How is internal migration reshaping metropolitan populations in Latin America? A new methodology and new evidence

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Abstract

Internal migration is a key driver of the patterns of human settlement and socio-economic development, but little is known about its spatial impacts. Exploiting the availability of census data, we propose a methodology to quantify the internal migration impacts on the population structure of places and estimate these impacts for eight large Latin American cities. Despite city-level variations, we showed that internal migration had feminising, downgrading educational and demographic window effects by reducing the local male-to-female population ratio, lowering the average years of schooling and rising the share of working-age population due to an increased young adult (aged 15-29) population. However, these effects were small and diminished over time. A rise in the proportion of males and a reduction in the share of young adult population moving into cities led to a reduction in the feminising and demographic window effects. Concurrently, a rise in the average years of schooling associated to people moving into cities attenuated the downgrading impact of internal migration local education levels.

Keywords: Internal migration, Latin America, socio-demographic composition, spatial impact, migration analysis

1. Introduction

Many countries have seen migration replacing fertility and mortality as the main agent of population change. With international mobility, internal migration is now the primary demographic process shaping the national patterns of human settlement. It underpins differences in population change and structure across sub-national areas. Understanding and determining the impacts of internal migration on changing the population composition of places is critical to respond to housing, health care, educational and transportation needs; deliver more accurate population forecasts; and assess the spatial distribution of skills, knowledge and labour.

Migration research has focused on understanding factors that trigger migration (Greenwood 1997; Cushing and Poot 2004). Less progress has been made on quantifying the effects of migration on changing the socio-demographic composition of places. This dearth can be partly traced to the absence of a comprehensive methodological approach to estimate these effects. Prior work has typically used three sets of approaches to quantify the spatial impacts of migration: comparative socio-demographic profiles, net migration-based measures and population growth equations have been used. However, they failed to effectively quantify the migration impact of multiple population sub-groups into a single indicator, and assess the migration impact on a wide range of socio-economic indices, such as the dependency ratio and GINI coefficient, at a fine geographical scale.

To redress these limitations, this paper aimed to develop a new methodology to estimate the impacts of internal migration on the socio-demographic composition of places, and quantify these impacts on eight large Latin American (LA) cities in Ecuador, Panama and Mexico. These cities were selected because of their importance in the national urban, migration and economic system (CEPAL 2012); and, because they are argued to provide valuable insights into better

understanding the impacts of internal migration on the population composition of places within LA countries.

The proposed methodology relies on census-based migration matrices which provide information on the local population at the census date and some earlier year. In the context of our methodology, this information is considered to capture the spatial distribution of population attributes after internal migration occurred (i.e. at the census date), and to represent a hypothetical scenario of no internal migration (i.e. at some earlier year). Given the reliance on census data, a key assumption of the methodology is the time invariability of population attributes. While this assumption is reasonable for time-constant population attributes (e.g. sex) and those that change in a predictable way over time (e.g. age), it is less adequate for time-changing attributes (e.g. employment status). Our methodology, however, has the advantage of effectively isolating the impacts of internal migration by removing the effects of international migration, births and deaths, and providing a way to decompose the overall change in the socio-demographic composition of places due to internal migration into the effects due to in-migration and out-migration. It thus provides an effective tool to progress our understanding of the relative contribution of in-migration and out-migration to the overall change in the socio-demographic composition of places.

The paper is structured as follows. The next section reviews the literature on the patterns of internal migration in LA countries and highlights the exiting theoretical discussion on the impacts of these movements on the socio-demographic composition of large cities. Section 3 discusses the key limitations of existing approaches to quantify internal migration impacts. Section 4 proposes a methodology that addresses these shortcomings and that provides a summary statistic that exploits the use of census data. Applying this methodology, estimates of the impact of internal migration on the age, sex and educational population composition of large

cities in Panama, Mexico and Ecuador discussed in Section 5. Section 6 summarises our main conclusions and suggests ways in which the proposed methodology can expand internal migration research.

2. Background

The internal migration system in LA countries has experienced major transformations over the last century. Between the 1930s and 1970s, rural-to-urban migration dominated the national migration settlement system, spurring significant population redistribution (Firebaugh 1979). Fostered by the introduction of import-substitution policies after WWII (Brea 2003; Rowe 2013a), net rural-to-urban migration accelerated the urbanisation process in LA countries, accounting for over 45 percent of urban growth (Lattes 1995; Lattes *et al.* 2004). Urban growth was concentrated in few urban centres, particularly in large cities, resulting in a pronounced population imbalance between the primate city and the rest of the country.

Rural-to-urban migration was characterised to follow a two-step process: first, moves from rural areas to small towns, and then from these to urban areas (Herrick 1965). Compared to the destination population, these flows were driven by a large proportion of young people, females and less educated people (Elizaga 1972; Herrera 2013). Like in European and North American countries, the out-migration of young individuals and less educated people from rural areas in the 1930s and 1970s was underpinned by a lack of educational and job opportunities (ECLAC 2012); but, out-migration flows were reported to be more geographically concentrated in a few urban centres (Zlotnik 1994), reflecting the prominent concentration of services provision in national capitals (ECLAC 2012).

The predominance of females in rural-to-urban migration reflects the greater migration propensity for women than men in LA countries, with a rate of 3 women for 2 men moving to cities

during the period of the 1940s to 1960s (Simmons *et al.* 1978; Lawson 1998). This gender selectivity reflected the prevalence of a patriarchal society and a growing urban service economy (Germani 1971; Gilbert, 1974; Jelin 1977). Patriarchal values entailed the migration of rural women as a part of the family unit, following the male head of household, coupled to scarce job opportunities in the agricultural sector. Unlike in Africa, males dominated agricultural employment in LA countries, with women moving into cities to take up informal service jobs (Elizaga 1966; Hugo 1993). The emergence and concentration of affluent classes in cities increased the demand for domestic service workers, primarily employing rural in-migrant women (Elizaga and Macisco, 1975; Chant 1999; Szasz 1995).

