doi:10.1111/pirs.12251

Internal migration in a developing country: A panel data analysis of Ecuador (1982–2010)*

Vicente Royuela[1], **Jessica Ordóñez**[2]

[1] AQR-IREA Research Group, Universidad de Barcelona, Avda Diagonal 690, 08034 Barcelona, Spain (e-mail: vroyuela@ub.edu)
[2] Departamento de Economía, Universidad Técnica Particular de Loja, 11–01–608, San Cayetano Alto, Loja, Ecuador (e-mail: jordonezx@utpl.edu.ec)

Received: 21 September 2015 / Accepted: 14 July 2016

Abstract. In this paper, we examine determinants of internal migration flows between the 21 provinces of Ecuador from 1982 to 2010. Using specifications based on the gravity model, we identified push and pull factors. We considered multilateral resistance to migration by using various monadic and dyadic fixed effects structures. The study confirmed the concentration of the population in the two provinces that contain the country's main cities. However, in recent years, this trend has weakened, to the extent that the provinces with the greatest influx of migrants are not necessarily the most populated. This indicates that growth has become more balanced throughout the territory, and that small and medium-sized cities are increasingly important.

JEL classification: J61, J62, O15

Key words: Ecuador, gravity model, internal migration, urban development

1 Introduction

International migration has been the focus of much media and academic attention for many years. However, internal migration continues to be enormously important due to its volume and its impact on population distribution within countries (World Bank 2009). In 2010, 51 per cent of the world's population lived in urban areas, 37 per cent of which inhabited urban areas with populations greater than 1 million. In 1960, that proportion was 39 per cent. Consequently, urbanization can be seen not only as a megacity phenomenon, but also as a process in which small and median cities increasingly matter. Changes in the distribution of urban population are the result of vegetative population growth and migration flows. The former has clearly decreased over time: between 1960 and 1970 the world's population increased at a 2 per cent annual growth rate, while between 2000 and 2010 the growth rate was just 1.2 per cent. This trend leaves a stronger role for migration flows to shape the distribution of population in space

* Vicente Royuela acknowledges the support of ECO2013-41022-R. Jessica Ordóñez acknowledges the support of the research grant provided by the Ecuadorean Secretaría de Educación Superior, Ciencia, Tecnología e Innovación.

within every country. This paper focuses on an analysis of internal migration flows, considering if and how urbanization has changed its role in push and pull factors for population mobility.

The size and intensity of migration flows depend on circumstances in the place of origin, which could be push factors, and those in the destination, which could be pull factors. Migrants subjectively evaluate economic, psychological, and social reasons for moving (Todaro 1980). Faggian et al. (2015) review regional science contributions on interregional migration determinants. One of the key aspects is migration's role as automatic stabilizer of utility over space. Nevertheless, permanent differentials hold in the long term due to place specific characteristics, including climatic conditions and natural and social endowments or due to the stability of variables such as the availability of housing, which contributes to reducing migration flows and the rate of convergence. There is wide evidence of migration responding to utility differentials (Hunt 2006; Biagi et al. 2011; Etzo 2011) and to natural amenities – place specific factors (Partridge et al. 2008; Faggian et al. 2012).

As Barro and Sala-i-Martín (1991, 1992) argue, the expected consequence of labour flows is territorial convergence, to the extent that differences in income and employment opportunities are tempered and the initial equilibrium is restored. If salaries and the marginal product of capital are inversely related, population flows are accompanied by capital flows, which accelerate the process. Such economic convergence can take place with or without territorial concentration of economic activity. As stressed in the 2009 World Development Report, territorial concentration and urban agglomeration matters: 'an important insight of the agglomeration literature – that human capital earns higher returns where it is plentiful – has been ignored by the literature of labour migration' (World Bank 2009, p.158). At the same time, several OECD reports (2009a, 2009b, 2009c) have found that growth opportunities are significant in both large and small urban areas. Following Barca et al. (2012), 'mega-urban regions are not the only possible growth pattern […] context and institutions do matter when we consider economic geography'. Finally, as Duranton and Puga (2000) argue, what matters is the efficiency of the overall 'system of cities' and 'there appears to be a need for both large and diversified cities and smaller and more specialized cities'.

This debate is key to the design of all economic and social policies. It is also essential to know the causes and conditions that influence migration decisions in order to anticipate the consequences in terms of economic progress. The size and intensity of migration flows depend on circumstances in the place of origin, which could be push factors, and those at the destination, which could be pull factors. Migration contributes to increase urbanization while making cities much more diverse places (IOM 2015).

In this introduction, we focused on world trends and global policy discussions. This paper, though, focuses on internal migration in a single country, Ecuador. Our work contributes to the empirical literature on interregional migration by analysing a small, open, developing country. Ecuador has specific circumstances that make it an interesting case study. Ecuador is situated in one of the more urbanized areas in the world: South America. Out of the 22 world sub-regions,[1] South America represents the part of the developing world where urbanization is among the highest (84% in 2010, only below Northern Europe and Australia & New Zealand, two developed world sub-regions). As in many other places in the world, the weight of large cities over total urbanization has decreased, from 47 per cent in 1960 to 45 per cent in 2010. Indeed, in 2010, 46 per cent of all inhabitants lived in urban areas of small or median cities (less than 1 million inhabitants). Ecuador has one of the lowest urbanization rates in South America, only above Guyana, Paraguay and Bolivia. Even though this figure has risen very fast in the last 50 years, this speed has been lower in larger cities: the proportion of urban population

[1] The classification of geographical regions corresponds to the United Nations Geoscheme, which can be accessed at http://unstats.un.org/unsd/methods/m49/m49.htm.

in cities above 1 million inhabitants represented 52 per cent of the total Ecuadorean urban population in 1960. In 2010, this proportion was about 47 per cent. Consequently, Ecuador represents a case in which the process of urbanization is taking place with a strong emphasis on small and medium cities.[2] Still, persistent territorial inequalities exist. Despite being a small country of around 16 million inhabitants, Ecuador has only two main cities: Guayaquil and Quito. As the rate of urbanization stands considerably lower than that of neighbouring countries, the process of internal migration is ongoing, and the proportion of the population that lives in cities is expected to increase in the future. Finally, around 10 per cent of the population of Ecuador has emigrated, which has had a considerable impact on internal population flows.

In this study, we adopt a random utility maximization (RUM) theoretical model, based on differences in economic expectations between the provinces of origin and destination. We use census data from 1974 to 2010 to propose and estimate a model of interregional migration, considering various key factors: population, distance, production structure, and urbanization. We also control for factors that affect the selectivity of migration, such as age structure or level of education. Finally, we calculate a set of models, including a series of monadic and dyadic fixed effects, which enables us to control various expressions of multilateral resistance to migration. In addition to confirming the importance of a sector's structure on migration flows, we observe that population flows are to the most populated provinces, but the pace of concentration drops gradually over time. If this trend is confirmed, we can state that there is a process of territorial balance in Ecuador, in which the growth of cities in provinces is balancing the territory.

The next section presents the case study of migration between Ecuadorian provinces. Section 3 describes the theoretical framework of reference and defines the empirical specification. The results of the calculations are given in Section 4, and Section 5 contains an analysis of the sensitivity and robustness of the calculations. The paper ends with the main conclusions of the study and some policy recommendations.

2 Internal migration in Ecuador

2.1 Economic and social context

Ecuador is the eighth largest economy in Latin America (LA). The country is divided into 24 provinces,[3] grouped into four geographical macro-regions: the Coast, the Andes, the Amazon, and Islands (Fig. 1). The average growth in GDP in the last 50 years was 4 per cent, and there has been a combination of deep recessions (the last one was in 1999) and strong periods of expansion (12% a year between 1973 and 1976; 8% in 2004 and 2011). Since 2000, the country has grown at a rate of 4.5 per cent per year (World Bank 2016). In addition to oil revenue, remittances from emigrants represented 2.3 per cent of GDP in 2014 – an amount similar to the total revenue from non-oil exports (CEPAL 2005). Table 1 provides an international comparison of some of the country's social and economic indicators.

The Ecuadorian labour market had an unemployment rate of around 4 per cent in 2014, although around 50 per cent of the active population worked in the informal sector (Instituto Nacional de Estadísticas y Censos - INEC 2015). Those in employment work mainly in the

[2] Among the other countries with low (below 80%) urbanisation rates in South America, only Paraguay and Ecuador experienced a decrease in the importance of the largest cities, while in Peru, Colombia, and especially Bolivia, the largest cities have grown substantially more than the other cities. Both Guyana and Surinam have no cities above 1 million inhabitants.

