2/9$, (A.27) is negative when $\log \Sigma_0 < \frac{13}{4}$. Thus, if $(\log \Sigma_0) > 0$ is not very large, this derivative will have a negative sign.

[25] Indeed, it holds that $d\left[\log\left(n_1^s / n_2^s\right) - \log\left(n_1^u / n_2^u\right)\right] / d\Delta = d\left[\log\left(n_1^s / n_1^u\right) - \log\left(n_2^s / n_2^u\right)\right] / d\Delta$.

region. This conclusion has a relevant implication. When Area 1 adopts skilled-biased share-altering technologies (*i.e.*, condition (A.13) is satisfied), later on it will be ready to adopt additional technological advances of the same kind, whereas if the innovations could not be profitably adopted in Area 2, this region will remain stuck with the old technology. And this implies that output will grow in Area 1, while Area 2 stagnates[26].

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[26] See also Seater (2005).

Appendix B

An application of Roback's model to migration flows

The equilibrium condition for workers' mobility in our model summarizes the main determinants of the decision to stay or migrate from one area to the other. In this section we build on this equilibrium condition to compute an empirical indicator of the economic gain, or cost, of migration, following the empirical literature inspired by Roback's seminal work.

Equation (4) of the model implies that, in equilibrium, nobody migrates and the utility of workers, gross of migration costs, is the same in the two regions. In particular, it holds that (4):

$$v_1 = (1 + \kappa) \cdot v_2$$

Using the utility level achieved in the more developed area, region 1, to normalize, the utility in region 2 can be rewritten as:

$$v_2 = 1/(1 + \kappa) \tag{B.1}$$

Using the expressions from (3) to substitute into (B.1), we obtain the following:

$$v_2 = \eta \cdot A_U(X_2) \cdot \frac{w_2}{r_2^{1-\mu}} = 1/(1 + \kappa) \tag{B.2}$$

If one allows the unemployment rate to be positive and different across areas, as for example in equation (17), condition (B.2) can be rewritten as:

$$v_2 = \eta \cdot A_U(X_2) \cdot \frac{(1 - u_2) \cdot w_2}{r_2^{1-\mu}} = 1/(1 + \kappa) \tag{B.3}$$

The utility of a worker living in Area 2 depends on the expected income $I = (1 - u_2) \cdot w_2$, namely the wage w_2 times the probability of finding a job, which is equal to 1 minus the unemployment rate in the region, $q = (1 - u_2)$. The utility of a resident also depends on the local endowment, X_2, of amenities, $A_U(X_2)$, and on the cost of land r_2, which can be considered as a proxy for the price of non-tradable goods. Whenever the left-hand side of this equation is strictly *lower* than the constant term on the right-hand side, workers will tend to move to region 1.

There is a large literature that exploits an equation like (B.3) to estimate the value of local characteristics whose value is not directly observable in the market. This strategy analyzes the impact of local characteristics on observable market prices. To see how this can be done, notice that the equilibrium values of any of the terms entering the indirect utility function v_2 depend on the endowment X_2. By totally differentiating v_2, one obtains:[27]

$$V_{2I} \cdot q \cdot dw + V_{2I} w \cdot dq + V_{2r} \cdot dr + V_{2X} \cdot dX = 0, \tag{B.4}$$

which can be rewritten as:

$$\frac{V_{2X}}{V_{2I}} \equiv p_X = -\frac{V_{2r}}{V_{2I}} \frac{dr}{dX} - q \frac{dw}{dX} - w \frac{dq}{dX}. \tag{B.5}$$

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[27] We drop the Area 2 sub-index from variables when not strictly necessary.