Given the large volume of rural-to-urban migration characterising the period from the 1930s to the 1970s, LA scholars have long argued that the selectivity of migration flows shaped the socio-demographic composition of large cities in the region (Rodríguez and Busso 2009; Villa and Rodríguez 1997). While its quantification is prevented by lack of appropriate data, rural-to-urban migration is claimed to have generated three main effects: a *demographic window, feminising* and *downgrading educational* effect; that is, leading to a rise in the share of working-age population, a decrease in the male-to-female population ratio and a concurrent decline in the local levels of education of large cities in LA countries, respectively.

In contrast, during the period extending from the mid-1980s to the 2010s, LA countries experienced significant economic and political changes which reshaped internal migration patterns and are expected to have altered the selectivity of internal migration flows into major urban centres (Gilbert 1993). Stimulated by a transition to an open-market economic system based on trade liberalisation, privatisation and development of natural resource-based export-oriented activities, the attraction of migrants to LA major cities diminished (Gilbert 1993; Brea 2003; Chavez *et al* 2016). Increased foreign direct investment on mining and agriculture-rich regions promoted greater

geographical dispersal of employment growth, with large cities reporting increasing out-migration to distant areas (Rodríguez 2011; Rowe 2014). Between the 1990s and 2000s, capital cities in many countries experienced net-migration losses for the first time since the 1900s (Rodríguez 2008, 2011b), coupled to a shift in the primary source of migrants. Rural areas were no longer the main suppliers of migrants for large cities (Rodríguez and Busso 2009). Small and intermediate urban areas are now the primary sources (Rodríguez 2011b), which is an inherent consequence of the high degree of urbanisation in LA (UN 2015; Bernard *et al.* 2017).

These shifts in the migration network of LA countries do not appear to have affected the preference of young migrants for large cities (Rodríguez and Busso 2009; Rowe 2013b), but evidence suggests that they altered the sex and educational composition of migration flows into large cities (Rodríguez 2004). Internal migration in LA during the 1990s and 2000s appeared to have been selective of males and highly educated individuals. Rodríguez (2004) estimated a male-to-female migrant population ratio of over 100 percent and a larger percentage of migrants with university degree relative to those staying in the region of origin, pointing to an over-representation of males and university educated people in the migration system.

Taken together, these changes suggest countries' transition from a dominant rural economy to a more industrialised, service-based system appear to have led to a migration network dominated by urban-to-urban migration, with more educated individuals moving to jobs. Internal migration thus appears to have reshaped the socio-demographic composition of LA cities. However, these compositional impacts have not been examined and are yet to be measured and understood. Based on the work reviewed above, we hypothesise that the prevalence of males and university educated individuals in the composition of migration flows reduced the feminising and downgrading education effect which characterised the period between the 1930s and the 1970s. At the same time, we believe that the continuation of youth migration selectivity remains to have a demographic

window effect on the population of large cities increasing the local share of working-age population. The next section reviews the most commonly used existing approaches to measure the impacts of internal migration and discusses their strengths and limitations.

3. Approaches to measure internal migration impacts

A primary impact of migration is on redistributing population, contributing to population growth in some areas while promoting declines in others. A crude approximation to measure the impact of internal migration on places involves quantifying the magnitude of inflows to a destination and movements in the reverse direction, estimating their resulting net balance. Yet the magnitude of inflows and outflows is not the only dimension that should be considered. To effectively quantify the impacts of internal migration, accounting for origin and destination differentials in migration selectivity is also important: there are significant variations in the rate of out-migration across population sub-groups (i.e. origin differentials). Migrants tend be younger, more educated, single and living in rental housing. Similarly, there are systematic variations in migration rates across destination regions, comparing the migrant and staying populations (i.e. destination differentials).

Accounting for these differentials is important to measure impacts of internal migration as they can produce significant compositional changes in origin and destination regions. Migration may operate to influence the local human capital base, accelerate population ageing and alter the local sex balance. To quantify such compositional impacts is important to capture four key population components: (1) the magnitude of in- and out-migration flows, (2) the size of non-migrant population, (3) the selectivity of migration flows, and (4) the composition of the staying population.

Commonly three sets of approaches have been used to quantify the impact of internal migration on the composition of places: Three sets of approaches can be identified: (i) comparative analysis of socio-demographic profiles, (ii) population-growth-equation approaches, and (iii) net-migration-based indicators. While useful, these approaches suffer from a series of shortcomings as we note below: they failed to provide a single statistical indicator that integrates the four above-identified components, to capture the combined migration impact of multiple population sub-groups and to assess the migration impact on a wide range of socio-economic indicators.

The comparative socio-demographic profiles approach involves the analysis of the frequency distributions of in-migrants and non-migrants with respect to a particular personal characteristic (e.g. Massey and Parr 2012). These distributions are examined to determine the selectivity of migration to a destination region. They provide a visual inspection of migration data, but they do not produce a statistical measure that quantifies the impact of internal migration. Moreover, this approach is based on ratios of population to migration inflows, but it does not directly quantify changes in the staying population due to out-migration flows. As a result, this approach only captures a part of the changes in the local population caused by internal migration.

Population-growth equations provide a more comprehensive approach to quantify internal migration impacts. It involves measuring the components of population change: fertility, mortality and net migration using a cohort-survival model (e.g. Green 1994; Gavalas and Simpson 2007). Survival probabilities are applied to derive net internal migration estimates as the residual between population estimates and projections. These net migration estimates are used to assess the impacts of internal migration. This approach, however, does not consider the size and selectivity of staying populations.