[3] Ecuador has 24 provinces, 221 cantons, and 1,149 parishes. While we acknowledge that more detailed data could improve our results, for instance looking at a more recent census with information on migration flows between cantons, we opted to work with province-level data in order to enlarge the analysed periods.

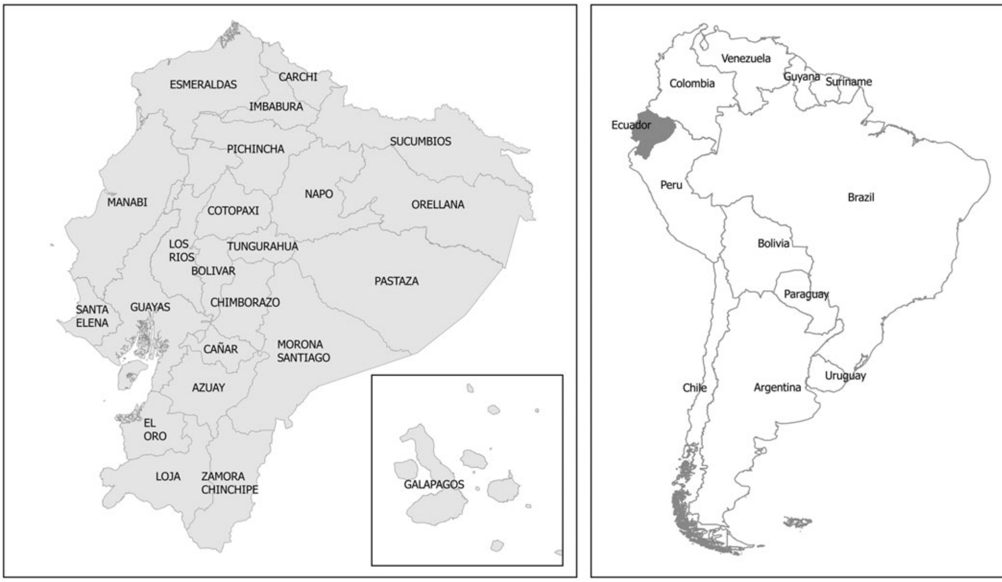

Fig. 1. Ecuador in Latin America
Source: Compiled by the author based on information from the *Instituto Geográfico Militar* (IGM) (2012).

tertiary and primary sectors (between 1990 and 2010, employment in primary activities dropped by close to 10%), and 31 per cent of the population lives in conditions of extreme poverty.[4] Inequality is high and has varied very little in the last 20 years.[5]

There is considerable disparity in Ecuador at the regional level. Four provinces are home to 62 per cent of the total population and 70 per cent of the economic activity (BCE 2014; INEC 2014): Pichincha (where the capital, Quito, is situated) and Azuay in the Andes; Guayas (where the capital is Guayaquil, the largest city in Ecuador); and Manabí on the coast. The poorest provinces are Bolívar (the Andes), Los Ríos and Esmeraldas (the coast), and Napo (the Amazon). In 2010, the economies of Pichincha and Guayas were specialized in the service sector, while in small and medium-sized provinces, such as Cañar, Cotopaxi, Chimborazo, Napo, and Sucumbíos, the main employment (almost 50% of the population) was in agriculture. The secondary sector was strongest in the provinces of Azuay, Imbabura, Loja, and Zamora Chinchipe.

2.2 Distribution of the population and internal migration in Ecuador

Between 1950 and 2010, the population of Ecuador increased fivefold: the urban population expanded tenfold, the rural population twofold, and the rate of urbanization increased from 29 per cent to 63 per cent. In 2010, the most urbanized provinces were the Galápagos, Guayas, El Oro, and Pichincha. Between 1982 and 2010, Pichincha and Guayas gained importance: they housed 42 per cent of the population between them in 1982 and 48 per cent in 2010. This indicates that a process of urban concentration has taken place alongside the urbanization process in the country. However, more recently, the rate of growth of these two provinces has slowed noticeably,

[4] The System of Social Indicators of Ecuador (SIISE 2014) considers that a person is in extreme poverty if he or she meets two or more of the following conditions: (*i*) Their dwelling has inadequate physical characteristics; (*ii*) Their dwelling has inadequate sanitary systems; (*iii*) The household has high economic dependence; (*iv*) There is a child (or children) in the household who does not go to school; and (*v*) The dwelling is in a critical state of overcrowding.

[5] The poorest tenth of the population received 1.86% and 1.85% of the national income between 1988 and 2012, while the richest tenth received 34.1% and 33.7% in the same period.

Table 1. International comparison of Ecuador's social and economic indicators

Indicators	Ecuador	Brasil	Colombia	México	Perú
GDP *per capita* (2014, PPP U.S. $)	6,346	11,384	7,904	10,326	6,541
Gini index (2013) %	43.7	52.9	53.5	48.1	44.7
Unemployment rate % (2014)	4,6	6,8	10,1	4,9	4,2
Urban populations % (2014)	64	85	76	79	78
Recent interregional migration[a] (2001)	5,24	3,39	8,1 [b]	4,4 [c]	8,6 [b]

Sources: World Bank (2016) and [a]Rodríguez Vignoli (2004); [b]Calls for 1993 data; and [c]for 2000.

while the population grew above the average rate in some Amazonian provinces; the 11 provinces with the lowest population (mainly Amazon) together housed 12.4 per cent of the total population in 1982, compared to 12.1 per cent in 2010. In other words, these provinces have hardly decreased in relative importance. In fact, between 2001 and 2010, the relative importance of this group of provinces increased compared to the national situation overall. The drop in the rate of concentration of population is notable and demonstrated by the lower migration rates in 2010 and in the lower rate of growth in Pichincha and Guayas. Consequently, the most populated provinces are not necessarily those that grow most (INEC 2012).

Changes in the relative importance of each province can be explained partly by transformations in the country's production structure. A major downturn in the manufacture and export of Panama hats in the 1950s led to migration to the rural areas of the Coast, the Amazon, and abroad (Espinoza and Achig 1981). In the 1960s, another major migration process occurred due to changes in the agricultural export model (Pachano 1988). The oil boom (the first oilfield was found in 1962) and the 'process of colonization'[6] made the Amazon a new destination for migrants (Guerrero and Sosa 1996). In the 1980s, Ecuador was affected by fluctuations in oil production and exports, natural disasters, and the military conflict with Peru. In 1999, the Ecuadorian economy suffered a serious economic and financial crisis that had severe effects on unemployment and poverty. It led to high emigration to other countries, particularly Spain (Bertoli et al. 2011). In 2000, Ecuador introduced dollarization and a period of economic stability began. Internal migration between provinces decreased, and many emigrants began to return due to the international recession and supportive government policy.

Against this background, we analyse changes in interprovincial migration in Ecuador using census data from 1982 onwards. Censuses can be used to calculate migration rates by comparing the province of residence with the province of birth (permanent migration or stock), and with the province of residence five years before each census (recent migration or flow). While the migrant stock has gradually increased, from 18.5 per cent in 1982 to 20 per cent in 2010, the flow (recent migrants) has fallen from 8.3 per cent in 1982 to 4.7 per cent in 2010. Therefore, there is a decreasing trend in internal migration flows.

The same decreasing trend in internal migration can be found in Latin America (CEPAL 2007) for various reasons. According to Rodríguez Vignoli (2004), the replacement of internal migration by international migration; the increase in daily journeys for work or study, which

[6] Since the beginning of the 21st century, measures have been in place to promote the colonization of these areas of the country. In 1885, the Eastern Province Act entered into force to encourage settlement in the east and to control borders, as Peru was expanding due to rubber activity, which was booming at that time. Among other matters, this Act approved the granting of financial incentives and the free allocation of plots of land to people who moved to the east, as well as various financial benefits for growers of rubber, chincona, coffee, and cacao (Esvertit 2005). At the start of the 1960s, an agreement was reached to recolonize and resettle the east to stimulate the impoverished agricultural sector. At the end of 1959, the government obtained funding from international organizations to support this project. In 1964, the Agricultural and Settlement Act was approved, and the Ecuadorian Institute of Agrarian Reform and Settlement (*Instituto Ecuatoriano de Reforma Agraria,* IERAC) was created to implement the new legislation. The programme involved actions on state properties, followed by semi-public and private properties for social purposes, and finally private properties, and generally followed the FAO's recommendations (González 1983).

eliminate the need to migrate; the increase in home ownership associated with rising incomes; and a slow-down in migration flows from the countryside to the city due to the expansion of urbanization have caused this decreasing trend. Rodríguez Vignoli does not argue that this is due to a process of regional convergence. According to CEPAL (2012), migration between areas in Ecuador continues and is associated with the multipolar economic development of the country and the persistence of chronic poverty in some provinces, which pushes the population to dynamic provinces or those with greater opportunities and resources.