Using the Roy identity, we obtain:

$$\frac{V_{2X}}{V_{2I}} \equiv p_X = L\frac{dr}{dX} - q\frac{dw}{dX} - w\frac{dq}{dX}, \tag{B.6}$$

where L is the quantity of non-tradable goods demanded. Dividing both sides by w this can be rewritten as follow:

$$\frac{p_X}{w} = \frac{rL}{w}\frac{d\log r}{dX} - q\frac{d\log w}{dX} - \frac{dq}{dX} \tag{B.7}$$

Equation (B.7) expresses the value of local amenities, X_2, in terms of the local wage w_2. Once the terms on the right-hand side of (B.7) are estimated, we can recover the monetary value of local amenities, X_2. In the empirical literature, the price of housing is used as a proxy for the price of non-tradable goods. The impact of X on local wages and on the price of non-tradable goods is obtained by augmenting conventional wage and rent regressions with the characteristics of the area (see Blomquist, Berger, Hoehn, 1988). Alternatively, one can augment such regressions with territorial dummies that are supposed to capture the impact of X on w, q, and r (see Gabriel and Rosenthal, 2004). This latter approach is empirically convenient, since it is less demanding in terms of information and not affected by unobservable local characteristics or by the lack of information on potentially relevant variables. However, territorial dummies are likely to capture the effects of variables other than local amenities, such as transportation or migration costs.

Empirical strategy

Following Gabriel and Rosenthal (2004), we estimate a wage equation controlling for workers' individual characteristics in order to gauge the effect of regional characteristics. We also estimate a housing price equation, in order to get the cost differential for non-tradable goods, and the regional differential in the probability of finding a job. These estimates give the elements for computing the right-hand side of equation (B.7). However, we differ from Gabriel and Rosenthal's interpretation of the empirical findings in two ways. First, we believe that migration costs are significant so that territorial dummies are likely to capture the *joint* impact of local amenities, X_2, *and* mobility costs, k. Second, we believe that regions are observed out of equilibrium, so that an estimate of the right-hand side of equation (B.7) gives a measure of the monetary cost, or gain, of living in the disadvantaged area, in terms of wages, probability of finding a job and price of non-tradable goods. This cost, or gain, will reflect the value that residents in Area 2 attach to amenities X_2, the cost of moving from Area 2 to Area 1, and the fact that regions are observed out of the equilibrium. That is, our estimates will also reflect a utility gap between Area 1 and Area 2 not yet arbitraged away by migration. As long as the differences in amenities and in migration costs remain fairly constant over time, the variation over time of the estimate of the right-hand side of (B.7) will mainly reflect the magnitude of the relative advantage (or cost) of migrating.

We exploit the Bank of Italy Survey on Households Income and Wealth to estimate wage and housing price differentials:

$$\log w_i = \lambda_2 + \beta s_i + \varepsilon_i$$

$$\log r_i = \delta_2 + \gamma z_i + \eta_i;$$

and Istat's labour force surveys to estimate the regional differential in probability of finding a job:

$$q = f\left(\phi_2 + \varphi n_i + u_i\right).$$

Table 1

Wage equations: South dummy estimates

	Total employment	< 35	< 35 unskilled	< 35 skilled
1993	−10.4	−14.7	−9.1	−19.2
1995	−11.5	−17.6	−14.6	−20.4
1998	−13.4	−19.3	−16.0	−23.5
2000	−12.9	−16.8	−17.0	−15.0
2002	−10.3	−9.4	−11.8	−7.9
2004	−13.0	−15.0	−14.1	−14.8
2006	−14.0	−14.7	−15.9	−11.6

$\varepsilon_i, \eta_i, u_i$ are i.i.d error terms, *s, z, n* are standard covariates and $\lambda_2, \eta_2, \phi_2$ are the regional dummies of interest, assumed to capture the impact of living conditions in the South on local wages, housing prices and the probability of finding a job.

As for labour market variables, we consider four groups of workers: total labour force, young workers (under 35), young unskilled workers (under 35 and no high school), young skilled workers (under 35 and with a high school education or more). We focus on young workers because migrants are mostly young. The distinction between skilled and unskilled workers reflects the intention of determining whether there are significant differences between these two groups, as our formal model predicts.

The Bank of Italy Household Income Survey is conducted every other year, with the exception of the 1998 edition, which followed that of 1995. We consider the period 1993-2006: 1993 is the first year for which micro-data from the labour force surveys are available, and 2006 is the latest Household Income and Wealth survey available.

We first estimate, year by year, a standard Mincerian equation. We regress log-monthly wages on a second-order polynomial of potential experience (age minus years of education), a sex dummy, a part-time job dummy, a set of education dummies, and a regional dummy denoting Southern workers, which is the variable of interest.