Using five-year census transition data, Table 1 illustrates this deficiency. Based on population aged 5-14, it displays net migration estimates for Quito and the rest of Ecuador,

revealing a net migration gain of over 3,600 people in the former, and a corresponding loss in the latter. Based on these balances, misleading conclusions can be drawn by indicating that the scale of the impact of internal migration on Quito and the rest of Ecuador is of a similar order if the size of the staying population in Quito and the rest of Ecuador is not considered. However, examining net migration rates, which take into account this population component, reveals that the impacts of internal migration for Quito are much larger than for the rest of Ecuador. Thus while the population-growth-equation approach provides a notion of the direction of the impact of internal migration (i.e. population gain and loss), it does not produce a direct estimate of the resulting change in the population composition.

[Table 1]

A second limitation is the stringent data requirement of the cohort method. It requires data on births, deaths, internal and international migration disaggregated by geographic areas. Such data are rarely available in less developed countries. An additional limitation is that this method only returns net migration estimates. This precludes the decomposition of the overall change in the population composition in a region into the contributions of in-migration and out-migration. This is a major constraint to understand the underpinning causes of internal migration shaping the local population structure.

A third alternative approach is the estimation and comparison of net migration rates based on transition matrices. Net migration rates effectively summarise the overall impact of internal migration flows by balancing net region-specific gains and losses due to internal migration (Thomas 1941). Computed for a population sub-group, net migration rates can also offer an assessment of the selectivity effects of internal migration, in addition to the size and composition of the staying population (e.g. Voss, Hammer and Meier 2001; Champion and Fisher 2003). A

negative value for these rates indicates population losses in a particular population sub-group due to net out-migration, whereas a positive score points to population gains due to net in-migration.

Net migration rates, however, do not provide a direct estimate of the impact of internal migration on the socio-economic composition of places. They only indicate the change experienced by a particular population sub-group as a result of internal migration. Yet a population sub-group can increase its share in the population at the destination despite of recording net migration losses if the corresponding net migration rate is lower than that for other population sub-groups. For this reason, if we seek to estimate the impact of internal migration on the population composition of a place, it is required to compare the net migration rates for all population subgroups into which a population can be divided in relation to a particular population attribute (e.g. age). For instance, if we seek to assess the impact of internal migration on the sex composition of a place, comparison of net migration rates for males and females is required. While this approach is useful, its implementation is computational intensive and complex as the number of comparisons increases by a combinatorial factor, with the number of population sub-groups under analysis. For example, if we sought to compare the changes in age composition across 11 age groups, the number of comparisons required would be 55.

Additionally, the net-migration approach suffers from two key additional limitations. First, it does not return a single summary indicator so that the overall impact of internal migration of multiple population subgroups on places can be effectively quantified and easily interpreted. Second, the approach cannot be employed to estimate the effect of internal migration on population-based socio-demographic indicators, such as the average years of schooling and dependency ratio, commonly used by local government agencies and transnational organisations, including the UN, to assess the developmental status of places. Net migration rates can only be used to explore changes in rates.

In this paper, we propose a methodology that produces a summary statistical indicator to quantify the impact of internal migration on the population composition of places. The proposed approach overcomes limitations of existing methods by integrating the four key population components outlined above, and exploits the availability of census data which is the most commonly available source of internal migration data around the world (Bell et al 2015).

4. Methodological framework

This section first describes the proposed methodology before presenting the data used in the analysis.

Methodology

The proposed approach provides a summary statistical index, the Compositional Impact of Migration (*CIM*), that quantifies the impact of migration on the socio-demographic composition of places. It is devised to take advantage of census-based matrices of interzonal migration flows and capture the interrelated effect of the four key components identified in Section 3. Thus, this approach overcomes a key limitation of existing methods to measure the spatial impact of migration.

The *CIM* is a counterfactual approach that involves a comparison between a Factual Value (*FV*) and a Counterfactual Value (*CFV*). These values are derived from the row and column marginals of a migration matrix based on a statistical indicator and labelled Migration Impact Indicator (*MII*) matrix. It is not a matrix of migration flows. Each element in this matrix represents a statistical indicator that provides a representation of the socio-demographic composition of the local population, such as the local sex population ratio and mean years of education. Like any standard migration matrix, the diagonal elements of the *MII* matrix relate to the staying population in an area *i*; off-diagonal elements relate to the migration flow from a region *i* to a region *j*; and the

column and row marginals relate to the total population in region *i* at a time *t*, and in region *i* at an earlier time *t-x*.

FVs correspond to the row marginals of the *MII* migration matrix which are based on the population distribution at the census date. Thus, they provide a representation of the socio-demographic structure of regions at the census i.e. *after* migration. *CFVs* correspond to the elements in the column marginals of the *MII* migration matrix which are based on the population distribution at an earlier year – one, five or ten years as recorded by censuses. Hypothetically, *CFVs* could be thought of as the expected population composition if there was no internal migration i.e. if migration had not happened, what would have been the local socio-demographic structure. Subtracting *CFVs* from *FVs* provides a measure of change between the start and end of a census interval and represents our proposed summary statistic, the *CIM*. The *CIM* measures the estimated percentage change in the local population structure, as captured by a *MII*, resulting from net migration redistribution. A positive *CIM* indicates that internal migration contributed to increase a given *MII* e.g. the local sex population ratio. A negative value denotes that internal migration reduced the *MII*. The index is computed as:

$$CIM_i = FV_i - CFV_i = MII_i^t - MII_i^{t-5} \quad (1)$$

Using five-year transition census-based migration data, t and $t-5$ correspond to the census date and five years earlier, respectively. To create the *MII* matrix, any statistical indicator can be adopted, including percentages, ratios, averages, medians as well as more complex composite metrics, such as the Duncan index of dissimilarity and Gini coefficient. In this section, in order to provide a complete exposition and mathematical formalisation of our methodology, we used the male-to-female population ratio to generate our *MII*. For our analysis in Section 5, in addition to the sex ratio, we used the share of population by age bands and the average years of

schooling to examine the impacts of internal migration on the sex, age and educational composition.