Appendix 1 shows the percentage of net migration and the proportion of the total population in each province. Between 1982 and 2010, except in Pichincha, all of the Andean provinces were affected by out-migration. Nevertheless, from the 2001 census onwards, this trend was reversed in some Andean provinces, which became net recipients of migration. In the coastal region, the provinces of Guayas and El Oro, which had been net recipients of migration, became less attractive to migrants, while the rest of the provinces in the region have net emigration. The eastern provinces (in the Amazon region) have become less attractive to migrants overall. As a result, starting in 2001 out-migration occurred in most Amazonian provinces, although two of them (Pastaza and Orellana) remained attractive to migrants due to the expansion of the demographic border and mining (CEPAL 2012). In the four censuses that were analysed, the Galápagos attracted migrants despite urban development regulations and the laws on residence in the archipelago, which are designed to protect ecosystems and biodiversity. In fact, since 1990 approximately two-thirds of the resident population in the Galápagos was born outside the province.

3 The gravity model of internal migration in Ecuador 1982-2010

3.1 Theoretical framework and empirical specification

According to models designed by Lewis (1954), Todaro (1969, 1980), and Harris and Todaro (1970), migrants move from rural or undeveloped areas with high unemployment and underemployment rates, poor working conditions, and low salaries to developed, urban areas, with higher levels and/or rates of productivity growth and better education opportunities, health care, and quality of life in general (Royuela et al. 2010). Any place can be considered a centre of production and consumption, although urban centres are at an advantage as they benefit from positive externalities (agglomeration economies). However, excessive concentrations can lead to problems of congestion and social inequalities (Henderson 2003). The neoclassical theory of migration is based on the concept of utility maximization: after a cost-benefit analysis, each individual decides whether or not to migrate and to which destination (Borjas 1988, 1999). The literature also assumes that migration is selective and depends on individual characteristics, including sex, age, and level of education.

From an aggregate perspective, and taking the work of Ravenstein (1885) as a starting point, migration models have drawn heavily on gravity models. The economics literature has developed models that result in gravity specifications. Our study is based on a theoretical development given in Beine et al. (2016).[7] Migration from the region of origin j to the region of destination k in the period t (m_{jkt}) is a function of the proportion of people who migrate (p_{jkt}) and the stock of population living in j (s_{jt})

$$m_{jkt} = p_{jkt} s_{jt}. \tag{1}$$

[7] Although this work is devoted to the analysis of international migration, the basic theoretical framework can be applied to any spatial dimension, as any of the assumptions are specific to international frameworks. The RUM has been extensively used for interregional migration analysis in the literature (e.g., Arzaghi and Rupasingha 2013). Thus, any difference will be found in the empirical model to be estimated.

This is the starting point for the RUM model, which assumes that the utility U_{ijkt} of an individual i moving from j to k at a time t depends on w_{jkt}, the deterministic utility gained by individual i due to moving from j to k in t; c_{jkt}, the costs of moving from j to k in time t; and $\in_{ijkt}$, an individual stochastic component of utility:

$$U_{ijkt} = w_{jkt} - c_{jkt} + \in_{ijkt}. \tag{2}$$

Assumptions about the distribution of the stochastic term in Equation (2) determine the expected probability of selecting destination k. If it is assumed that $\in_{ijkt}$ is stochastic, independent, and identically distributed, according to extreme value type 1, and that the deterministic component of utility does not vary with the origin j (the expected average utility of not migrating is normalized to zero), then the expected gross migration flows from j to k could be close to gravity Equation (3):

$$E(m_{jkt}) = \varphi_{jkt} \frac{\gamma_{kt}}{\Omega_{jt}} s_{jt}, \tag{3}$$

where: $\gamma_{kt} = e^{wkt}$, $\varphi_{jkt} = e^{-cjkt}$ y $\boldsymbol{\Omega}_{jt} = \sum_{l \in D} \varphi_{jlt}\, \varphi_{jlt}\, \gamma_{lt}$.

According to Equation (3), expected migration flows depend multiplicatively on (*i*) s_{jt}, which is the capacity of expulsion from j in t; (*ii*) γ_{kt}, the capacity of attraction of the destination region k; and (*iii*) $\varphi_{jkt} < 1$, the accessibility of the destination region k to potential migrants from j. Expected migration flows are inversely related to (*iv*) $\boldsymbol{\Omega}_{jt}$, which represents the expected utility of potential migrants from the place of origin. The value of this last element increases when accessibility increases ($\partial\boldsymbol{\Omega}_{jl}/\partial\varphi_{jll} > 0$), which means that enhanced accessibility of an alternative destination l will invariably lead to a drop in the expected bilateral flow of migration from j to k.

The property of independence of irrelevant alternatives (IIA), which is derived from a distribution according to McFadden (1974) of the stochastic component of utility in (2), implies that a variation in the attractiveness or accessibility of an alternative destination (l) leads to a proportional, identical change in $E(m_{jkt})$ and $E(m_{jjt})$. To move from terms of mathematical expectation to an expression based on data, we must add to Equation (3) a component of the error term η_{jkt}, with $E(\eta_{jkt}) = 1$ to obtain the classic gravity model in the literature on migration:

$$m_{jkt} = \varphi_{jkt} \frac{\gamma_{kt}}{\Omega_{jt}} s_{jt} \eta_{jkt}. \tag{4}$$

The IIA axiom may not be true for various reasons, which leads to multilateral resistance to migration. According to Bertoli et al. (2011), the scale of migration flows between two destinations depends not only on their relative attractiveness, but also on the attractiveness of alternative destinations. Therefore, an increase in the attractiveness of a third destination will decrease the probability of migration flows between the two initial destinations. If this concept is overlooked, biased estimates could be produced (Bertoli et al. 2013a). Multilateral resistance to migration may arise when assumptions about the distribution of the stochastic component are altered or if we consider the sequential nature of migration decisions.

Population groups in the place of origin may be heterogeneous, and as a result the same destination may have a different level of attractiveness for them, for example, due to sex, age, level of education, or aspects associated with the psychological costs for different population groups. The existence of this heterogeneity introduces a pattern of correlation with all destinations into the stochastic component of utility. According to Bertoli et al. (2013b), if a correlation is assumed to exist in the stochastic component of utility, then an increase in the attractiveness of a third destination that is perceived as a substitute for k will reduce the number of migrants between j and k (m_{jkt}) proportionally more than the number of individuals who decide to remain in the place of origin (m_{jjt}).

Similarly, we can assume that the model should include not only the present characteristics of alternative destinations, but also the future expectations of migrants on each destination (in $t+1$). Even if we assume that the stochastic component of utility is independent and identically distributed (IID) and of extreme value type 1, the final model will be sensitive to expectations about the future attractiveness of alternative destinations (Bertoli at al. 2013a; Beine and Coulombe 2014). Therefore, in accordance with Hanson (2010) and Beine et al. (2016), traditional models explain migration flows as a result of different characteristics in the place of origin and destination, assuming the IIA property and avoiding multilateral resistance to migration. However, the impact of conditions in the place of origin tends to be overestimated if the influence of alternative destinations is not considered.

These effects are controlled in various ways in the literature. When the panel is large enough in terms of cross-sectional and longitudinal data, the multilateral resistance term adapts to the structure of the common correlated effects estimator (CCE; Pesaran 2006) as used, for example, in Bertoli et al. (2013a) and Bertoli and Fernández-Huertas Moraga (2013). Our case study does not have the right characteristics to apply these types of techniques. Consequently, we follow the applied migration literature (see below) and we aim to capture these aspects by using various dummy variable structures, as we have three data dimensions (origin j, destination k, and moment in time t).[8] We estimate models with different fixed effects structures, from the simplest model, which is *a priori* biased, to more complex structures that lose some of the information but enable us to estimate parameters that are free of some biases.