The log-wage differential is higher for younger workers and shows no clear trend. For young workers, skilled or unskilled, the regional differential was somewhat greater in the 1990s than after the turn of the century; but whereas in the 1990s the differential was greater for skilled workers, in this decade the opposite seems to be true.

For the probability of finding a job, we estimate a Heckprobit on a yearly basis: that is, the probability of finding a job controlling for the selection due to the participation choice. We adopt a specification similar to Ciccone, Cingano and Cipollone, (2004), including a sex dummy, a second-order polynomial of potential experience, a set of dummies for education, a dummy for student and a dummy for university student. In the selection equation, this set of variables was augmented with a dummy for married workers and the interaction between the dummies for sex and marital status.

Table 2

Probability of finding a job: South dummy estimates

	Total employment	**< 35**	**< 35 unskilled**	**< 35 skilled**
1993	−8.8	−16.8	−16.9	−17.1
1995	−11.2	−20.3	−20.4	−20.3
1998	−12.8	−22.3	−23.1	−21.6
2000	−13.0	−23.4	−24.3	−22.3
2002	−11.7	−22.0	−22.7	−20.7
2004	−11.4	−21.7	−22.6	−20.2
2006	−8.9	−18.6	−19.2	−17.6

Table 3

Probability of working

	Total employment		< 35		< 35 unskilled		< 35 skilled	
	South	C-N	South	C-N	South	C-N	South	C-N
1993	84.6	92.2	69.4	83.0	69.3	82.5	66.7	82.6
1995	79.9	91.2	61.8	82.3	63.5	83.0	57.2	80.1
1998	77.8	91.5	58.8	83.2	58.6	82.9	57.9	82.9
2000	79.5	93.4	61.5	87.1	59.9	85.8	62.4	87.7
2002	82.2	94.1	66.0	88.5	63.3	86.3	69.8	91.1
2004	83.1	94.5	67.8	89.5	64.5	87.1	71.4	91.6
2006	86.2	95.1	71.2	89.8	69.6	88.8	73.1	90.7

The regional differential in the probability of finding a job is much higher for younger workers: it increased in the second half of the 1990s and declined after the beginning of the current decade. The regional differential is even wider for unskilled workers. Table 3 reports the probability of finding a job in the South and in the Centre-North. In the South, during the 1990s, employment probability deteriorated more for young unskilled than skilled workers, and the recovery that started with the beginning of this decade has been more pronounced for the skilled.

Last we estimate an equation for the cost of renting a house, considering both effective rents and imputed rents, *i.e.* rental value as assessed by homeowners themselves. The Bank of Italy survey collects a comprehensive set of data on the house and its location, allowing us to estimate a hedonic price and the regional differential we are interested in. The equation includes house size

Table 4

Rent equation: South dummy estimates

	Rent differential
1993	−14.3
1995	−15.5
1998	−32.1
2000	−41.5
2002	−45.7
2004	−43.7
2006	−37.0

Table 5

Relative cost of staying in the South relative to the North

	Total employment	< 35	< 35 skilled	< 35 unskilled
1993	−12.2	−21.5	−17.7	−24.8
1995	−14.5	−25.2	−22.7	−27.5
1998	−11.0	−21.5	−18.7	−24.7
2000	−7.5	−18.0	−17.1	−17.5
2002	−2.8	−10.9	−11.6	−10.4
2004	−5.6	−15.3	−13.7	−15.6
2006	−6.9	−15.0	−15.2	−13.2

and square of size, house age, quality class, the size of the municipality, the house location (downtown, outskirts, etc.) and its quality (high-value or low-value suburb), type of heating plant, number of bathrooms, type of contract (for instance, administered or market price), owner (individual, private company, non-profit entity, government, etc.), a dummy for actual or imputed rent, and finally the South dummy we are interested in.

Having obtained these estimates, we take the rent differential as a proxy for the non-tradable price differential, and compute the right-hand side of equation (B.7). According to the consumption survey, non-tradables represent 38 per cent of total consumption in the South. Therefore we set $rL/w = 0.38$, while q is the probability of finding a job in the South.