Using the male-to-female population ratio ($P(m)/P(f)$) to quantify the impact of internal migration on the local sex composition, the CIM_i is:

$$MII_i^t - MII_i^{t-5} = \frac{P(m)_i^t}{P(f)_i^t} - \frac{P(m)_i^{t-5}}{P(f)_i^{t-5}} \quad (2)$$

where: $P(m)_i^t$ and $P(f)_i^t$ denotes the local male and female population at the census date *(t)* in region i; and, $P(m)_i^{t-5}$ and $P(f)_i^{t-5}$ represents these populations five year earlier *(t-5)*. Equation (2) can be decomposed into four elements, as shown by Equation (3), to demonstrate that our methodology effectively accounts for changes in the effect of the four key components that determine the impact of internal migration on the local population composition. These components are: (1) the magnitude of in- and out-migration flows (M_{ij} and M_{ji}), (2) the size of non-migrant population (P_{ii}), (3) the selectivity of migration flows (M conditional on gender (f and m)), and (4) the composition of the non-migrant population (P conditional on gender).

$$MII_i^t - MII_i^{t-5} = \frac{P(m)_{ii} + \sum_{j=1}^{n} M(m)_{ji}}{P(f)_{ii} + \sum_{j=1}^{n} M(f)_{ji}} - \frac{P(m)_{ii} + \sum_{j=1}^{n} M(m)_{ji}}{P(f)_{ii} + \sum_{j=1}^{n} M(f)_{ji}} \; ; where\ i \neq j \quad (3)$$

We can use Equation (3) to decompose the overall impact of migration into the impact of in-migration and out-migration. The *CIM* index can be divided into two component indices: an index for inflows (CIM^I) and an index for outflows (CIM^O). The CIM^I is computed by comparing the *MII* for a region after migration. It captures the migration inflows from every other area in the system and that of the staying population for that region. The CIM^O is measured as a subtraction between the *MII* for a region at a year prior to the census date -accounting for all outflows to all other zones in the system- and that of the staying population. For the sex ratio, these indices are:

$$CIM_i^I = \frac{P(m)_{ii} + \sum_{j=1}^{n} M(m)_{ji}}{P(f)_{ii} - \sum_{j=1}^{n} M(f)_{ji}} - \frac{P(m)_{ii}}{P(f)_{ii}} \quad (4)$$

$$CIM_i^O = \frac{P(m)_{ii}}{P(f)_{ii}} - \frac{P(m)_{ii} + \sum_{j=1}^{n} M(m)_{ji}}{P(f)_{ii} - \sum_{j=1}^{n} M(f)_{ji}} \quad (5)$$

A key consideration in the implementation of the methodology is the way in which internal migration is measured. We require a measure that captures the isolated impact of internal migration. A common problem to define internal migration relates to the population at risk. The population at the start of a census interval includes both people who die and people who emigrate during the interval. Rates based on this population confound the risk of mortality, emigration and internal migration. Rees *et al.* (2000) recommended the use of the population at the end of the census interval which includes people who were in the country at the start of the census interval, and survived and were enumerated at the census. The resulting count of internal migrants excludes the influence of mortality, emigration, immigration and fertility. We adopted this definition with the advantage of effectively isolating the impact of internal migration from other key components of population change. Figure 1 illustrates the age-time classification used in the methodology; that is, the age at the end of the census interval. For example, it shows that persons who were aged 15 to 19 at the time of the census and 10 to 14 at the start of the interval are included in the calculation, whereas persons aged 0 to 4 at the census are excluded as they were not alive at the start of the interval. Figure 1 also shows that persons aged 65+ comprised the group of people who were aged 60+ at the start of the interval. It is important to note that this definition omits migration moves occurring between census intervals (e.g. return and onward migration).

[Figure 1]

Another important consideration relates to the way the results from our methodology must be interpreted. There is a temptation to take cohort approach, assuming for example that internal

migration impact estimates for people aged 5-9 at the end of the census interval are those of the cohort aged 0-4 at the start of the interval. This interpretation is inappropriate for two reasons: first, it adopts a longitudinal view of the impacts of internal migration; and, second, it provides the misleading idea that cohort effects are being captured. Our methodology does not capture cohort effects. It is counterfactual approach that measures the impacts of internal migration on places at the end of the census interval. It compares the factual population distribution in an area at the census date and a counterfactual distribution, representing what would have been the population distribution if a particular population subgroup had not had migrated. The results must be interpreted in a "what-if" fashion: what if internal migration of the 5-9 age group had not have happened? How would the age composition of the destination be? We recognise people aged 5-9 at the end of the interval correspond to people aged 0-4 at the start of the interval. Our methodology, however, measures internal migration impacts at the end of the interval when this population was in the 5-9 age group at the destination region.

In relation to existing approaches, the proposed methodology offers four key advantages: (1) quantifies the internal migration impact of multiple population sub-groups in a single index; (2) can be employed on a range of socio-demographic statistical measures; (3) provides an opportunity to contribute to theory development and guide policy design; and (4) enables to expand our understanding of structural relationships in the national migration system at fine geographical scales. We elaborate these points in Table 2.

[Table 2]

A key limitation of the proposed methodology is imposed by the assumption of time-invariance of population attributes. Our methodology relies on a counterfactual distribution, assuming that the observed population characteristics at the census remains stable over time. While this assumption is reasonable for socio-economic characteristics that do not change, or change in a predictable way

over time, it is less appropriate for time-variant attributes, such as employment. We note however that this limitation is shared by the wide range of analytical approaches based on census data and widely accepted by migration scholars as census data only provide information on individual characteristics at the census date.