1 Basic model with origin and destination variables and time fixed effects:

$$ln\ m_{jkt} = \alpha + D_t + \beta_1 X_{jkt} + e_{jkt}, \tag{5}$$

where α is the intercept, D_t is the vector of dichotomous variables for each year, and X_{jkt} is the vector of independent variables in the model. The vector of dummy variables for each year enables us to control common disturbances in time in all provinces. However, if multilateral resistance to migration exists, this model will produce biased estimates. The inclusion of time fixed effects enables us to capture general time shocks in all observations. In turn, this enables us to capture the multilateral resistance to migration of potential destinations that are not included in the database.

2 Panel model with monadic fixed effects of the origin and the destination and time fixed effects:

$$ln\ m_{jkt} = D_j + D_k + D_t + \beta_1 X_{jkt} + e_{jkt}, \tag{6}$$

where D_j and D_k correspond to dichotomous variables for each origin and destination province respectively, X_{jkt} is the vector of independent variables in the model and D_t is again the vector of time fixed effects. Mayda (2010) includes fixed effects of the origin and destination to control for specific effects of each origin / destination that are not captured by deterministic components of utility. This is the traditional strategy for capturing multilateral resistance to migration in cross-sectional studies. Mayda (2010) uses it to control for the effect of migration policy that is common to all spatial units. In our case, it would enable us to capture the permanent migration policy for the Amazonian provinces or the legal restrictions to immigration to the Galápagos. Nevertheless, this model does not account for most types of multilateral resistance described above.

[8] See Beine et al. (2011), McKenzie et al. (2014), and Ortega and Peri (2013) for different justifications for the inclusion of these dummies.

3 Panel model with dyadic fixed effects of origin-destination:

$$ln\ m_{jkt} = D_{jk} + D_t + \beta_1 X_{jkt} + e_{jkt,} \tag{7}$$

where D_{jk} is the vector of dichotomous variables of origin-destination. This specification is similar to the above, with the added feature that we can now quantify specific deterministic effects for each pair of regions (Ortega and Peri 2013). This fixed effects structure captures specific bilateral relationships between j and k, which reflect fixed migration costs, geography, historic migration networks between pairs of regions, and even permanent migration policies. This structure also includes constant specific characteristics of the origin and destination. However, the distance variable is not included in this model; to the extent that it remains constant for each pair of regions (Karemera et al. 2000; Ortega and Peri 2013), it shows perfect multicollinearity with this fixed effects structure.

4 Panel model using origin variables of origin and dyadic fixed effects of destination-time:

$$ln\ m_{jkt} = \alpha + D_{kt} + D_j + \beta_1 X_{jt} + e_{jkt}, \tag{8}$$

where D_{kt} is the vector of the destination's dyadic dummy variables for each year, while X_{jt} is the vector of independent variables of the origin regions. This panel model enables us to control for all of the 'pull' determinants of migration, particularly multilateral resistance derived from heterogeneity in the future perspectives of the destination regions (Beine and Parsons 2012). The structure also enables us to control for time-invariant characteristics of migration policies that are the same for all provinces. Beine and Parsons (2012) use dyadic fixed effects of destination-time to control for specificity between potential destinations for any period of time. This method can be used to control for bias in the parameters of the origin variables due to multilateral resistance caused by the heterogeneity of expectations about each destination. Like Beine and Parsons (2012), we also include fixed effects for each origin. To be clear, this will be our preferred model to capture the parameters associated with the characteristics of the place of origin.

5 Ordinary least squares with destination variables and dyadic fixed effects of origin-time:

$$ln\ m_{jkt} = \alpha + D_{jt} + D_k + \beta_1 X_{kt} + e_{jkt,} \tag{9}$$

where D_{jt} is the vector of the origin's dichotomous variables for each year. This method enables us to control for all the 'push' determinants of migration, as well as the multilateral resistance derived from heterogeneity in migration preferences by origin. Ortega and Peri (2013) use these dyadic fixed effects of origin-time to control for any specificity in the place of origin in any period of time. This approach can be used to eliminate bias in the parameters of the destination associated with multilateral resistance due to heterogeneity in preferences of migration by origin. Bertoli and Fernández-Huertas Moraga (2012) use a cross-section model to estimate heterogeneity in preferences by destination subgroup, with dummy variables to control for these subgroups, which we do not consider in this study. This is our preferred model to capture the parameters associated with the characteristics of the destination.

Given the nature of the proposed panel of models, a structure of the random term that is only associated with idiosyncratic errors e_{jkt} can be assumed for the estimation. Alternatively, we can also assume the existence of a structure composed of permanent individual errors corresponding to the fixed structure of the panel, that is, for each pair of regions [ξ_{jk}]. The second case represents a random effects model, which increases the efficiency of the estimation. Given that in most cases the fixed effects structures will control for unwanted consequences of random effects models, we generally use the panel estimation assuming the existence of specific random effects for each pair of regions.

One issue not covered in the theoretical approach of the model presented here is the selection of deterministic factors for the function of the utility of individuals. In the empirical literature, the most common aspects are pull factors and opportunities to earn an income at the destination (Mayda 2010), the gap in income *per capita* between the origin and the destination (Ortega and Peri 2009), the population in the place of origin and the income at the destinations (Karemera et al. 2000), differences in terms of quality of life (Faggian and Royuela 2010), and the level of urbanization (Royuela 2015). Given the assumption of normalization in the utility at origin, the deterministic component of utility in the empirical model measures the effect of increasing the gap in expected benefits between the origin and destination. According to empirical literature on migration, we can apply the relative difference in the deterministic component of utility to the variable that approximates material welfare. Beine and Parsons (2012) use the log of the income ratio, while Ortega and Peri (2009) analyse both linear and logarithmic differentials.

Attractiveness is estimated using the distance between the origin and the destination, which can be determined physically (using the Euclidean distance or distance by road) or economically (the average distance in terms of time), or it can be derived from differences in terms of language, customs, history, culture, and institutions (Belot and Ederveen 2012; Caragliu et al. 2013).

Very few studies on this topic relate to Ecuador. Studies that refer to Ecuador mainly focus on the influence of international migration. Notable studies are those by Gratton (2007) on the characteristics of migration from Ecuador to Spain and the United States; Bertoli et al. (2011, 2013b), who analyse how migration policy redirected traditional migration patterns from the United States to Spain; Gray (2009, 2010), who studies the relationship between migration, remittances, and environmental variables in Ecuador's rural communities; and, Laurian et al. (1998), who analyses how migration affects family structure and fertility.

3.2 The empirical model for Ecuador

The proposed empirical model analyses the flow of recent migrations by province of origin and destination using databases of Ecuador's Census of Population and Housing (CPV) from 1982, 1990, 2001 and 2010. Today, Ecuador has 24 provinces. The provinces of Sucumbíos and Orellana were created in 1989 and 1998 respectively, when they were separated from Napo province. Santo Domingo de los Tsachillas and Santa Elena, which had belonged to the provinces of Pichincha and Guayas respectively, became provinces in 2007. To work with a standardized database for the entire period, we added data from the province of Orellana to that of Napo, Santa Elena to Pichincha, and Santo Domingo to Guayas to obtain a total of 21 provinces. We did not take into account non-delimited areas, as these are not representative at the national level.[9] Recent internal migration refers to the population that changed residence in the five years prior to the census. Consequently, it does not include migration that occurred at an earlier time. To avoid problems of simultaneity, the explanatory variables in the model refer to the previous census, so migration flows between 2005 and 2010 are explained by the characteristics of the provinces in 2001. As we separate the dependent and the explanatory variables by five years, we minimize the chance that a shock could affect simultaneously the dependent and the explanatory variables. As in Rupasingha et al. (2015) and Levine et al. (2000), we

[9] We did not consider migration data for Sucumbíos for 1982, as this information was added to that of the province of Napo. In Ecuador, 1,419 km^2 of the territory is not assigned to any province. In 2010, these territories had 32,384 inhabitants and corresponded to the areas of Las Golondrinas, La Manga del Cura and El Piedrero.

understand that future migration does not affect current levels of explanatory variables. We also use information from the 1974 census to calculate control variables for the characteristics of the origin and destination of migration flows for the 1982 census. Finally, as Beine et al. (2016, p. 9) argue, ‘controlling for multilateral resistance to migration can make instrumentation unnecessary as long as the endogeneity problem is not due to reverse causality, or as long as the resistance terms capture a big part of the omitted factors’.