This implies that, in 2006, given that $\dfrac{d \log r}{dX} = -37.0$ percent; $q = 0.86186$;

Figure B1

Total labour force

Labour force under 35

Under 35, skilled

Under 35, unskilled

--- Expected income   ····· Cost of living   —— Index
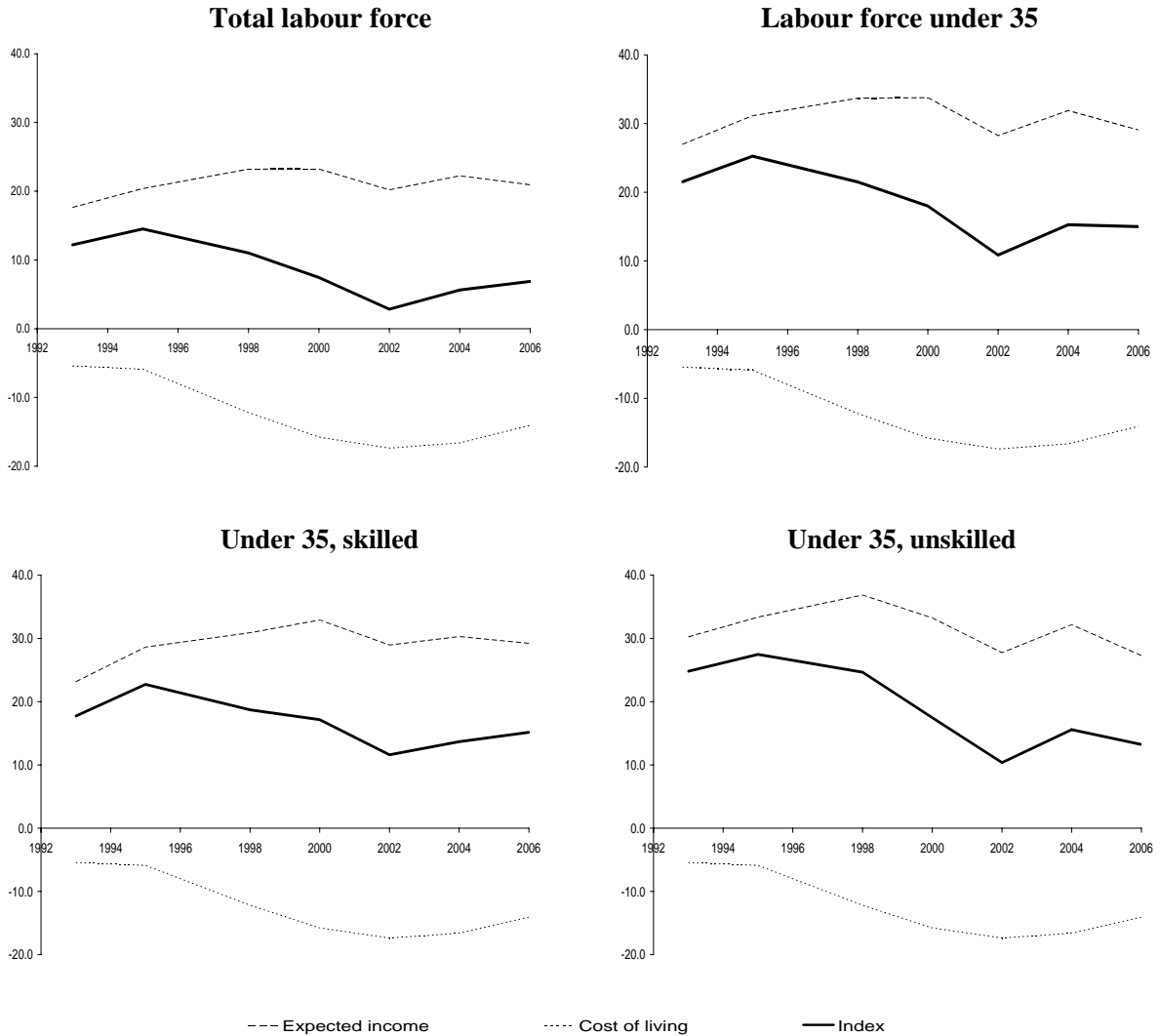
$\dfrac{d \log w}{dX} = -14$ percent; and $\dfrac{dq}{dX} = 8.883$ percentage points, our indicator is equal to:

$$-0.38 \cdot 37.0 + 0.86184 \cdot 14 + 8.883 = -6.9 \text{ percent}$$

According to Table 5, the relative cost of staying in the South (that is, the relative advantage of migrating to the Centre-North) is substantially higher for young workers, but it has declined since the turn of the decade, mainly because of a widening gap in the cost of living, as proxied by the housing prices, and narrowing unemployment rate differentials. This drop has been particularly pronounced for young unskilled workers, as shown in Figure B1.

The pattern of the index is roughly consistent with migration flows in recent years. As Figure B2 shows, the net outflow of workers from South to Centre-North increased during the 1990s and declined somewhat during the first half of the present decade. There is also evidence that an increasing share of migrants are skilled, university-educated workers. Their share of net outflows rose from 1.5 per cent in 1990 to 7.3 per cent in 2000 and held stable in 2001, 2002 and 2003 (6.7 per cent).

Migration flow from South to Centre-North
(thousands)

Outflow   Inflow   Net outflow(right axis)
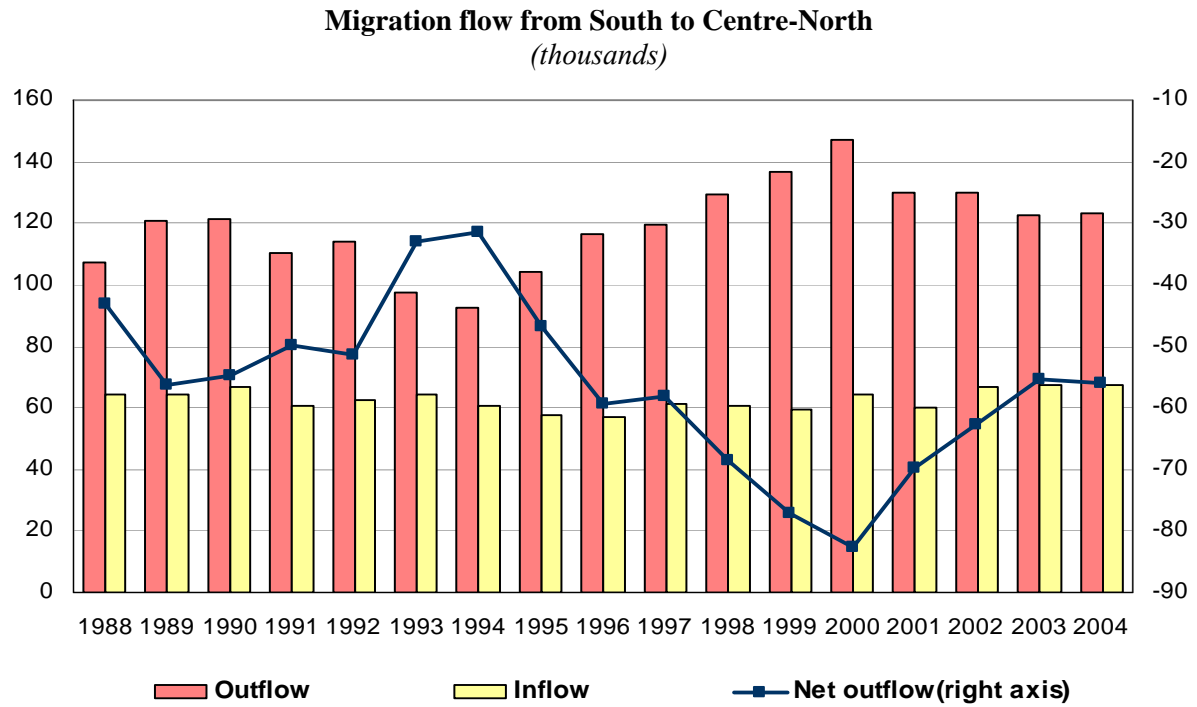
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