Data

We applied the proposed methodology to measure the impacts of internal migration on the population composition of eight large LA cities: Quito, Guayaquil and Cuenca in Ecuador, Mexico City, Guadalajara, Monterrey and Tijuana in Mexico and Panama City in Panama. These cities have a resident population of over one million. We used data from the 2000 and 2010 census rounds extracted from the online census micro-data platform REtrieval of DATa for small Areas by Microcomputer (REDATAM) and city administrative boundaries from the "Spatial Distribution of Population and Urbanisation in Latin America" database -both hosted by CELADE. The geographical boundaries used are temporally consistent and correspond to those for the 2010 census round. These boundaries reflect administrative areas of suburban expansion, accounting for the effects of urban population growth.

We used data on the full population for Ecuador and Panama. For Mexico we drew on data from the extended census questionnaire, equating to a 10% population sample: 10,099,182 and 11,938,402 individuals from the 2000 and 2010 census, respectively. The sampling design for the Mexican extended questionnaire is rigorously tested and samples are carefully assessed post-data collection by the Mexican National Statistical Office (INEGI 2012). Sample weights are available and were applied to make the samples statistically representative of the full census population. We also tested differences between census periods for Mexico. All differences were statistically significant at a 99% confidence level, except for the 45-59 and 60+ age groups for Guadalajara for the analysis of age composition. We believe our results are robust and provide an adequate

representation of the way internal migration has contributed to shape large Ecuadorian, Panamanian and Mexican cities.

We used five-year transition data to measure internal migration. The data cover the second half of the 1990s (i.e. 1995-2000) and 2000s decade (i.e. 2005-2010). We measured the impact of internal migration on three key population dimensions: sex, age and educational composition, using three indicators. These indicators comprise our *MII* (Equation 1) and are described in Table 3. We used the sex ratio to measure changes in sex composition; the share of population by five age bands to estimate changes in age structure; the average year of schooling for three age groups to quantify changes in educational levels.

[Table 3]

As indicated above, given a reliance on census data, a key assumption of our methodology is time-invariance of population attributes. Information on individuals' situation is only available at the census date and this may differ from their pre-migration circumstances. This creates major difficulties with characteristics such as education which may change over time, especially at young ages, because it is unclear if a rise in the local average year of schooling is the result of the in-migration of highly skilled people, or of less educated individuals who acquired formal education in the destination after migration.

We considered this issue as an integral part of the interpretation and tested the robustness of our results. We measured the internal migration impacts on education for three population subgroups (Table 3). Consistent with the UN's human development index and educational attainment statistics, we first focused on the average years of schooling for people aged 25+, because it provides a comparable measure across populations and countries (UNDP 2015) -and produces more accurate estimates of the impact of internal migration by removing the effect of individuals obtaining education after arrival in the destination. Second, because the in-migration

of young and less educated people may still be argued to reduce local average years of schooling at the destination, we conducted a robustness check by comparing the consistency of our results for the 25+ age group with those for two older age groups: 34-44 and 45-49.

Implementing the methodology outlined in Section 4 and measures reported in Table 3, we computed sex, age and education CIMs. These indices quantify the impact of internal migration and provide empirical evidence on the feminising, demographic window and downgrading educational effects, which relate to the speculation of previous studies on the impacts of internal migration on the population structure of large LA cities. Negative sex and education CIMs suggest that internal migration had a feminising and a downgrading educational effect on local population structures by reducing the relative share of male-to-female population and the average years of schooling. Coupled with positive age CIMs for the 15-59 population, negative age CIMs for the 15-14 and 60+ populations suggest that internal migration had a demographic window effect by reducing the local dependency ratio i.e. decreasing the share of local population aged 5-14 and 60+ and simultaneously increasing the share of younger people in productive ages 15-59. We report three additional CIM statistics: (1) the relative CIM which measures the relative percentage change in the CIM over census intervals, and the (2) CIM^I and (3) CIM^O which quantifies the separate influences of in-migration and out-migration on contributing to the overall migration impact. The FV and CFV used for our calculations are reported in Appendix A.

5. Result and discussion

This section discusses the impacts of internal migration and the way these impacts have changed between 1995-2000 and 2005-2010. The discussion focuses on the changes in sex composition before examining changes in age and educational structures.

Sex balance

Table 4 reports the CIMs for the sex ratio. The results show that, except for Cuenca, all cities in the sample display a negative CIM for the 1995-2000 period, suggesting that internal migration operated to reduce the local sex ratio by increasing the share of local female population. These reductions were particularly pronounced in the Ecuadorian cities of Quito and Guayaquil, showing a 0.7 decrease in the sex ratio. Consistent with previous work (e.g. Elizaga 1966, Alberts 1977), these results indicate that internal migration continued to have a feminising effect on the demographic structure of large LA cities during the second half of the 1990s by increasing the share of local female population.

[Table 4]

Table 4 also reveals pronounced cross-city differences in the main source, contributing to this feminising effect. While in-migration appears to be the main contributing force in Panama, Mexico and Guadalajara, out-migration comprised the main driving force in Tijuana and Quito, and both in- and out-migration in Guayaquil and Monterrey. These differences in relative contribution were paralleled by differences in the direction of their influence, with both acting to shape the reduction in the sex ratio in Panama City, Mexico City, Monterrey, Guadalajara and Guayaquil, while they operated in opposite directions in Tijuana and Quito. In the latter cities, out-migration appeared to reduce the local sex ratio, while a larger share of males in the in-migration flows -relative to the local staying population- contributed to increase the local male-to-female ratio. In absence of this in-migration effect, out-migration would have led to a 0.37 reduction in the sex ratio in Tijuana and a 0.77 contraction in Quito. Thus, consistently, an over-representation of men in out-migration flows relative to the staying population has been the main driver underpinning this feminising effect.