As explanatory variables, we include basic gravity factors – the population of origin and destination and the distance between them – approximating the costs associated with migration (Peeters 2012). The distance variable can be measured in kilometres and expressed in logarithms (*L Dist*), as in Mayda (2010), or in terms of time (*L Time*), which is closer to the economic concept of the cost of moving.[10] We use proportions of employment by branches of activity to control for the sector structure. In general, greater importance of the agricultural sector is traditionally associated with a lower level of development. The most developed provinces are expected to have a higher proportion of people employed in manufacturing (*Manufacturing_Ind*) and services (*Services*) and less employment in primary activities including agriculture (*Agriculture*) and mining and quarrying (*Mines & Quarrying*). The construction sector is also included in the analysis (*Construction*). We also consider the characteristics of the labour market (LM) according to whether workers receive salaries (*LM-Employee*); are owners or partners (*LM-Partner*), or are involved in another form of employment (*LM-Other*).

The probability of obtaining higher income levels is a key factor in the decision to migrate. To represent this, Karemera et al. (2000) use gross value added (GVA), Mayda (2010) uses the average salary of employees, while Ortega and Peri (2009) and Beine and Parsons (2012) consider GDP *per capita*. The Ecuadorian census does not include salary information, and gross value added data is not available for provinces for the entire study period. Therefore, in order to take into account the concept of different material characteristics in the place of origin and destination, we use census information on the condition of dwellings, including their structural characteristics, the water supply, the existence of a sewer system, and access to electricity. We construct an index of material conditions (*Relative Index Material WB*) for provinces up to 1974 by regressing the non-oil GDP *per capita* on indicators of the conditions of dwellings, keeping the estimated coefficients constant.[11] Again, we lag indicators by five years before the initial period of the dependent variable, as there is a chance that migrants anticipate future changes of income. Models 4 and 5, including destination-time and origin-time fixed effects respectively, remove bias due to omitted variables in the destination (model 4) and origin (model 5) region. In addition, our measurement of material welfare, based on housing characteristics, is much less cyclical than any wages or income variable. We have no information on amenities in our data set. Nevertheless, the variable that we use to capture material conditions is both a proxy of income and an indicator of the material living conditions of the population. Given the structure of fixed effects in the empirical models, we account for permanent natural and human made amenities in both origin and destination.

As an additional approximation to control for the level of income and the selectivity of migrants, we use level of education (*No Education, Primary, Secondary, and Higher Education*). A higher level of education is expected to enable a higher salary to be obtained. Likewise,

[10] The variables of physical distance and time are obtained from two sources: Ecuador’s yellow pages (L Dist Y-P) and Google Maps (L Dist Google). We added the Euclidean distance between the capitals in each of the provinces (L Dis-crow). The distances for the Galápagos Islands were calculated by adding the distance to the closest province with an air link (Pichincha and Guayas).

[11] In addition to the regression model, we consider other alternatives based on information about dwelling indicators (arithmetic means and principal components). Details of the construction of the index that was finally used and alternative indices can be found in the Additional Material section.

higher levels of education in the place of origin are expected to be associated with a higher level of migration. Similarly, given that a population's characteristics determine propensity to migrate, we consider age cohorts in the regression analyses.

We consider the rate of urbanization (*Urbanization rate*) as a pull factor for migration. Urbanization is associated with economic and social development – increasing industrial expansion, higher productivity and salaries, greater probability of finding work and a better quality of life – despite the high level of urban unemployment. Since Marshall (1890), there is a theoretical framework proving agglomeration economies. Duranton and Puga (2004), Rosenthal and Strange (2004), and Puga (2010) among many others address the causes of agglomeration economies. Various studies relate empirical findings of a growth-augmenting result of various measures of urbanization (including urban concentration) on countries' income in the long run (such as Henderson 2003; Brülhart and Sbergami 2009).

If urbanization is expected to promote economic growth, it is likely to be associated with more opportunities and larger migration flows. In addition, as underlined by Rodríguez-Pose and Ketterer (2012, p. 536), 'economic and noneconomic territorial features have been found to be essential elements determining utility differentials, and hence migration incentives of potential movers, across different territories'. A significant number of human made amenities are efficiently produced in urban areas. Thus, cities lead to more opportunities, spreading the 'capabilities' *à la* Sen (1987), and improving the wellbeing of individuals. By the same argument, we would expect a high rate of urbanization in the place of origin to act as a brake on emigration.

Both the dependent variable and the explanatory variables are expressed in logarithms, with the exception of variables that are already expressed as percentages. The coefficients are interpreted as elasticities. Table 2 presents the descriptive statistics of the variables considered in the model.

4 Estimation and results

4.1 Basic results

In this section, we present the results of estimating the models described in Section 3 using a panel data analysis and considering random effects. We estimate standard errors and assume the presence of a potential time correlation between the observations at origin-destination (models 1 to 3), destination (model 4), and origin (model 5) level. The estimated models measure the impact of push and pull variables on migration flows and the characteristics of resident individuals to control for the selectivity of migrants to a certain extent. Models 4 and 5 report estimates free of bias resulting from different types of multilateral resistance and are our preferred models. Table 3 presents the results of all models for comparison.

The distance measure considered is the logarithm of the distance between provincial capitals, which is based on the time it takes to travel on the best route by road, according to Google Maps. In all the estimated models, the parameter associated with this variable is negative, as expected. When fixed effects structures are considered, the parameter gets bigger, stressing the importance of space once local specificities are taken into account.

The index that shows relative differences in material welfare is not significant in model 4. As this specification controls for the destination's specific circumstances, we can state that lower levels of material welfare in the place of origin do not lead to an increase in migration. On the contrary, in model 5, controlling for origin specific factors, we observe a positive and significant parameter. The elasticity is 0.16, a result within the range of results for GDP *per*

Table 2. Statistical description of variables

Migration $_{jk}$	Average	St. dev.	Min.	Q1	Q2	Q3	Max.	Asymmetry
1982	1,466	4981	0	50	181	752	72,843	9.29
1990	1,235	3050	1	85	225	847	34,123	5.43
2001	1,306	3452	1	77	239	858	39,511	6.14
2010	1,369	3004	4	107	335	973	23,388	4.06