In contrast to the 1995-2000 period, the 2005-2010 period showed a diminution or a reversal of the feminising effect of internal migration. Quito, Guayaquil and Mexico City registered a reduction in their corresponding sex CIM from -0.70, -0.71 and -0.53 in 1995-2000 to -0.67, -0.23 and -0.24 in 2005-10, while Panama City and Guadalajara saw a shift from a negative (- 0.28 and -0.11) to positive CIM (0.03 and 0.22). In Panama City and Guadalajara, these changes point to a major shift in the sex composition impact of internal migration, with internal migration masculinising the local populations.

As revealed by Table 4, these patterns appeared to be largely driven by over-representation of males in in-migration flows, which increased the local sex ratio. Relative to the local staying population, this male selectivity in in-migration augmented the local share of male population, offsetting the impact of out-migration which increased the local share of female population and resulting sex ratio. These effects were particularly pronounced in Quito where out-migration contracted the local sex ratio by 0.92. Outflows exceeded an offsetting increase of 0.26 due to in-migration and reduced the local representation of male population leading to an overall reduction in the local sex balance (-0.66).

Monterrey, Tijuana and Cuenca represent interesting cases. While, overall, the feminising impact of internal migration reduced, it strengthened in Monterrey and Tijuana. In Monterrey, in- and out-migration contributed to increase the local women population. In Tijuana, only out-migration expanded the female population base. In-migration had an increased masculinising effect. These patterns seem to reflect greater inflows of female migrants to Monterrey, escaping from female homicides in Ciudad Juárez, and an attraction of women from cities on the Mexican-

US (including Tijuana) which were severely affected by the 2008 global financial crisis (Chavez et al 2016). In Cuenca, internal migration had a masculinising effect but this decreased over time, reflecting a greater representation of males in out-migration flows. This appears to reflect economic restructuring changes towards female-dominated employment sectors, such as hospitality, accommodation and trade which may entice non-local female labour from neighboring areas (Chavez et al 2016).

These findings point to a key historical change in the patterns of internal migration in LA. In contrast to the dominant female selectivity in migration flows to large LA cities during the 1930s to 1970s (Elizaga 1966; Herold 1979; Herrera, 2013), a greater sex balance in these flows implied a diminution of this feminising effect. The dominant female selectivity during the 1930s to 1970s reflected the mass migration of women from rural areas to take low-skilled jobs in service activities in response to a shrinking agricultural sector (Useche 2013). As countries experienced rapid urbanisation and agricultural decline, rural female migrants being employed as domestic servants in high-income households was a common feature of the mobility system in LA countries during the 1930s to 1980s (Rodríguez and Busso 2009). Many rural towns have now evolved into small and intermediate urban areas and diversified their economies, developing tourism, accommodation and food industry sectors, and expanding local job opportunities for women (Drentea 1998). Intermediate cities have also seen growing investment on university and vocational infrastructure, enlarging the range of local postsecondary education opportunities (Bulmer-Thomas 2003). Together, these developments may have promoted the retention of the local female population in small and intermediate cities, balancing the sex ratio in population movements from/to large LA cities.

Age structure

Table 5 and Figure 2 report the age CIMs. For the 1995-2000 period, they show negative signs for the populations aged 5-14 (children) and 60+ (old people), indicating that internal migration reduced the share of these age groups in the local population. There were large variations in the extent of these reductions. Internal migration appeared to generate the largest reductions in Panama City and Tijuana, leading to a contraction of over 4% in the share of children population in Panama City, and over 7% in the share of elderly population in Tijuana. Reductions were marginal in Mexico City, with internal migration producing changes of less than 1%. There were also exceptions to this downsizing trend. Internal migration acted to expand the 60+ population in Guadalajara and Guayaquil but these expansions were tiny.

[Table 5]

[Figure 2]

The reductions in the shares of children and elderly population were reflected in a concomitant expansion in the share of the working-age population (i.e. age 15-59), driven by a greater 15-29 aged population. In fact, internal migration acted to reduce the local 30-44 and 45-59 populations. Panama City and Tijuana experienced the largest rises in the share of working-age population, 1.9% and 1.7% respectively, while Mexico City, Monterrey, Guadalajara and Guayaquil saw the smallest rises (under 0.2%). The biggest percentage increases were observed in Tijuana, Quito, Cuenca and Panama City, where internal migration operated to augment the local share of 15-29 population by over 4%. Receiving a rising share of young workforce relative to the dependent population may produce a demographic dividend effect by boosting local economic growth.

Table 5 reveals that the main source underpinning the reduction in the shares of people aged 5-14 and 60+ during the 1995-2000 period was in-migration, as indicated by consistently larger corresponding CIM^Is than CIM^Os. Negative CIM^Is indicate that the percentage of children and old people in in-migration flows to cities tended to be smaller than in the staying population, and as a result, in-migration contributed to reduce the share of these groups in the local population. In Panama City, in-migration contributed to significantly reduce the local children population, accounting for 93% of the contraction in the share of local 5-14 population.