	Standard deviation						Correlation with L Migration	Correlation with L Pobl
	Media	Overall	Between	Within	Min	Max		
L Migration $_{k}$	5.31	1.68	1.63	0.39	0	9.54	1	
L Pop $_{k}$	12.42	1.27	1.23	0.31	8.3	15.19	0.518	1
L Dist-crow $_{jk}$	5.40	0.80	0.80	0	3.12	7.2	–0.565	–0.089
L Dist-Google $_{jk}$	5.92	0.69	0.69	0	3.48	7.39	–0.580	–0.112
L Time-Google $_{jk}$	5.75	0.54	0.54	0	3.71	6.69	–0.498	–0.095
L Dist-YP $_{jk}$	5.94	0.69	0.69	0	3.71	7.39	–0.585	–0.122
L Time-YP $_{jk}$	5.56	0.61	0.61	0	3.4	6.58	–0.512	–0.128
Urbanization rate (%) $_{k}$	41.9	18.66	16.62	8.25	6.85	20.71	0.408	0.309
Agriculture (%)$_{k}$	44.21	16.7	14.37	8.3	9.06	76.85	–0.383	–0.314
Mines & Quarrying (%)$_{k}$	0.91	1.74	1.51	1.02	0	12.63	–0.271	–0.200
Manufacturing Ind (%)$_{k}$	9.02	5.62	5.29	1.89	2.95	27.28	0.248	0.393
Industry Other (%)$_{k}$	0.39	0.23	0.14	0.18	0.04	1.11	0.270	0.322
Construction (%)$_{k}$	5.41	2.04	1.36	1.51	1.19	11.46	0.224	0.140
Services (%)$_{k}$	40.07	13.72	11.51	7.32	16.64	75.03	0.375	0.220
LM-Partner (%)$_{k}$	49.17	9.62	4.67	8.42	22.92	69.65	–0.018	0.195
LM-Employee (%)$_{k}$	39.87	11.03	7.11	8.42	18.61	69.13	0.177	–0.031
LM-Other (%) $_{k}$	12.13	5.06	3.92	3.17	1.17	31.11	–0.332	–0.302
No Education (%)$_{k}$	16.01	9.98	5.61	8.29	2.21	45.15	–0.136	–0.078
Primary Education (%)$_{k}$	52.00	10.16	4.53	9.07	27.53	69.94	–0.269	–0.245
Secondary Education (%)$_{k}$	25.45	12.81	5.11	11.78	5.21	48.92	0.165	0.142
Higher Education (%)$_{k}$	6.45	4.96	2.77	4.1	0.35	22.34	0.389	0.294
Pop_0_4 (%)$_{k}$	14.09	2.53	1.53	2	10.03	19.79	–0.332	–0.428
Pop _5_9 (%)$_{k}$	13.38	1.9	1.09	1.55	9.56	17.3	–0.337	–0.325
Pop _10_14 (%)$_{k}$	12.42	1.24	0.8	0.94	8.68	14.81	–0.276	–0.076
Pop _15_19 (%)$_{k}$	10.44	0.74	0.48	0.56	8.21	12.3	–0.190	0.098
Pop _20_24 (%) $_{k}$	8.87	0.97	0.8	0.55	7.13	11.8	0.253	0.002
Pop _25_29 (%)$_{k}$	7.44	1.14	1	0.52	5.81	11.99	0.218	–0.157
Pop _30_34 (%)$_{k}$	6.33	0.93	0.73	0.58	4.79	9.83	0.260	0.005
Pop _35_39 (%)$_{k}$	5.54	0.75	0.44	0.62	4.29	8.68	0.241	0.134
Pop _40_49 (%)$_{k}$	8.59	1.31	0.62	1.15	6.31	13.4	0.259	0.306
Pop _50_59 (%)$_{k}$	5.84	1.18	0.74	0.93	3.55	8.23	0.235	0.391
Pop _60_69 (%)$_{k}$	3.93	1.13	0.87	0.71	1.78	6.47	0.154	0.361
Pop _70+ (%) $_{k}$	3.39	1.44	1.08	0.96	1.09	6.59	0.136	0.382
Index Material WB (%) $_{k}$	6224.9	2141	1709	1292	2519	12544	0.355	0.411

capita in Caragliu et al. (2013) at the international level, much higher than Rupasingha et al. (2015) for wages at the county level in the United States, and close to some of the results in Arzaghi and Rupasingha (2013) for rural urban migration between counties in the United States. Consequently, we can conclude that material welfare acts as a pull factor for migrants in Ecuador.

Variables related to population structure have significant parameters with different signs, which we interpret as a control for the selectivity of emigrants in the place of origin. Model 4 reports lower migration from regions with younger (between 20 and 24) and older (above 70) residents, but higher migration for regions with higher porportions of residents between

Table 3. Basic results of gravity models 1 to 5

	Model 1		Model 2		Model 3		Model 4		Model 5	
L Time Dist Google	–1.387***	(0.0741)	–1.639***	(0.0746)			–1.634***	(0.0889)	–1.639***	(0.0983)
Relative Index Material WB	0.0382	(0.0336)	0.0651**	(0.0286)	0.0733***	(0.0282)	–0.00614	(0.0303)	0.163***	(0.0371)
L Population_O	0.890***	(0.0367)	0.745***	(0.156)	0.750***	(0.154)	0.721***	(0.0921)		
Urbanization rate_O	–0.0102***	(0.00310)	–0.0185***	(0.00359)	–0.0185***	(0.00354)	–0.0188***	(0.00295)		
Pop_10_14_O	0.0217	(0.0463)	–0.0202	(0.0487)	–0.0223	(0.0481)	–0.00451	(0.0338)		
Pop_15_19_O	–0.0337	(0.0382)	0.0171	(0.0409)	0.0181	(0.0403)	–0.00463	(0.0442)		
Pop_20_24_O	–0.118***	(0.0423)	–0.162***	(0.0430)	–0.162***	(0.0424)	–0.158***	(0.0501)		
Pop_25_29_O	0.198**	(0.0838)	0.163**	(0.0790)	0.160**	(0.0779)	0.167*	(0.0924)		
Pop_30_34_O	–0.0436	(0.0984)	0.0140	(0.0973)	0.0156	(0.0959)	0.0135	(0.104)		
Pop_35_39_O	–0.0260	(0.0838)	–0.0204	(0.0841)	–0.0240	(0.0830)	–0.0114	(0.111)		
Pop_49_49_O	0.0264	(0.0471)	0.0109	(0.0490)	0.0125	(0.0484)	0.0141	(0.0501)		
Pop_50_59_O	–0.0104	(0.0668)	0.0302	(0.0688)	0.0231	(0.0678)	0.0294	(0.0670)		
Pop_60_69_O	–0.0589	(0.0933)	0.0369	(0.105)	0.0320	(0.104)	0.0494	(0.0851)		
Pop_70m_O	–0.173**	(0.0795)	–0.249***	(0.0817)	–0.246***	(0.0807)	–0.257***	(0.0771)		
Primary Education_O	0.0175***	(0.00585)	0.0105	(0.00650)	0.0105	(0.00641)	0.0107*	(0.00590)		
Secondary Education_O	0.0277***	(0.00973)	0.0226*	(0.0119)	0.0226*	(0.0118)	0.0238**	(0.00985)		
Higher Education O	0.00380	(0.0133)	–0.0103	(0.0159)	–0.00986	(0.0157)	–0.0138	(0.0150)		
Mines & Quarrying_O	–0.00730	(0.00846)	–0.00642	(0.00991)	–0.00673	(0.00976)	–0.00758	(0.0114)		
Manufacturing Ind_O	0.00513	(0.00664)	0.0141*	(0.00771)	0.0136*	(0.00761)	0.0147	(0.00975)		
Industry Other _O	0.107	(0.0977)	0.0358	(0.102)	0.0272	(0.101)	0.0716	(0.0867)		
Construction_O	0.0320**	(0.0127)	0.0485***	(0.0139)	0.0492***	(0.0137)	0.0388***	(0.0140)		
Services_O	0.00991	(0.00654)	–0.00660	(0.00747)	–0.00641	(0.00738)	–0.00542	(0.00641)		
LM-Employee_O	–0.00348	(0.00419)	0.00230	(0.00423)	0.00213	(0.00416)	0.00229	(0.00374)		
LM-Other _O	0.00229	(0.00522)	0.00860	(0.00569)	0.00846	(0.00560)	0.00889*	(0.00531)		
L Population_D	0.579***	(0.0431)	–0.695***	(0.156)	–0.690***	(0.154)			–0.669***	(0.142)
Urbanization rate_D	–0.00336	(0.00372)	0.00356	(0.00439)	0.00345	(0.00432)			0.00197	(0.00404)
Pop_10_14_D	–0.0737	(0.0495)	0.0325	(0.0500)	0.0328	(0.0493)			0.0453	(0.0432)
Pop_15_19_D	0.172***	(0.0431)	0.107**	(0.0447)	0.105**	(0.0441)			0.0863*	(0.0466)
Pop_20_24_D	–0.00920	(0.0459)	–0.0513	(0.0427)	–0.0502	(0.0421)			–0.0477	(0.0447)
Pop_25_29_D	0.151*	(0.0815)	–0.0597	(0.0784)	–0.0640	(0.0773)			–0.0666	(0.0655)
Pop_30_34_D	–0.0464	(0.0951)	0.176*	(0.0952)	0.182*	(0.0940)			0.206**	(0.0852)

(Continues)

Table 3. (Continued)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Pop_35_39_D	–0.280***	(0.0862)	–0.151*	(0.0880)	–0.155*	(0.0867)			–0.153**	(0.0773)
Pop_49_49_D	0.195***	(0.0538)	0.245***	(0.0546)	0.247***	(0.0539)			0.238***	(0.0432)
Pop_50_59_D	–0.229***	(0.0673)	–0.254***	(0.0688)	–0.259***	(0.0679)			–0.235***	(0.0665)
Pop_60_69_D	–0.130	(0.0864)	–0.249**	(0.0981)	–0.254***	(0.0967)			–0.234***	(0.0902)
Pop_70m_D	–0.0885	(0.0709)	0.135*	(0.0742)	0.138*	(0.0730)			0.131**	(0.0553)
Primary Education_D	0.00606	(0.00544)	0.00644	(0.00605)	0.00651	(0.00597)			0.00766	(0.00703)
Secondary Education _D	–0.0181*	(0.00936)	0.00363	(0.0108)	0.00373	(0.0106)			0.00456	(0.0104)
Higher Education D	0.00403	(0.0131)	0.00136	(0.0152)	0.00115	(0.0151)			–0.00211	(0.0140)
Mines & Quarrying_D	–0.0431***	(0.0104)	–0.0101	(0.0120)	–0.0106	(0.0119)			–0.0109	(0.0115)
Manufacturing Ind_D	0.0174***	(0.00511)	0.0168**	(0.00673)	0.0167**	(0.00663)			0.0171***	(0.00509)
Industry Other_D	0.114	(0.110)	0.0294	(0.111)	0.0293	(0.110)			0.0619	(0.124)
Construction_D	0.101***	(0.0146)	0.0649***	(0.0138)	0.0642***	(0.0136)			0.0591***	(0.0110)
Services_D	0.0298***	(0.00623)	0.00648	(0.00698)	0.00688	(0.00689)			0.00728	(0.00620)
LM-Employee_D	–0.0105**	(0.00422)	–0.00298	(0.00432)	–0.00298	(0.00426)			–0.00119	(0.00319)
LM-Other_D	0.00697	(0.00493)	–0.00125	(0.00530)	–0.00121	(0.00524)			0.000368	(0.00425)
Constant	–6.142***	(2.011)	12.68***	(3.396)	2.660	(3.180)	6.024***	(1.921)	21.60***	(2.875)
Fixed effects	Time		Time, origin and destination		Time and origin – destination		Destination – time and origin		Origin-time and destination	
Observ / N° groups	1,600	420	1,600	420	1,600	420	1,620	420	1,620	420
Overall R^2	0.796		0.877		0.979		0.880		0.878	
Within / Between R^2	0.404	0.796	0.473	0.891	0.473	1.000	0.555	0.890	0.531	0.891

Notes: Significance: *10%; **5%; ***1%. Standard errors are given in brackets (robust, and with the possibility of correlation between the various dyadic origin-destination structures). The default categories are Population below 10 years, No Education, Agriculture sector, and LM-Owner Partner.

25 and 29. It is more difficult to interpret the results for the destination, as different signs are found for very close age cohorts. However, the signs and, in most cases, the signficance are maintained in the different specifications of the gravity model, which indicates that the impact of the age structure on migration is not affected by bias due to multilateral resistance to migration.

The provinces with high proportions of the population with primary and secondary levels of education are those with the highest levels of emigration. In contrast, provinces with increasing proportions of the population with higher education qualifications do not have differential levels of migration. The education structure in the destination does not appear to be a pull factor or a barrier to migration flows.

In terms of the structure of employment by sector, we find that a highly cyclical sector such as construction is always associated with significant parameters for the place of origin and destination. This confirms with empirical evidence in other studies indicating that migration flows are more feasible in periods of expansion and increasing housing availability than in times of recession. For the destination, the manufaturing sector is a significant parameter in all models considered. The fact that development associated with growth in the manufacturing industry is significant is in favour of the Harris-Todaro models of rural-urban transformation associated with development. On the contrary, the estimates do not report a significant impact of the weight of mining industries as a pull factor, in contrast to the role of the oil sector in making the Amazon an atractive destination for migrants.

The strucuture of the labour market only appears to have a degree of influence at the place of origin. Thus, in model 4 the ‘LM-Others’ category is associated with a marginally significant, positive parameter. Therefore, structures that can be related to underempoyment in the place of origin can be considered push factors.

Finally, we pay special attention to the population variable and to the rate of urbanization. Model 4 shows how provinces increasing in size push out larger numbers of the population, which confirms a question of scale that is inherent in gravity models. As expected, greater and increasing rates of urbanization in the place of origin are factors linked to lower levels of migration. The models that control for multilateral resistance to migration to a greater or lesser extent indicate a greater influence of urbanization than observed in model 1. Model 4, which controls for the heterogeneity of expectations about the destination, shows a negative impact of urbanization in the place of origin, 84 per cent higher than the parameter in model 1. In other words, there are fewer reasons to leave provinces with higher rates of urbanization (more and better services, *a priori*), and there may be different expectations, perhaps because there is better information about destinations.

The destination’s level of population and rate of urbanization are variables with parameters that require deeper reflection. Model 5 reports a significant negative parameter for population, while the urbanization rate is not significant. This result could be surprising, but is in line with the description in Section 2, which indicates a drop in the rate of population concentration in the most populated provinces and that ‘the most populated provinces are not necessarily those that grow most’ (INEC 2012). In fact, in 1982, 41 per cent of the urban population was concentrated in the three most urbanized provinces (Galápagos, Guayas and Pichincha). This proportion continued to be 41 per cent in 2010 due to the notable increase in the rate of urbanization in the other provinces.

Model 1 finds a positive, significant parameter for population size. To understand such a dramatic difference, we follow Baltagi and Griffin (1984) and Pirotte (1999). If we assume a dynamic relationship, the fixed-effects estimates capture the short-run impact of the variable, being the pool and random effects estimations of the long estimates (captured by the between estimate) and short estimates. Consequently, model 1 shows how the most populated provinces are recipients of larger population flows. On the contrary, model 5 reports that most growing provinces are not those receiving higher migration flows. We interpret these results, suggesting that the recent process of development in Ecuador is not driving to deepen territorial concentration, particularly due to the growth of medium-sized and small cities in comparison to the large metropolises of Guayaquil and Quito.

4.2 Analysis of sensitivity and robustness

We then estimate the specifications of the model using different measures and sub-samples. Next, we include the analysis dividing the full sample in two sub-periods. Table 4 displays the results of models 4 and 5 for the sub-periods 1982–1990 and 2001–2010. We only present the results of distance, material well-being index, and population and urbanization rate. The regressions for the 1982–1990 sub-period, when urbanization was substantially lower, indicate that the urbanization rate was relatively more important in retaining population. When we consider variables associated with the destination, we see that a process of population concentration is taking place, as population matters more as pull factor. In the second sub-period, urbanization is less important. These results contrast with those obtained for the full sample. In any case, it is important to take into account that the global model results are not purely an average between sub-periods and consequently that the variance between sub-periods matters in explaining results of the final model. Consequently, the results obtained for the full data set describe a 40-year story in a country in which urbanization has boomed and regional population flows have decreased.

Given that one of the parameters of greatest interest in the study corresponds to the destination's population and the rate of urbanization at the destination, we assess the robustness of the results, excluding the destinations of the provinces of Pichincha and Guayas on one hand and the Galápagos on the other. Table 5 presents the estimates of the parameters. The signs and significance of the parameters are similar when these provinces are excluded.

We also tested the influence of oil production in the Amazon. Although we control for the weight of such sector, we remove from the sample the three provinces where mining and quarrying play a stronger role: Napo, which includes Orellana, Sucumbios, and Zamora Chinchipe. The results show a non-significant parameter for population and a positive and significant parameter for the urbanization rate. Even though the oil producing regions have experienced a large scale urbanization, they have attracted decreasing numbers of migrants. Given their particular characteristics, once they are excluded from the sample we observe how the overall growth in urbanization in the country has slowed the process of population concentration: many rural provinces that in the 1970s had double digit emigration rates have experienced a a joint course of urbanization and population retention.

Table 4. Results by sub-period

	Model 4			Model 5		
	1982–1990	2001–2010	1982–2010	1982–1990	2001–2010	1982–2010
L Time Dist Google	–1.694***	–1.582***	–1.634***	–1.706***	–1.582***	–1.639***
Relative Index Material WB	–0.310	0.0335	–0.00614	–0.321**	0.0335	0.163***
L Population_O	1.635***	3.339***	0.721***			
Urbanization rate_O	–0.0898***	–0.0110	–0.0188***			
L Population_D				2.920***	1.093	–0.669***
Urbanization rate_D				–0.0710***	0.00361	0.00197

Notes: Significance: *10%; **5%; ***1%.

Table 5. Sensitivity of parameters associated with the destination's population and rate of urbanization

	Total Sample	Without Pichincha and Guayas	Without the Galápagos	Without the Oil Provinces[a]
Model 1				
L Population_D	0.579***	0.508***	0.347***	0.537***
Urbanization rate_D	–0.00336	–0.00271	–0.000497	0.00818**
Model 5				
L Population_D	–0.669***	–0.375**	–0.759***	–0.019
Urbanization rate_D	0.00197	0.000610	–0.00568	0.00977**

Notes: Significance: *10%; **5%; ***1%. [a]The provinces spesialized in oil are Napo (which considers Orellana), Sucumbios, Zamora Chinchipe, as both have an average of employment in this sector above 3 per cent.