While out-migration tended to have a smaller impact than in-migration across all age groups and cities, we noted that out-migration tended to have differentiated impacts: in some instances, amplifying the impacts of in-migration flows, and in others, counterbalancing these effects. The counterbalancing effects of out-migration are notable for older age groups (45-59 and 60+). As indicated by positive CIM^Os, out-migration tended to involve a smaller share of 60+ population compared to the staying population's share, amplifying the presence of this age group. This finding points to the fact that the overall impact of internal migration on reducing the local old population is not because of people leaving large cities, but because of working-age people moving in, particularly those in the 15-29 age group. This result is consistent with the low propensities to migrate among old people (Roger *et al.* 1978), and also reflects the absence of a double bulge in the age distribution of migration in LA countries (ECLAC 2012). In industrialised countries, migration age profiles tend to first peak at around the mid-twenties and early-thirties, and have a second peak at around the retirement age, reflecting the mobility of old people to rural and coastal areas (Hugo and Bell 2002). In LA countries, this second peak does not happen as retirees living in large cities stay put to take advantage of the high quality of local health care facilities (López-Calleja and Morejon 2015).

As in the 1995-2000 period, Table 5 indicates that internal migration continued to contract the shares of children and old populations in Panama City and large Mexican and Ecuadorian cities during the 2005-2010 period. However, larger CIMs in 1995-2000 than in 2005-2010 reveal that this downsizing effect diminished. The average CIM for the shares of people aged 5-14 and 60+ across cities reduced by 30% and 10% between 1995-2000 and 2005-2010. Among the children population, this reduction was primarily due to a lessening in the impact of in-migration, while among the elderly population it was driven by a strengthening in the impact of out-migration. For the former, this points to the fact that, as in the 1995-2000 period, in-migration continued to involve a smaller share of people aged 5-14 than that in the local staying population, although this difference was less pronounced in the 2005-2010 period generating a smaller contraction of the local children population. For the latter, this result indicates that the percentage of people aged 60+ leaving large cities decreased between 1995-2000 and 2005-2010, with out-migration increasing the local share of elderly population.

Taken together, these patterns concurrently reflect an increasing share of people in the working-age group, specifically of young adults in the 15-29 age band, moving into large Panamanian, Mexican and Ecuadorian cities. This evidence is consistent with the patterns of young people moving into large cities in pursuit of better education, employment opportunities and a more vibrant lifestyle in industrialised countries (Williamson 1988; Fielding 1992; Rowe *et al.* 2016). However, the rejuvenating effect of internal migration on the age structure of cities in our sample declined and this seems to be linked to an overall reduction in the share of young migrants to large cities in response to a dispersal of employment opportunities, expanding to medium-sized cities (Gilbert 1996). The decline in the rejuvenating effect of internal migration is expected to continue as LA countries move to more advanced stages of the demographic and urban transition at which

an acceleration of population ageing and strengthening of medium-size cities' economies are expected (Gilbert 1996; Rodríguez 2011).

Educational levels

In contrast to the impacts of internal migration on lifting the working-age population, examining the education CIMs for the 25+ population reveals that internal migration tended to have a downgrading effect on education by reducing the average years of schooling (Table 6 and Figure 3). CIMs under 0.12, however, reveal that this effect was marginal, indicating decreases of 0.12 in average years of schooling. While there was variation in the main source contributing to this effect across cities, out-migration appeared to consistently erode the local human capital base as indicated by negative CIM^{O}s, except for Panama City. In Ecuadorian cities, both in- and out-migration contributed to generate the largest reductions in the local average years of schooling. In Mexican cities, the downgrading educational effect produced by out-migration was offset by in-migration of people with higher education than the locals.

[Table 6]

[Figure 3]

These results are illuminating in two ways. First, they reveal a tendency for more educated people to leave major cities in Ecuador, Mexico and Panama. This is contrary to what could be anticipated as large cities concentrate educational and career development opportunities. This pattern appears to resemble the "escalator region" process that characterise the internal migration system in the UK (Fielding 1992), with young people moving to the South East region of England to develop their careers, and they "step off" the escalator and move down the urban hierarchy once they achieve a high occupational status and family-related reasons gain importance. Second, the

results reveal that in-migration into large cities does not necessarily lead to a reduction in the average years of schooling. We found that in-migration lifted local levels of education in Mexican cities. This opposes to the traditional assumption that large cities attract a disproportionate number of less educated people to take up low skilled jobs and education.

As pointed out in Section 4, a key assumption of our methodology is the time invariability of population attributes. As formal education tends to increase over time, we checked the robustness of our results comparing the CIMs for the 25+ population with those for two older age groups: 30-44 and 45-49. The results are consistent. While there are variations in magnitude, the CIMs for the 30-44 and 45-49 age groups were negative. They indicate that internal migration contributed to reduce the average years of schooling and that the out-migration of more educated people tended to be the main factor underpinning this reduction.

Additionally, Table 6 reveals that the downgrading effect of migration on education has weakened over time. In the 2005-2010 period, while migration continued to reduce the average number of years of schooling, the associated reductions were by less than 0.07 years. In part, this weakening in the overall impact of migration tended to reflect a diminution in the effects of both in-migration and out-migration on lowering the average years of schooling, but it may also relate to a decline in the propensity to move among highly educated people. The decline in migration probabilities is a common feature of the mobility patterns in many countries across the globe (Bell and Charles-Edwards 2013). LA countries are not an exception (Rodríguez 2011). In Chile, Rowe (2013a) found that the probability of tertiary educated individuals to migrate declined from 2.63 in the 1977-82 census period to 1.93 in the 1997-2002 period and that these individuals were more likely to live in the main metropolitan area of the country, Santiago. Increasing rootedness of highly

educated individual has been linked to this pattern (Cooke 2009) and it may explain the declining effects of migration on the educational composition of large LA cities.

National pictures

Thus far, the results have been discussed according to individual characteristics but what do they represent for the studied countries? This section links the observed patterns of internal migration impact to socio-economic and demographic processes in each national setting, acknowledging that a comprehensive analysis of the factors underpinning these processes is beyond the scope of this paper.