Finally, we acknowledge that despite our concerns and the design of our empirical exercise, endogeneity may affect our results if there are shocks affecting both migration and population simultaneously, biasing the population coefficient and consequently affecting other parameters. We perform additional estimates (unreported) removing population as an explanatory variable. These computations show very minor absolute changes in the parameters of the main explanatory variables, and no change is observed in their significance.

5 Conclusions

In this study, we analyse determinants of migration flows in Ecuador between 1984 and 2010 by estimating gravity models. To obtain robust parameters without bias from multilateral resistance to migration, we estimate a range of specifications using different fixed effects structures.

The main results obtained are in line with the empirical literature on different countries. Thus, migration flows are greater between more populated provinces that are close to each other. The relative index of material well-being is raised as a pull factor, as the estimations show significant parameters for the destination regions. The education structure in the migrants' destination does not appear to be a pull factor or a barrier to migration flows, while the sectoral composition of the economy played a significant role: the construction sector reported significant parameters both at the origin and destination, while the manufacturing industry played a key role in attracting migrants, in line with the Harris Todaro transformation models. Labour markets with structures close to under-employment in the place of origin can be considered push factors.

Finally, we pay special attention to the role of population and urbanization. In the descriptive analysis we find that population flows tend to be towards the most populated provinces, but the concentration rate has dropped over time. Consequently, in recent periods the largest provinces have not been those with the most growth. The estimated models confirmed this trend: territorial concentration has slowed due to the growth of medium-sized and small cities. The sensitivity analysis allows us to see that the urbanization process in the country acts as deterrent factor for population concentration. To be clear, a process of territorial balance is occurring in Ecuador in which growth in provinces, associated with urbanization, is hampering territorial concentration.

In terms of economic policy, the results highlight the importance of understanding jointly the migration and urbanization phenomena as shaping the distribution of a population in space. Consequently, the provision of basic resources (including education and health services) should be increased in parallel, or even proportionally more, in small and medium-sized cities.

Agglomeration economies could be better exploited if, in practice, increasing levels of urbanization were accompanied by elements that contribute to making better use of the larger size of cities (Castells-Quintana 2016).

Additional work is required to further understand regional migration flows in Ecuador, including the role of international migration in substituting internal flows, different behaviours for alternative educational levels, and inspection of shorter distance flows, such as those that take place at the canton level.

Appendix 1. Percentage of net migration, population distribution and rate of urbanization (1982–2010)

	Percentage of net migration				Provincial weight respect of all national				Urbanization rate			
Province	1982	1990	2001	2010	1982	1990	2001	2010	1982	1990	2001	2010
The Andes												
Azuay	–6.9	–0.2	3.9	2.7	5.5	5.3	5.0	4.9	38.3	43.2	52.1	53.4
Bolívar	–28.6	–14.6	–15.1	–8.7	1.8	1.6	1.4	1.3	15.6	21.1	25.5	28.2
Cañar	–9.6	–3.2	1.9	0.5	2.2	2.0	1.7	1.6	16.2	29.3	36.5	42.0
Carchi	–27.1	–12.2	–13.1	–8.5	1.6	1.5	1.3	1.1	37.7	40.6	47.2	50.1
Cotopaxi	–13.0	–7.9	–5.1	–3.4	3.5	2.9	2.9	2.8	15.4	23.7	26.8	29.6
Chimborazo	–17.2	–8.4	–9.0	–3.9	4.0	3.8	3.3	3.2	28.2	32.9	39.1	40.8
Imbabura	–11.7	–3.1	–1.8	–0.8	3.1	2.8	2.8	2.8	37.3	48.7	50.1	52.7
Loja	–25.2	–11.4	–9.3	–4.3	4.5	4.0	3.4	3.1	33.4	39.5	45.3	55.5
Pichincha[a]	22.3	7.2	9.7	3.8	17.2	18.3	19.8	20.4	70.4	72.9	71.8	69.0
Tungurahua	–6.9	–2.1	–1.8	–0.4	4.1	3.8	3.6	3.5	36.9	41.9	42.7	40.7
The Coast												
El Oro	3.2	6.8	1.2	–0.4	4.2	4.3	4.4	4.2	63.9	70.5	76.4	77.4
Esmeraldas	–4.4	–5.9	–9.2	–4.9	3.1	3.2	3.2	3.7	47.6	44.0	40.7	49.6
Guayas[b]	16.1	3.9	2.7	0.8	25.4	26.3	27.4	27.4	68.7	76.3	81.8	82.2
Los Ríos	–12.9	–6.4	–5.3	–2.0	5.7	5.5	5.4	5.4	32.5	37.8	50.2	53.4
Manabí	–26.0	–8.5	–12.5	–4.2	10.8	10.8	9.8	9.5	36.7	42.0	51.9	56.4
Amazon												
Morona Santiago	9.9	4.6	–1.3	0.5	0.9	0.9	1.0	1.0	23.7	28.3	33.3	33.6
Napo	46.5	15.0	–1.3	0.0	1.4	1.1	0.7	0.7	17.4	22.9	31.4	38.1
Orellana			18.3	9.0			0.7	0.9			29.8	40.3
Pastaza	17.6	17.1	12.9	9.0	0.4	0.4	0.5	0.6	32.5	36.2	43.5	44.0
Zamora Chinchipe	18.4	16.0	–1.2	0.7	0.6	0.7	0.6	0.6	22.7	24.6	35.6	39.6
Sucumbíos		25.4	7.7	–0.7		0.8	1.1	1.2		26.6	38.9	41.4
Galápagos	28.1	31.2	20.8	10.9	0.1	0.1	0.2	0.2	73.4	81.9	85.4	82.5

Source: INEC.
Notes: Data for 2010: [a]Include Pichincha and Santo Domingo; [b]Includes Guayas and Santa Elena.

Appendix 2. Definition and sources of variables

Variable	Definition	Source
Migration	People who changed residence in the 5 years prior to the Census of Population and Housing (CPV) (INEC 2014), from the province of origin *j* to province of destination *k*	1982: CEPAL – CELADE: 1990–2010: National Institute of Statistics and Census (INEC)
Population	Number of people who live in province *j* (L_Pop)	1974– 1982: hard copies of the census (CPV). 1990–2010: INEC

(Continues)

Appendix 2. (Continued)

Variable	Definition	Source
Rate of urbanization	Proportion of individuals who live in areas delimited as urban in each province (Urbanization rate)	1982: 1982: hard copies of the census (CPV). 1990–2010: INEC
Distance and time – 1	Kilometres (and time in minutes) from the capital of the province *j* to the capital of the province *k* (L Dist Y–P, L Time Y_P)	http://www.guiatelefonica.com.ec/Distancia_entre_ciudades_Ecuador
Distance and time – 2	Kilometres (and time in minutes) from the capital of province *j* to the capital of province *k* (L Dist Google, L Time Google)	Google Maps
Branch of activity of the economically active population (EAP)	Percentage of the economically active population that is employed in the following sectors: agriculture, hunting, forestry, and fishing (Agriculture); mining and quarrying (Mines & Quarrying); manufacturing industries (Manufacturing Ind); other industries Industry Other); construction (Construction); services (Services)	1974–1982: hard copies of the census (CPV). 1990–2010: CPV – INEC
Level of education	Percentage of people who have completed no regular education level (No Education), primary education (Primary Education), secondary education (Secondary Education), and higher education, including postgraduate studies (Higher Education)	1974–1982: hard copies of the census (CPV). 1990–2010: CPV – INEC
Age	Percentage of people by age groups. (Pop_0_4 … Pop_70 and over)	Census of Population and Housing, National Institute of Statistics and Census (INEC)
Category of employment	Percentage of people in each employment category: employee (LM–Employee); owner or partner (LM–Partner); other form of employment (LM–Other)	1974–1982: hard copies of the census (CPV). 1990–2010: CPV – INEC
Characteristics of the dwelling	Characteristics of the conditions of the dwelling, used to construct the index of material welfare (Index Material WB)	1974–1982: hard copies of the census (CPV). 1990–2010: CPV – INEC

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