In Panama City, in-migration consistently operated to enlarge the population in the 15-29 and 30-44 age groups, reduced local educational levels, and transitioned from having a feminising to masculinising effect. Over the last 25 years, Panama City has experienced rapid economic growth due to the expansion of trade, real estate and professional services activities associated to the Panama Canal (Chavez et al. 2016). These activities have attracted domestic and international migrants, and unlike in many LA nations, they form part of the formal economy (Chavez et al. 2016). They tend to employ a larger share of individuals in the 30-44 age group than in the 15-19 age band, attracting thus a disproportionate percentage of non-local labour in this group. These activities have also been found to be male dominated (Chavez et al. 2016) and may explain the masculinisation of migration flows to Panama City.

In Ecuador, a series of factors have contributed to shape migration patterns during the end of the 20th and start of the 21st century, including a socio-economic crisis, dollarisation of the local consumer market and a greater role of the government (Calderón et al. 2016). They promoted international emigration, consolidated Quito as the main national migration destination and

resulted in a net migration balance in Guayaquil. Concurrently, our results indicate that the impact of internal migration on the local age and education population compositions was similar across cities: increasing the local share of people aged 15-29 and reducing average years of schooling. However, its impact on the sex composition exhibited spatial variations, feminising the population structures in Quito and Guayaquil but masculinising that of Cuenca. International migration of local male labour has been documented in Cuenca and in-migration of male workers is seen as the replacement for this component of the local workforce (Herrera 2008)

In Mexico, as in other LA countries, the transition to export-oriented economic development strategy has transformed the patterns of internal migration resulting in net migration losses in Mexico City (Useche 2013). Historically, Mexico City has been the primary attraction centre for migrants but the development of new poles of economic activity driven by the maquiladora sector promoted population movement to cities on the Mexican-US border (Gilbert 1996). In the maquiladora industry, young women are a desirable source of labour as they typically work longer hours and display a greater dexterity than men in performing repetitive assembly tasks (Chavez et al. 2016). Women are thus attracted to Mexican-US border cities and can be linked to an augmented feminising internal migration effect in Tijuana during the 2005-2010 period -an effect which may be representative of Mexican-US border cities. This effect was reproduced in Mexico City, Monterrey and Guadalajara where it was coupled to a consistent erosion of local education levels -a reduction in the average years of schooling- which was driven by the out-migration of people higher educational qualifications than the locals (Table 6)."

6. Conclusions

Despite its wide-ranging implications, little progress has been made to understand and measure the impacts of internal migration on the socio-demographic composition of places. A key obstacle has been the lack of an approach to capture the simultaneous influence of key population components which determines the spatial impact of internal migration: the size, balance and selectivity of migration and staying populations. We proposed a methodology that captures the dynamics of these components, exploits the availability of census data and returns a single summary measure, the *Compositional Impact of Migration* (CIM). We showed how this index can be decomposed to measure the relative contributions of in-migration and out-migration.

We applied our methodology to quantify the impact of internal migration on the sex, educational and age composition of eight large LA cities. The estimated impacts were generally small, echoing the inertia of the human settlement pattern in large cities. Systematic patterns emerged. Internal migration tended to reduce the local sex ratio and average years of schooling, and increase the percentage of local young adult (aged 15-29) population, entailing feminising, downgrading educational and demographic window effects on the population structure in our sample of cities. We also showed that the strength of these effects diminished over time. A greater representation of males and a smaller share of 15-29 population in in-migration flows to these cities reduced the feminising and demographic window effects, and a larger proportion of highly educated people moving in diminished the downgrading educational effect. We also highlighted that the estimated impacts of migration were small as they concern the aggregate impacts on metropolitan populations. They are likely to be more acute in particular zones within metropolitan regions, in places concentrating net migration gains and losses. Future research is required to determine the extent of these impacts at a sub-metropolitan scale.

It is important to recognise that our methodology focuses on quantifying the migration effect of time-invariant attributes. Estimation of attributes that change over time is more complex. Our work contributes to advancing migration research in three ways. First, it provides tools to expand our knowledge of the impacts of internal migration. To date, existing scholarship has assessed the impacts of migration by examining flows and net migration balances. The proposed methodology enables to complement this knowledge by quantifying and examining the compositional effects of migration on local populations.

Second, our work has the potential to guide policy design. Measuring and understanding the compositional impacts of internal migration are a key input for policy development. Existing migration policies tend to focus on restricting in-migration (UN 2010). Yet our findings revealed that internal migration may lead to a demographic window effect, expanding the local working-age population, promoting policies that focus on in-migration. Concurrently, our findings revealed that migration tended to reduce local levels of education –which may justify restrictive in-migration policy measures. Yet they indicated that out-migration is the main mechanism for such loss in educational levels and, taken together, these results invite to move away from traditional in-migration-focused policy approaches to adopt a more comprehensive framework that considers both in-migration and out-migration, as well as the size, balance and composition of migration flows.

Third, our findings also have implications for further research on migration within LA countries. Prior work has documented a gradual reduction in female selectivity in the internal migration system of LA countries (Rodríguez 2004), but to date, little is known about how this change has shaped metropolitan populations. Our results revealed that migration continues to have a feminising effect on these population structures, but it is diminishing, and in certain cities –

including Panama City, Guadalajara and Cuenca- a masculinising effect has emerged. This finding motivates a fruitful avenue of future research to develop a better understanding of the socio-economic changes and explain the shifting sex selectivity of migration flows in LA countries. This involves examining changes in the labour market of cities, specifically changes in the domestic sector which has historically been a major employer of female labour but has experienced a gradual downsizing (Chant 1999). Understanding the changing sex selectivity of migration also requires investigating the socio-economic changes in places of origin. In the 1970s and 1980s, these places were predominantly rural and highly dependent on agricultural activity. They are now small vibrant urban environments but little is known about their industrial structure and employment patterns.

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